A NATURAL HISTORY OF THE

BRITISH LEPIDOPTERA

A TEXT-BOOK FOR STUDENTS AND COLLECTORS

BY

ames illiam
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Author of "The British Noctuæ and their Varieties," "Monograph of the British Pterophorina," "British Butterflies," "British Moths," etc.

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PREFACE.

I have great pleasure in offering a third volume of *British Lepidoptera* to my brother entomologists, and I sincerely hope that they may be able to give it the same satisfactory reception as its predecessors. I can assure them that, whatever labour was expended on volumes i and ii, the work of preparing this volume has been much greater than that of either. This has been due essentially to the fact that the species discussed in this volume are all exceedingly well-known, and, as a result, they have been treated by so many authors, that a complete grasp of the literature relating to them, has been more difficult to obtain than when dealing with a group that is but little known and has been but little studied. One could possibly write half-a-dozen volumes of this size *de novo*, in the time that one has to spend in doing justice to the work of one's predecessors and seeking out minor details that one may have missed in one's own work.

It was quite clear from the commencement that, if the species were to be treated at anything like the length that their previous study deserved, there could be no general chapters in this volume. The amount of material relating to *Lasiocampa quercûs* alone that had to be digested was so great, and the different points of view from which it had to be treated were so varied, that it was clear that the account of this species alone could be made to form the basis of a liberal education in lepidopterological science. Again, the consideration of the Attacids and the Sphingids on a wide basis also opened up so many and so different views of entomological science—synonymical, biological, physiological and classifactory—that it was self-evident that these chapters would more than recompense for any feeling of disappointment that might be felt by some in the absence of any summaries of special points relating to the general subject.

We are, in spite of our efforts, entirely dissatisfied with our knowledge of the relationship of the various families of the Saturniides *inter se*, of those of the Sphingides *inter se*, and of these two superfamilies to each other. One might have supposed that of these two superfamilies, composed of species of such large size, lepidopterists knew almost everything that could possibly be learned. As a matter of fact there can be very few superfamilies, even among the smallest lepidoptera, of which our knowledge is more vague and less satisfactory than is that of our knowledge of the Sphingids to-day. We can only claim to have tried to throw light into some of the dark and difficult places.

For any scientific value that there may be in this volume, lepidopterists are indebted to many willing helpers, and es ecially to Dr. Chapman, Messrs. A. W. Bacot and L. B. Prout. To these my sincerest thanks are due, for not only have all their own discoveries and original descriptions been inserted first hand, but the generous labour that they have bestowed on the work in order to make it a success has been no whit less onerous than my own. To many other lepidopterists my best thanks are also due, among whom, Mrs. Cowl, Messrs. Bignell, Durrant, Griffiths, Oberthür and Sich may not pass unmentioned. The body of the work itself will show where help has been so generously given.

The criticisms passed on the last volume, so far as they bore suggestions to carry out in future volumes, were largely, as I had anticipated, directed to the problem of getting a quart into a pint pot. Those of Messrs. Kirby and Merrifield for an extended Contents," I have, in this volume, carried out, that of Mr. Bateson for a comprehensive general index in addition to the one already supplied is more difficult. It is purely a question of time which I have unfortunately not at my disposal. If anyone will do a careful general index to vols. i, ii, and iii, I will publish it with the next volume. Mr. Bateson's further claim on our space for fuller references must also at present remain unheeded. One may fairly claim that few lepidopterological books are so thoroughly indexed, and none has so complete a set of references (synonymic and otherwise) as this. Books like this are after all a labour of love, they can never be expected to pay expenses, and a busy man must draw the line somewhere.

In this volume another departure has been made. In vols. i and ii I accepted the ruling of certain authorities in the matter of nomenclature. My own opinion that "Synonymy is of the devil" has been quoted sufficiently to ensure that British lepidopterists, at least, know my own private opinion thereof. But my readiness to accept the dicta of the authorities (who differ so widely among themselves) led me into many illogical positions and forced me at last to take an independent stand on the subject. I have discussed the synonymy of the Sphingids largely on the lines of the "Merton Rules," and certainly to me we appear to have reached a point at which the maximum of accuracy and the least possible alteration of names in the future have been attained if the rules be logically applied. I would if I could have nothing to do with synonymy; circumstances are frequently stronger than ourselves.

The completion of another volume enables me to again fulfil one of the most delightful obligations, viz., to thank all those lepidopterists without whose generous help these volumes would never see the light. Few new subscribers have come in since the publication of the last volume. More particularly I am disappointed that the work, so kindly received by a few leading American lepidopterists, has not been found more generally useful in America, where scientific entomology has touched a point never reached before. Perhaps the title *British Lepidoptera* is against the work abroad; one can only trust that it is not so.

To those whose names have previously been published have now to be added—

ALLEN, J. E. R., F.E.S.
ASHBY, H., F.E.S.,
BARNES, WILLIAM
BLAND (Major), T. D.
EMSLEY, F.
GARDNER, JNO., F.E.S. (omitted by error from vol. i.)
GARDNER, J. E.
KEARFOTT, W. D.
MUSHAM, J. F.
NORTH LONDON NATURAL HISTORY SOCIETY
ROGERS. E. A.
SMITH, G. B.
WHEELER (Rev.), G., M.A.

I would here beg all subscribers to send me in detail a list of the species that inhabit their own immediate neighbourhood for use in future volumes. Many lepidopterists, living in outlying and little worked districts, can be of the greatest service in this direction. It will be observed that some counties are scarcely ever mentioned in the lists of "Localities," even for the commonest species. It is, unfortunately, the occurrence of common and less local species that is least often recorded. Of the capture of rarities one always hears; it is much more difficult to make up a really good list showing the distribution of the more common species in the British Islands, due to the fact that so many lepidopterists consider that the record of the occurrence of a common species is not worth making. May I ask each of our subscribers to send up his own complete list of localities for all the remaining British Sphingid species (rare or common) not treated in this volume, so that I may have really reliable data as to the distribution of these species? It is the detail that is valuable. I would earnestly ask our lepidopterists to give me such information as they can.

J. W. TUTT.

PRESS NOTICES OF VOL. II.

"The second volume of Mr. Tutt's great work fulfils the promise of the second, and indeed supplies some chapters which were wanting to complete matters of a general character. That most striking of all the attributes of insects, metamorphosis, is in this second volume treated at length, the observations and theories of the well-known leading authorities on the subject being stated and discussed with especial reference to the many recent contributions to the knowledge of it by Dr. Chapman, to which great prominence is given, and whose views are generally adopted by Mr. Tutt. There is a separate chapter on phenomena incidental to metamorphosis, such as the passing sometimes of several years in the pupal stage, and the impossibility in such cases of forcing. The external morphology of the pupa has a chapter to itself, the author correcting some common errors as to the structure and significance of the different parts, and setting forth the view that the pupa is the (modified) representative of the ancestral form of the insect, from which the larva on the one side, and the imago on the other, have been developed. Professor Poulton's views are discussed very fully, and in some cases combated. Many interesting questions are treated in a separate chapter on the internal structure of the pupa, including the formation of the wings, and of the scales upon them. The chapter on the phylogeny of the lepidopterous pupa is by Dr. Chapman, whose previously published writings on the subject are well known, and it is unnecessary to say that it is characterised by great fulness of original observation and carefully thought-out conclusions. The introductory chapters noticed occupy as far as the hundredth page; the rest of the volume, comprising 467 pages, is taken up with descriptions of species and all that belongs to them, in the same copious style as in the first volume. Over three hundred of the pages are occupied with the superfamily of the *Psychides*, that strange tribe with the extraordinary females—fleshy bags—to our eyes singularly repellent and even loathsome, but most fascinating and attractive to their gay and active partners. There is no accounting for tastes, especially where sex comes in. These three hundred pages present all that is known of the British species, with very full references to many others, and a complete catalogue of the species of the Palæarctic region. Vast labour has been devoted by the author and his coadjutors to this part of his work, a study of which is indispensable to all who desire to be fully informed on this obscure and difficult subject. The rest of the volume is occupied with a portion of the *Lachneides*, which many will know by the older name *Lasiocampidae*, or, as Stainton called them, the *Bombycidae*, the woolly brown moths with large and beautiful caterpillars, which are the delight of young collectors and breeders. The present volume takes in our old and familiar friends, the "December moth" *(Poecilocampa populi)*, *Trichiura crataegi*, the "small eggar," *Lachneis (Eriogaster) lanestris*, and the "lackeys," *Malacosoma (Clisiocampa) neustria* and *castrensis*. The volume is completed by that great desideratum, a full index, and there are several plates. . . . We would venture to suggest that in the forthcoming volume, to which we look forward, there should be a table of contents, naming the species treated of. It may seem a little ungracious to find any sort of fault—though only in matters of very minor importance—in this most valuable work; our excuse must be that we wish to render it even more so. With this we must for the present conclude. Nothing but a lengthened study, such as there had been no time to give it, could do justice to the work; and when we think of the amount of attention necessary to assimilate its contents, we are filled with admiration of the labour that must have been devoted to its production."—F. Merrifield, F.E.S., *The Entomologist*. August, 1900.

"It is pleasant to write a few words in appreciation of the second volume of Mr. J. W. Tutt's *British Lepidoptera*. Of the great utility of the work there can be no doubt whatever, and the punctual appearance of Vol. II will be a matter of general congratulation amongst naturalists. Mr. Tutt's work aims at being, in the first place, a complete collection of all that is as yet known of the natural history of the species dealt with. These books are no mere compilations, but in the fullest sense original treatises. No pains have been spared to get together everything that relates to the structure, distribution, variation, life-history and habits of each form in its several stages. Many of the facts, thus given, are new, a large part being the results of the author's own direct observation. Moreover, much of the information here published has been communicated privately to Mr. Tutt by his numerous correspondents, and the mass of facts, given at first hand, is greatly increased. This is especially the case in regard to the life-histories, which, in many instances, have been worked through in minute detail by Mr. Tutt and his coadjutors expressly for this book. Owing to the wide appeal which the author has made to living entomologists for such personal records, and to his laborious researches into the literature already printed, the book probably represents the sum of existing knowledge on the subjects contained. It is a special charm of Mr. Tutt's treatise that the reader has a comfortable sense that his author is giving him no scamped work. Everything capable of verification has been verified, and nothing is repeated in slovenly fashion unchecked. For such a work, not only professed entomologists, but all naturalists who, from time to time, require precise information as to lepidoptera, will be grateful to Mr. Tutt, and his books will be required in every working library of natural history. Nothing of the kind has hitherto been attempted, and by reference to them much searching and weary correspondence will be avoided. The present volume deals with the *Psychides* and part of the *Lachneides*. Whether the views adopted by Mr. Tutt on questions of classification and the like are sound or not, can, of course, only be judged by specialists, but it will be evident to any student of zoology that he has attacked these problems in a most fruitful way, and that, in each of the numerous discussions of special questions, he has provided a marshalling of the facts which will help succeeding students. Several sections of this kind are introduced, relating to general questions of the morphology of lepidoptera, especially the nature of metamorphosis and the structure of pupæ. In addition to these there is an important chapter written by Dr. T. A. Chapman on the phylogeny of the lepidopterous pupa, a subject on which he is the recognised authority."—W. Bateson, M.A. F.R.S., *The Entomologist's Record*. September, 1900.

"The second volume of Mr. Tutt's exhaustive work has now appeared, and this continuation merits all the good words which were so freely spent upon the appearance of the first volume. We have first 100 pages devoted to general subjects, such as 'Metamorphosis in Lepidoptera,' and the 'External Morphology of the Lepidopterous Pupa,' &c., and then (pp. 102—434) there is such a full account of the Psychides as has not before been published. This is the chief merit of Mr. Tutt's work, that everything that has been written on a species has been consulted; the original description is given, the synonymy has been exhaustive, all known and many new biological facts are carefully added. The number of pages devoted to a single species is thus far in excess, and the work has so much the more value for consultation. With regard to the Psychides, it seems extraordinary that there should still be so much that is new and yet to be learned about the European members of this difficult group. The author has been careful to give the gist of what has been published in France and Germany, and concludes his study of the British species by a catalogue of the Palæarctic Psychides. Thus there is a broad basis to Mr. Tutt's work, which relieves it from all charge of insularity, and should commend it at the same time to continental students no less than to those everywhere interested in the subject. Pages 434 to the close of the volume are given to the commencement of the Lachneides, and this group is very carefully treated, particular attention being given to Dr. Dyar's studies, while, on plate vii, a phyletic tree is produced from the pen of our American authority. . . . . It is not possible, within the limits of this notice, to enter into questions of detail. Mr. Tutt has generally quoted all opinions upon the intricate question of generic synonymy. Where these have differed, in any one case, then the matter has been originally inquired into and a conclusion reached. . . . . To conclude: No general faunal study is known to the reviewer which can compare with Mr. Tutt's in scope and execution. It is greatly to be hoped that the volumes we now have will be followed by others to the completion of the entire work."—A. R. Grote, M.A., *Canadian Entomologist*. November, 1900.

"It will be remembered that some time ago we noticed (*Science Gossip*, N.S., vol. vi., p. 275) Mr. J. W. Tutt's first volume of *A Natural History of British Lepidoptera*. In that volume the author divided his subject into two parts, the first dealing with 'The Origin of the Lepidoptera,' 'The Ovum,' 'Embryology,' 'Parthenogenesis,' 'Structure of the Lepidoptera,' 'Variation of the Imagines of Lepidoptera,' 'Protective Coloration and Defensive Structures of the Larvæ,' and 'Classification.' In the second part was considered 'The Sphingo-Micropterygid Stirps, Subfamilies i, ii, iii, and iv,' 'The Micropterygides,' 'The Nepticulides,' 'The Cochlidides,' and 'The Anthrocerides.' The whole volume formed a most valuable treatise, so far as it went, on the order Lepidoptera, although primarily intended for British students. We received in due course the second volume of this work, and regret that various events have delayed an earlier notice of so important a book. Following the plan adopted in vol. i, Mr. Tutt again divided the subjects in the second volume into two parts. The first is occupied by chapters on 'Metamorphosis in Lepidoptera,' 'Incidental Phenomena relating to Metamorphosis,' 'External and Internal Morphology of the Pupa,' and 'The Phylogeny of the Pupa.' The second section is occupied by a continuation of the Sphingo-Micropterygid stirps, the subfamily v, Psychides, and commencement of subfamily vi, Lachneides, occupying the rest of the volume. There cannot be any doubt as to the amount of hard conscientious work put into this second volume by the author. The result is that tho promise indicated in the first volume has been more than fulfilled towards forming a really fine book on the British lepidoptera. Of course, treated as has been the subject by the author, these two volumes by no means exhaust it, and we must expect much more from his pen before an end comes to his labours in this direction. Whilst contemplating the author's task, what he has already done towards it, and the comparatively small leisure he has for this purpose, we are arrested by admiration, if not amazement, at his perseverance and dogged pertinacity. Added to these qualities, so necessary to the successful author, is that of originality, the valuable faculty of arranging the work of others, and, with his own, weaving a plan independently of previous writers. Such deviation from the beaten track is never popular with the older students of any subject, and especially is this so among the lepidopterologists, the most conservative of naturalists. Yet, in face of all opposition, Mr. Tutt has slowly won for himself the respect deserved by his work; and, if not the whole of his audience are disciples, he has awakened among them a wider, more scientific, mode of thought and study than has hitherto obtained among them. We all know for how long tbe term 'lepidopterist' was but a synonym for collector, and how readily the more exact students in some other branches of science sneered at them for 'moth-catchers.' This is now passed, as there has arisen a numerous body of scientific lepidopterologists, of which the author of the volumes before us is the type. They will engender in the rising generatiou of students of this order, an entirely new system of work, as they realise that the identification and arrangement in cabinet drawers is but the smallest part of the duties of a good entomologist. The first portion of each of the two volumes issued, of Mr. Tutt's work on British lepidoptera, forms an elaborate natural history of earlier stages of the order until we reach the pupa, which is most fully and scientifically considered. Any student following these chapters with thoroughness will have a liberal education upon insect metamorphosis. In addition, he will meet with comparative points, indicating the value of this knowledge, when studying the question of evolution of animals in the wider sense. With regard to the second portion of the volumes, the old arrangement and consideration of the lepidoptera have gone, and gone, we suspect, for ever. Whether Mr. Tutt's views are wholly accepted or not, he shows that, with the present wider knowledge of the order in the embryonic stages, the old classification, founded on the morphology of the perfect insects, is impossible. Therefore, the reader who will obtain this work must expect to be 'shocked,' if he be an old collector; but the shocking should be for his benefit. In his treatment of subfamily v, the Psychides, we have by far the most comprehensive monograph on them yet written in the English language. Again, repeating our previous statement, the amount of good work done by Mr. Tutt in the 330 pages, devoted to the Psychides is astonishing. It is very pleasing to find the amount of support he has received from all parts of the continents of Europe and America. friends and strangers alike placing most valuable information at his service. We have thus before us an unravelling of a most complicated subject. Here again will be found a rearrangement of facts of the utmost value in the study of evolution at large. This work is indispensable to all lepidopterists."—John T. Carrington, F.L.S., *Science Gossip*. December, 1901.

"The second volume of this important work described by Mr. Merrifield (*Entomologist*, April, 1899), as being, 'in comprehensiveness and fulness of detail on all points of interest to the biologist, the systematist and the collector . . . , without a rival,' has now been published. It consists of 584 closely printed demy octavo pages, on good paper and well-bound in cloth. It has an index consisting of thirty columns of references merely to the names of the species dealt with and referred to, and the whole book contains, not only a complete *resumé* of the families dealt with culled from all possible sources, but a large mass of original matter written by the author and those entomologists whose help he was fortunate to obtain. The book consists of two parts: (1) The introductory part (100 pages) containing chapters on 'Metamorphosis in Lepidoptera,' 'Incidental phenomena relating to Metamorphosis in Lepidoptera,' 'The External Morphology of the Lepidopterous pupa,' 'The Internal Structure of the Lepidopterous pupa,' and 'Phylogeny of the Lepidopterous pupa.' (2) The systematic part (469 pages) dealing with the species. In this section each species is described under a series of headings—Synonymy, Original description, Imago, Sexual dimorphism, Gynandromorphism (description of all known forms), Variation (with original descriptions of all known forms), Comparison with allied species, Egg-laying, Ovum, Habits of Larva, Larva, Variation of Larva, Comparison of Larva with those of allies, Cocoon, Double and Composite Cocoons, Variation in colour of Cocoons, Parasites, Food-plants, Habits and habitat, Pupal Habits and extended duration of Pupal Stage, Time of Appearance (details for phenological work), Localities (county lists for the British Islands), Distribution (classified lists under the countries in which the species occur). The headings just enumerated are those under which *Lachneis lanestris* is described. In addition to most of these, there are other headings in the *Psychides*—Case, Puparium, Dehiscence of Pupa, &c. There are also full details of the superfamilies, families, subfamilies, tribes and genera under which the species have been described. The feature of this volume will be considered, undoubtedly, the very full and complete monograph of the *Psychides*. This exceedingly interesting group has been hitherto practically unknown to British lepidopterists, and such authors as have dealt with it have largely copied their descriptions and notes from the Continental authorities, with the result that a very large proportion of the little that has been published about them in Britain is erroneous. In this work almost every British species of the Micro-Psychina, as well as the Macro-Psychina, has been worked out in detail, and there is no doubt that British lepidopterists will now be far ahead of their Continental brethren in their knowledge of the group, especially as in the Micro-Psychina the author has given a summary of the whole of the known Palæarctic species. A full consideration of their position with regard to their superfamilies and *inter se* has been given, and the whole group has been so thoroughly overhauled that the work will be invaluable to Continental as well as British lepidopterists. The superfamily *Lasiocampides* or *Lachneides* has been similarly treated. The whole of the family has been considered historically, and the positions of the various authorities discussed. With the exception of a few instances, the author finds himself in agreement with Aurivillius as to the names to be used, but the life-histories have had to be worked out *de novo*, on modern lines, to determine the characters on which the classification of the group should be based. The work has been so arranged as to make the facts of the greatest possible use to the synonymist, the systematist, the biologist, phenologist, and the student of variation and distribution. At the same time the collector has unequal lists of food-plants, dates of appearance, full county lists, full account of the habits (larval and imaginal) and habitats, mode of pupation, &c., in such detail as has never been offered before. Help has been obtained from a very large number of our best lepidopterists at home and abroad. Lord Walsingham, Messrs. Durrant, Kirby and Prout are stated to be almost entirely responsible for the synonymy; Dr. T. A. Chapman and Mr. Bacot for the life-histories, descriptions of larvæ, pupæ, &c. Some 250 local and county lists have been overhauled and put together for the localities, which form a really good series of county lists. Special help has been obtained from those who know any species particularly well, whilst considerable help has also to be acknowledged from Messieurs Oberthür, Dupont, and Dr. F. J. M. Heylaerts, of Breda. As the work can only be continued by the goodwill of subscribers, it is hoped that every entomologist who is anxious that we should have a series of books on British lepidoptera that shall be far in advance of anything before offered to the entomological public, and form a real work of reference, based on the lines of modern science, will support this undertaking, not only by becoming a subscriber, but also by inducing his friends to do so."—*Entomologist's Record.* July, 1900.

"Mon attention a été encore appelée spécialement sur la famille des Zygénides par l'apparition récente d'un ouvrage des plus importants dû à un auteur anglais, M. J. W. Tutt. Dans le premier volume, paru in 1899, de sa *Natural History of the British Lepidoptera* (Londres, Sonnenschein and Co.), l'auteur n'a pas consacré moins de 163 pages d'un texte très serré aux Zygénides. Il ne s'occupe, il est vrai, que des espèces britanniques, mais il étudie leurs variétés et leurs races même continentales. Jamais, à ma connaissance, il n'avait été fait une étude aussi approfondie des Lépidoptères, examinés minutieusement dans leur quatre états successifs ainsi qu'au point de vue des mœurs, de la répartition géographique et de l'habitat. Je renvoie à cet ouvrage ceux des lecteurs qui voudraient faire une étude approfondie de la famille des Zygénides."—(Professor) L. DUPONT, *Les Zygènes de la Normandie*. 1900.

"The first volume of Mr. Tutt's great work on British Lepidoptera appeared in January, 1899, and already the second volume is lying before us. We are glad to find that the author has received so much encouragement that he is enabled to proceed with the book without delay, and in the most elaborate manner. The second volume is thicker than the first by no less than 24 pages, and is similarly divided into two parts. The first part is divided into five chapters, of which the first two deal with metamorphosis in Lepidoptera, and the others with the external morphology, internal structure and phylogeny of the Lepidopterous pupa. The second part includes the Psychides (divided into Micropsychina and Macropsychina) a catalogue of the Palæarctic Psychides, the first portion of the Lachneides and Index. The author has not only epitomized a large portion of the extensive literature relating to the various subjects, of which he treats, but has added a very large amount of entirely new and original matter derived from the observations of himself and his correspondents. No less than 334 pages of the second volume are devoted to the interesting but extremely difficult group of the Psychides, which is one of the most remarkable among the Lepidoptera. The females are almost always apterous, and, in some species, are almost destitute of legs and antennæ as well, being thus reduced to the condition of mere helpless egg-bags. The larvæ form cases for themselves on the plants on which they feed, somewhat resembling those formed by the larvæ of caddis-flies (Trichoptera) to which some entomologists have considered the Psychides to be allied. Here the pupa is formed, and the more helpless females never quit it but deposit their eggs within it. Another peculiarity is that parthenogenesis is so common in some of the species, especially in the genus *Solenobia*, that you may go on breeding from the larva-like female for generation after generation, without even seeing a male, which greatly adds to the difficulty of satisfactorily separating and defining the species. Mr. Tutt has thoroughly revised this difficult group. His catalogue of the Palæarctic Psychides includes no less than 11 families, 20 subfamilies, 36 genera (of which 8 are new) and 143 species, besides varieties, &c. Among the Psychides, Mr. Tutt places several genera which many previous authors have included in the Tineides, such as *Diplodoma*, *Lypusa*, *Melasina*, *Solenobia*, *Taleporia*, &c. But if we exclude these we find that the Psychides proper, which a few years ago used to form a single family of three genera at most, and which were often included in one, has now expanded to four families comprising twelve sections and twenty-seven genera. This will appear to old-fashioned entomologists a terrible and unnecessary amount of subdivision, but, in most similar cases, the foresight of the author making the innovation is, sooner or later, largely justified by the judgment of his successors. The natural history of each species is also worked out as exhaustively as possible; thus the account of *Pachythelia villosella*, Ochs., comprises more than eighteen closely-printed pages. The reprint of the original description of each genus and species, whether short or long, is a great assistance, especially as the original types of the genera are clearly indicated. Had this always been done, we should have been spared a tremendous amount of confusion, though few cases are quite so glaring as that of the genus *Œcophora*, to which we may here allude, though it does not belong to any of the families that have yet been discussed by Mr. Tutt. . . . The remainder of the present volume is devoted to a portion of the Lachneides (or Lasiocampides), and the classification of Hübner, Aurivillius, Dyar, and others are quoted in full. Only five species are dealt with, however, in the present volume—*Poecilocampa populi*, *Trichiura crataegi*, *Lachneis lanestris*, *Malacosoma castrensis* and *M. neustria*. Mr. Tutt estimates that the remaining five genera and six species of the superfamily Lachneides will occupy 200 pages of the next volume. In his remarks on the phylogeny of the Lachneides, we are pleased to see that, while freely expressing his own views, and criticising those of his predecessors, he puts them forward tentatively, and quite avoids the dogmatic tone assumed by certain writers on what must necessarily long remain one of the most difficult and uncertain problems in entomology—all the more so because, in lepidoptera at least, we have nothing but the barest fragments of any geological record to help us to verify any of our conclusions, and without this we are necessarily groping in the dark. Five of the seven plates in the present volume are devoted to Psychides—phylogeny, neuration, spurs, antennæ, imagines and cases of *Whittleia retiella*, and the transformations of *Thyridopteryx ephemeraeformis*. Plate i is devoted to the wings, wing-scales, &c., of lepidoptera, and plate vii to Dyar's phylogeny of the Lachneides. We can fully sympathise with what Mr. Tutt says in his preface about the difficulty of getting more matter into each volume; but yet we should like to suggest that it would be very useful to include in the Contents a list of the British genera and species discussed in each volume. As the number of these is very limited, this would require very little space, and would probably not involve the sacrifice of more than a single page."—W. F. KIRBY, F.L.S., *Annals and Magazine of Natural History*. October, 1900.

BRITISH LEPIDOPTERA.

Superfamily VI: LACHNEIDES (continued).
Family: LACHNEIDÆ.
Subfam.: PACHYGASTRIINÆ.

This subfamily has always been looked upon as a strictly typical Lachneid group. The early authors, however, did not separate it from the allied subfamilies, and we find it included by Schrank, in 1802, in his *Lasiocampa*, with most of the then known Lachneid species, and by Ochsenheimer in section C of *Gastropacha* (where, however, *Macrothylacia rubi* is placed with *Pachygastria trifolii*, *P.* var. *medicaginis* and *Lasiocampa quercûs*), whilst Germar included in his genus *Lasiocampa*, such divergent species as *dumeti*, *taraxaci*, *rubi*, *quercûs*, *medicaginis*, *lobulina*, *pini*, *neustria*, *castrensis*, *franconica* and *crataegi*. Hübner was the first author to really separate the subfamily from the allied groups, and reference to our previous quotation from Hübner's *Verzeichniss* (*anteà*, vol. ii., pp. 450—451) will give that author's views on the subject. He transfers the name *Lasiocampa* to an Eutrichid group, and gives to the subfamily that we now have under consideration the name *Pachygastriae*, the first plural name applied to the group, and hence the one that we prefer to use in forming the subfamily and tribal names. He included in his genus *Pachygastria* the species *trifolii*, *spartii*, *quercûs* and *medicaginis*. Meyrick unites (*Handbook* &c., p. 320) the species of this subfamily into a single genus, *Lasiocampa*, and diagnoses it as:

Palpi short. Forewings: 6, 7, 8, approximated at base, 9 to termen. Hindwings: 6 from angle of cell, 7 from upper margin before middle, 8 connected or anastomosing shortly with 7.

Staudinger, in the recently-published 3rd edition of his Catalog, pp. 120-121, maintains this grouping also under the generic name *Lasiocampa*. The characters which Aurivillius gives (*Iris*, vii., p. 148) for the subfamily read as follows:

IMAGO.—Eyes (weakly and not uniformly) haired; palpi short, not (or scarcely) extending beyond the forehead, shaggily-haired, the terminal joint distinctly haired, the hairs more appressed; legs medium; femora with long hairs; the front tibiæ anteriorly with appressed scales, posteriorly with long hairs; the middle and hind tibiæ long-haired all round, and armed terminally with two spurs; all the tarsi with appressed scales. Wings with margin entire or slightly wavy, with moderately long to short fringes. Forewings with costa almost straight, or slightly arched behind the middle, hind margin straight, outer margin more or less arched, and apex rounded; hindwings with costa arched at the base, afterwards straight, and outer margin more or less strongly rounded. Neuration: discoidal cell of all wings closed; the "closing-nervure" of the forewings broken in the middle, that of the hindwings broken near the front angle. Forewings with 12 nervures: 2—5 separately out of the middle cell, 6—8 either all free out of the front angle of the middle cell or 6 and 7 *(decolorata, staudingeri)* with very short stalk, or 8 out of 9 and 10 *(salomonis)*, 9 and 10 with a common stalk, which is always much (3 to 5 times) shorter than the free part of the nervures, 11 free out of the costa, 2—9 run into the outer margin. Hindwings with 8 nervures: 2—5 free out of the middle cell, 6 out of the front angle of the cell, 7 arising before the middle of the upper margin of the cell; 8 approaches 7 for some distance behind the commencement of the latter, and anastomoses with it either a longer or shorter distance, or is joined to it by a short obliquely-placed transverse nervure The basal cell is consequently moderately large, and extends almost as far outwards as the front angle of the middle cell; from it, no distinct supplementary nervures run towards the costa. Antennæ, ♂, strongly pectinated; ♀, with short pectinations or nearly simple, with scarcely noticeable pyramidal teeth *(staudingeri)*. Abdomen uniformly-haired without anal wool. Wings in *staudingeri*, aborted, very short, in the rest of the species longer in the ♀ than in the ♂. Flies June to August. LARVA: The full-grown larva densely and uniformly-haired; the hairs consist both of longer erect ones and of shorter ones bent in different directions. The hairs cover the whole upper side, and leave only the front and hind margin of each segment free; there, on this account, the colour and markings of the skin are very distinct; head varying from yellow-brown to brown, with dark markings or blue-grey with light markings. PUPA: Thin-shelled, yellow-brown in colour, without anal hooks, in a firm and thick parchment-like cocoon, which is without an "athemloch" or "breath-hole."

There are, in this subfamily, two well-defined tribes: (1) The *Pachygastriidi*, including the species so generally known as the Lasiocampids *(sens. strict.)* and divisible into three genera—*Lasiocampa* (type *quercûs*), *Aurivillia** (type *decolorata*), *Pachygastria* (type *trifolii*). (2) The *Lambessidi*, with only one genus—*Lambessa* (type *staudingeri*). These subdivisions are well shown in the tabulation proposed by Aurivillius (*Iris*, vii., pp. 150—151), which reads as follows:

A. Female with developed wings and shortly-pectinated antennæ.
  - *a*. Forehead and front tibiæ unarmed; front tibiæ longer than the first tarsal joint—*quercûs, grandis, serrula.*
  - *b*. Forehead with a corneous protuberance.
    1. Front tibiæ at the tip unarmed, as long as first tarsal joint—*decolorata, datini, davidis.*
    2. Front tibiæ at the tip armed with a distinct spine, shorter (or at least not longer) than the first tarsal joint—*trifolii, josua, eversmanni, nana, concolor.*

B. Female with undeveloped wings, and with nearly simple (unpectinated) antennæ; forehead and front tibiæ armed—*staudingeri.*

Of these groups we have in Britain representatives of A, sect. *a*—*quercûs*, and A, sect. *b*—*trifolii*. The former species is the type of the genus *Lasiocampa*, the second of the genus *Pachygastria*. Christoph gives (*Stett. Ent. Zeit.*, xxviii., pp. 240—242) a note on *Pachygastria eversmanni*, in which he states that it is a distinct species, and that he inclines to believe *ratamae* and *terreni* to be varieties of this rather than of *P. trifolii*, while he also is inclined to consider *cocles* a distinct species.

Gynandromorphism must be exceedingly prevalent in this subfamily, if the known examples of *Pachygastria trifolii* and *Lasiocampa quercûs* may be considered as offering any basis for generalisation. Schultz alone records (*Illus. Zeits. für Ent.*, ii., p. 494, and iii., p. 311) no less than 31 gynandromorphous examples, *viz.*, *Pachygastria trifolii* 5,

* Diagnosed by Aurivillius as: "Forehead with a corneous protuberance. Front tibiæ at the tip unarmed, as long as first tarsal joint." There is, we know, a genus *Aurivilliana*, Dist., but we consider this name sufficiently distinct.

P. trifolii and var. *medicaginis* 1, *P. trifolii* var. *medicaginis* 1, *Lasiocampa quercûs* 24. We have added, in our detailed account of the species, others not noted by Schultz. Standfuss states (*Handbuch* &c., p. 57) that Wagner has hybridised *Lasiocampa quercûs* ♂ × *Pachygastria trifolii* ♀ and obtained a female from the cross. This we would call *Lasiocampa* hybr. *wagneri*. Bouskell records the laying of a few parthenogenetic eggs by a ♀ of *P. trifolii* (*anteà*, vol. i., p. 29).

The subfamily is, so far as is known, a small one, and confined to the Palæarctic area, the species extending (with only one or two exceptions) no great distance north or south of the Mediterranean, but travelling further eastward into Central Asia.

Tribe: Pachygastriidi.

This tribe, as we have already said, includes the typical Lasiocampids and has three Palæarctic genera—*Pachygastria*, *Lasiocampa* and *Aurivillia*. It excludes the *Lambessidi*, typified by *Lambessa staudingeri*, in which the female is more or less apterous. The genera are highly specialised, and form a branch apparently quite distinct from the Eutrichids, and having no close relationship with *Macrothylacia*, with the species of which those representing the Pachygastriid genera have been included, even in the same genus.

Genus: Pachygastria, Hübner.

Synonymy.—Genus: *Pachygastria*, Hb., "Verz.," p. 186 (? 1822); Tutt, "Brit. Lep.," ii., pp. 436, 439, 458, *et seq.* (1900); Bacot, "Tutt's Brit. Lep.," ii., p. 439 (1900). *Bombyx*, Schiff., "Schmett. Wien.," p. 57 (1775); Fab., "Mant. Ins.," ii., p. 112 (1787); "Ent. Syst.," iii., 1, p. 423 (1793); View., "Tab. Verz.," i., p. 33 (1789); Panz., "Fn. Germ.," xix., pl. xxiii (1794); Hb., "Larvæ Lep.," iii., Bomb. ii., Veræ, P. *a.* 1 (? 1800); "Eur. Schmett.," ii., fig. 171 (? 1803); text p. 143 (? 1805); Ill., "Syst. Verz. Wien.," n. Ausg., i., p. 110 (1801); Schrk., "Faun. Boica," ii., Abth. 1, p. 277 (1801); Haw., "Lep. Brit.," pt. 1, p. 83 (1803); Godt., "Hist. Nat.," iv., p. 99 (1822); Bdv., "Eur. Lep. Ind. Meth.," p. 48 (1829); "Icones," p. 158, pl. lxv., fig. 2 (*circ.* 1840); "Icon. Chenilles," pl. v., fig. 3 (*circ.* 1840); "Gen. et Ind. Meth.," p. 71 (1840); Dup., "Hist. Nat.," supp. iii., p. 85 (1836); "Icon. des Chenilles," ii., pl. iv., fig. 2 (*circ.* 1840 ?); "Cat. Méth.," p. 78 (1844); Frr., "Neu. Beit.," pl. 434 (1844); Boh., "Vet. Ak. Handl.," 1848, p. 141 (1850); Staud., "Cat.," 1st ed., p. 29 (1861); 2nd ed., p. 68 (1871); "Hor. Soc. Ent. Ross.," xiv., p. 357 (1879); Snell., "De Vlind.," p. 184 (1867); Berce, "Faun. Franç.," ii., p. 189 (1868); Nolck., "Lep. Fn. Est.," i., p. 127 (1868); Newm., "Brit. Moths," p. 44 (1869); Wallgrn., "Skand. Het. Fjär.," ii., p. 65 (1869); Cuní y Mart., "Cat. Lep. Barc.," p. 68 (1874); Guén., "Lép. Eure-et-Loir," p. 82 (1875); Mill., "Cat. Lép. Alp.-Mar.," p. 143 (1875); Curò, "Bull. Soc. Ent. Ital.," viii., p. 150 (1876); Frey, "Lep. Schweiz," p. 96 (1880); Lampa, "Ent. Tids.," vi., p. 41 (1885); Jordan, "Schmett. N.-W. Deutsch.," p. 96 (1886); Rühl, "Soc. Ent.," v., p. 178 (1891); Tutt, "Brit. Moths," p. 56 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 57 (1898). *Phalaena (-Bombyx)*, Esp., "Schmett. Eur.," iii., p. 87, pl. xv., figs. 1—6 (1783); Vill., "Linn. Ent.," ii., p. 136 (1789); Bkh., "Sys. Besch.," iii., p. 88 (1790); "Rhein. Mag.," i., p. 363 (1793). *Phalaena*, Lewin, "Trans. Linn. Soc.," iii., p. 3, pl. ii., figs. 1—4 (1797). *Lasiocampa*, Schrank, "Faun. Boica," ii., Abth. 2, p. 154 (1802); Germ., "Bomb. Spec.," ii., p. 47 (1812); Leach, "Edin. Ency.," ix., p. 132 (1815); Oken, "Lehrb. Naturg.," p. 707 (1815); Curt., "Brit. Ent.," iii., pl. 181 and expl. (1827); "Guide," p. 142 (1829); Stphs., "Ill. Haust.," ii., p. 39 (1828); "Cat. Brit. Ins.," p. 46 (1829); "List An. Br. Mus.," v., 1st ed., p. 46 (1850); 2nd ed., p. 42 (1856); Meig., "Eur. Schmett.," ii., p. 197 (1830); Wood, "Ind. Ent.," p. 21, fig. 41 (1839); Humph. and Westd., "Brit. Moths," p. 58 (? 1843); Sta., "Man.," i., p. 153 (1857); Humph., "Gen. Brit. Moths," p. 24 (1860); Ramb., "Cat. Lép. And.," p. 357 (1866); Bang-Haas, "Nat. Tids.," (3), ix., p. 412 (1874); Buckl., "Larvæ, &c.," iii., p. 78 (1889); Ström, "Danm. Somm.," p. 20 (1891); Kirby, "Cat.," p. 828 (1892); Meyr., "Handbook, &c.," p. 321 (1895); Auriv., "Iris," vii., p. 151 (1894); Barr., "Brit. Lep.," p. 21, pl. xc (1896); Dyar, "Can. Ent.," xxx., p. 5 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 70 (1898);

Tutt, "Proc. Sth. Lond. Ent. Soc.," 1898, pp. 1 *et seq.* (1898); Staud., "Cat.," 3rd ed., p. 121 (1901). *Bombix*, Latr., "Hist. Nat.," xiv., p. 178 (1805). *Gastropacha*, Ochs., "Die Schmett.," iii., p. 262 (1810); Evers., "Faun. Volg.-Ural.," p. 153 (1844); H.-Sch., "Sys. Bearb.," ii., p. 107 (1847); Heyden., "Lep. Eur. Cat. Meth.," ed. 3, p. 26 (1851); Speyer, "Geog. Verb.," i., p. 412 (1858); ii., p 288 (1862); Hein., "Schmett. Deutsch.," p. 206 (1859); Auriv., "Nord. Fjär.," p. 63 (1889). *Bombyx (-Lasiocampa)*, Led., "Verh. z.-b. Wien," ii. Abh., p. 75 (1853). *Ireocampa*, Rbr., "Cat. Lép. And.," pl. v., figs. 1—2 (1858).

The genus is diagnosed (*Verz.*, p. 186) by Hübner as follows:

Die Schwingen mit einem weissen Punkt und auch die Senken mit einem breiten hellen Streif bezeichnet.—*Pachygastria trifolii*, Schiff., "Verz.," Bom. K., 4; Hübn., "Bom.," 171. *P. spartii*, Hübn., "Bom.," 173, 224. *P. quercûs*, Linn., "Syst. Phal.," 222; Hübn., "Bom.," 172, 225. *P. medicaginis*, Ochs., "Schm.," 42, 11; Hübn., "Bom.," 264.

Hübner's genus, as here diagnosed, is heterotypical, and we have already pointed out (*anteà*, vol. ii., p. 450) that *trifolii*, owing to the elimination of *quercûs* as the type of *Lasiocampa*, becomes the residuary type of *Pachygastria*. At the time of the publication of Hübner's *Verzeichniss*, Latreille and Germar's restrictions of *Lasiocampa* (*vide*, *loc. cit.*, pp. 449—450) had left only three possible types of this genus, *viz.*, *quercûs*, *neustria*, and *castrensis*. In this work, Hübner created the practically monotypical genus *Malacosoma* for *castrensis*, *neustria*, &c. (the divergent *loti*, which he included, not agreeing with the generic diagnosis), while, from this removal of *castrensis* and *neustria*, they ceased to be possible types of *Lasiocampa*, and left *quercûs* the residuary type of the genus. But this determination at once removed *quercûs* as a possible type of *Pachygastria*, and left *trifolii* the residuary type of the latter genus.

The European species belonging to this genus are *trifolii*, Esp., *josua*, Staud., *eversmanni*, Evers., *nana*, Staud., and *concolor*, Christ. The first of these is the only species obtained in Britain, where it is extremely local, but often abundant in its restricted haunts. It is especially interesting from the tendency it exhibits to form local races, and at the same time the minor variations in individual specimens are so numerous as to make it almost polymorphic, and between the pure yellow-coloured extremes of ab. *flava*, n. ab., and the purely dark red-brown extremes of ab. *rufa*, n. ab., there is exhibited a great range of colour-variation. It may be further noted that whilst the unicolorous forms are also extreme from the point of view of having no markings whatever, and remind one of the unicolorous females of *Lachneis* and *Malacosoma*, others have exceedingly well-developed transverse lines, in all the typical forms of each colour aberration. Aurivillius treats (*Iris*, vii., p. 151) *grandis*, which Rogenhofer described as a variety of *P. trifolii*, as a distinct species belonging to the genus *Lasiocampa*. Christoph's note, already referred to, does not conclusively prove that *P. eversmanni* may not be really a local form of *P. trifolii*. It is somewhat like eastern European examples of *P. trifolii* var. *terreni*, in build, colour and general appearance, the females, however, scarcely larger than the males. One female example from Sarepta (in the Brit. Museum coll.) is suffused, inclining to buff, and reminds one a little of the peculiar tint of true *P. trifolii* var. *ratamae*.

The eggs of the species of this genus are broadly oval (often but little removed from oblong in outline). The surface is shiny, and apparently smooth, but, under a lens, is seen to have a very fine polygonal reticulation with minute black points at the angles. Observers are divided as to whether the eggs (of *P. trifolii*) be laid loosely or attached to a stem of a plant *(vide, posteà)*, but in *Lasiocampa (quercûs)* the eggs appear always to be scattered whilst the female is on the wing. The newly-hatched larva of *Pachygastria* is stated (*vide*, *anteà*, vol. ii., p. 461) to be quite a moult behind *Lasiocampa* when it hatches from the egg, judged by the character of the warts, so that the latter genus appears to have had at least a moult thrust back upon that period of development that takes place in the egg. Writing of the generic claims of *Pachygastria*, Bacot observes: "The first larval stages of *Lymantria monacha* and *Porthetria dispar* are structurally identical and only differ slightly in size and colour, and yet, taking into account all the allied European and exotic species, they certainly represent two well-marked groups, each of which is distinctly of generic value, and many parallel cases might be quoted. If this be granted, and the very close similarity between the larvæ of *Odonestis pruni* and *Eutricha quercifolia* in their hybernating instars be no bar to their being placed in separate genera (and the action of all the authorities supports this), we may conclude that differences in the first larval instar are, in the Lachneid group, of great importance, and of generic value. I consider, therefore, that *quercûs* and *trifolii* should be placed in separate genera, the larvæ in their first stages being quite distinct" *(in litt.)*. The adult larva of *Pachygastria (trifolii)* also shows several structural peculiarities, but its mode of life is so different from that of *Lasiocampa (quercûs)* that one expects some variation in response to environment. Both genera have similar cocoons, and the pupæ are of the same squat type, but Aurivillius, as we have already pointed out (*anteà*, p. 2), finds characters of the imagines which further serve to separate *Pachygastria* from *Lasiocampa*.

The *Pachygastria* species are limited largely to that portion of the Palæarctic area that runs from France and Spain eastwards to Central Asia in about the latitude of the former countries, and are localised as follows: *Trifolii* (southern and central Europe, southern Sweden, Livonia, Asia Minor, Transcaspia, Palestine, Syria, and Mauretania), *josua* (Palestine), *eversmanni* (the Russian steppe district, Armenia, Pontus, Taurus, Syria, Issyk Kul district, and Fergana), *nana* (north-east Persia and Central Asia), *concolor* (north-east Persia). *P. trifolii* has the widest range, and extends somewhat to the north and south of the general area indicated.

In order that one may have the necessary means of comparison, we append the original descriptions of the non-British species:

1. *Josua*, Staud., "Iris," viii., p. 296, pl. v., fig. 8 (1896).—From pupæ whose larvæ Herr J. Paulus found last year in the Jordan valley, we bred here in the autumn some 20 specimens of this new species. Herr Paulus writes me that this form must, in his opinion, especially according to the larva, be distinct from all other species found by him in Palestine. As the *B. josua* has a large spur on its short front tibiæ, like *B. trifolii* and its varieties, Prof. Aurivillius considers it must be a variety thereof. But I hold *bathseba* from Palestine, which has like front tibiæ, and is much more like *trifolii*, to be its local form there. Also the specimens from Palestine, which I have placed as *terreni* (?), may belong as aberrant specimens to *bathseba* (therefore to *trifolii*). But that *josua* cannot be a local form of the Jordan valley is proved by two ♂ specimens of it captured near Jerusalem, which I years ago placed as a separate form, but would not describe from these two specimens alone. In size *B. josua* varies from 45 to 63 mm., the ♂s mostly 45—49mm., the ♀s 50—55 mm. The principal difference of *B. josua* from all other allied species is that its *brown forewings* are

densely yellowish *dusted*, that they have a *sharply defined, light basal patch*, acutely running outwards, and a *sharply* expressed *light outer band*. The *latter* is continued (almost always) *equally distinctly* on the brown *hindwings*. In particular the distinct light basal patch, mostly produced into two points, is not present thus (pointed) in any similar species. When in the light varieties of *bathseba* and *ratamae* a light outer band is present (which is rarely the case), it does not stand out so sharply on all the wings as in *josua*, and is not curved in somewhat *S-form*, as in that species. The ♀♀ of *B. josua* are far more densely light-sprinkled than the ♂♂, occasionally they are on the forewings predominantly light. In these specimens the light basal patch is narrowly brown margined, but also prolonged into a point; the light outer band is here internally sharply dark margined (as mostly in *bathseba* when it there occurs). Only in the smallest (somewhat rubbed) very pale ♀ *josua* is the light outer band on the upper side of the hindwings hardly perceptible at all. In all *(josua)* there is a distinct light, dark-margined central spot on the forewings. The underside is in most specimens predominantly pale (only in some males the brown colour predominates); the outer marginal part (behind the light band) is predominantly brown, intersected by the light nervures. There seems to me no doubt that this *B. josua* must be a distinct species from *bathseba*, since I have not received, among a great number of the latter, a single specimen which even approximately forms a transition to *josua*. Whether Herr Paulus will really succeed in establishing constant differences between the larvæ, appears to me doubtful. The larvæ of var. *ratamae*, found by me in abundance at Cadiz, vary quite extraordinarily—much more than the very variable moths bred from them (Staudinger).

2. *Eversmanni*, Evers., "Bull. Mosc.," 1843, iii., pp. 542—4, pl. x., figs. *2a*—*c*.—*α*. *Gasteropacha* alæ anticæ supra ochraceo-luteæ, ciliis, striga externa modice flexuosa punctoque medio ferrugineis; hoc albo-pupillato; posticæ ferrugineæ, unicolores. *β*. Alæ anticæ spatio inter strigam et basin ferrugineo, postice luteo. Comes near *Gasteropacha medicaginis* or *trifolii*, but differs in the yellow colour of the forewings and especially in the ferruginous or cinnamon stripe, not yellowish; the stripe is therefore darker than the ground colour, while in *G. medicaginis* it is paler, and is slightly flexuous, parallel with the outer margin. The yellow colour of the forewings does not differ much from that of ♀ *G. potatoria*; the ferruginous colour of hindwings hardly differs from ♀ *G. medicaginis*, except in being somewhat paler. Difference in size between the ♂ and ♀ much less than in the related species; ♀ differs from ♂ in rather paler colour. In variety *β* the space between the base and the ferruginous stripe is filled up with ferruginous, the yellow colour only remaining at the posterior margin [*i.e.*, inner margin] of wings. Larva differs from those of all the allies: fuscous with bluish incisions, short ferruginous hairs, fulvous-spotted beneath, laterally striped with yellow, anterior segments above varied with red. Feeds on *Caragana frutescens*. Pupates end of June, imago appears after the middle of August. Inhabits Ural and southern Altai districts (Eversmann).

3. *Nana*, Staud., "Stett. Ent. Zeit.," xlviii., p. 99 (1887). *Herzi*, Chr., "Hor.," xxii., p. 309 (1888).—Haberhauer sent me four bred females from Margelan, unfortunately in part somewhat crippled, which can only be a dwarf form of *eversmannii*.* They measure 33—38 mm., consequently are only as large as ♀ *neustria* or *castrensis*. My largest *eversmannii* ♀ measures 55 mm., my strikingly smallest from Sarepta only 40 mm. These var. *nana* of Central Asia either show no trace of the narrow brownish outer band of the forewings, or, where (in two specimens) it is just faintly perceptible, it stands immediately behind the median cell (thus about the middle of wing) and is connected with a very faint brownish, light, granulated spot at the end of median cell, only showing in one of the four ♀s. It is very instructive that also in my small Sarepta ♀ of *eversmanni* this brown band is brought back much further inwards, close against the brown central spot. The distance of such bands from the outer margin or central spot has very frequently been used in descriptions as a specific difference (Staudinger). Christoph, under the name of *herzi*, diagnosed both sexes (*Horae Ross.*, xxii., p. 309) as: "♂♀. Ochracea; alæ anticæ striga obliqua obsoleta punctoque medio ferrugineis. Long. alæ ant. ♂ 16 mm., ♀ 19 mm. Distinguished from *B eversmanni* by the more elongated wings—with a more oblique transverse line, much more shortly pectinated antennæ, and very different larva. Schahrud. The larva in May on *Lycium barbarum*."

4. *Concolor*, Christoph, "Iris," vi., p. 88 (1893).—Proxima *Bombyx herzi*, Christoph (=*nana*, Staud.). Alis ochraceis, venis leviter brunnescentibus ♂♂. Long. alæ ant. ♂ 15 mm., ♀ 20 mm. Hyrcania—Schahrud.

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* *Nana* was here described by Staudinger as a var. of *eversmanni*. He later considered it to be a distinct species.

Pachygastria trifolii, Schiffermüller.

Synonymy.—Species: *Trifolii*, [Schiff.], "Schmett. Wien.," p. 57 (1775); Esp., "Schmett. Eur.," iii., p. 87, pl. xv., figs. 1–6 (1783); Brahm, "Fuess. Neu. Mag.," iii., pp. 151, 160 (1787); Fab., "Mant.," ii, p. 112, no. 46 (1787); "Ent. Syst.," iii., pt. 1, p. 423, no. 52 (1793); View., "Tab. Verz.," p. 33 (1789); Vill., "Linn. Ent.," ii., p. 136 (1789); Bkh., "Sys. Besch.," iii., pp 88–90, no. 23 (1790); "Rhein. Mag.," i., p. 363 (1793); Panz., "Fn. Germ.," xix., pl. xxiii (1794); Hb., "Larvæ Lep.," iii., Bomb. ii., P *a.*, figs. 1*a*—*b* (*circ.* 1800); "Eur. Schmett.," ii., pl. xxxix., fig. 171 (? 1803); p. 143 (? 1805); "Verz.," p. 186 (? 1822); Ill, "Syst. Verz. Wien.," n. Ausg., i., p. 110 (1801); Schrk., "Faun. Boica," ii, Abth. 1, p. 277 (1801); Abth. 2, p. 154 (1802); Latr., "Hist. Nat.," xiv., p. 178 (1805); Ochs., "Die Schmett.," iii., p. 262 (1810); Germ., "Bomb. Spec.," ii., p. 47 (1812); Leach, "Edin. Encycl.," ix., p. 132 (1815); Oken, "Lehrb. Naturg.," p. 707 (1815); Godt., "Hist. Nat.," iv., p 99 (1822); Curt., "Brit. Ent.," expl. pl. 181 (1827); "Guide," p. 142 (1829); Stphs., "Ill. Haust.," ii., p. 39 (1828); "Cat. Brit. Ins.," p. 46 (1829); "List Br. An. Br. Mus.," v., 1st ed., p. 46 (1850); 2nd ed., p. 42 (1856); Bdv., "Eur. Lep Ind. Meth.," p. 48 (1829); "Icones," p. 158, pl. lxv., fig. 2 (*circ.* 1840); "Icon. Chen.," pl. v., fig. 3 (*circ.* 1840); "Gen. et Ind.," p. 71 (1840); Meig., "Eur. Schmett.," ii., p. 197 (1830); Dup., "Hist. Nat.," supp. iii., p. 85 (1836); "Icon. des Chen.," ii., pl. iv., fig. 2 (*circ.* 1840); "Cat. Méth.," p. 78 (1844); Wood, "Ind. Ent.," p. 21, fig. 41 (1839); Humph. & Westd., "Brit. Moths," p. 58 (? 1843); Frr., "Neu. Beit.," pl. 434 (1844); H.-Sch., "Sys Bearb.," ii., p. 107 (1847); Guén., "Ann. Soc. Ent. Fr.," p. 450 (1850); "Cat. Lép. Eure-et-Loir," p. 82 (1875); Boh., "Vet. Ak. Hand.," 1848, p. 141 (1850); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 26 (1851); Led., "Verh. z.-b. Wien.," ii., p. 75 (1853); Selys, "Ann. Soc. Ent. Belg.," i., p. 58 (1857); Sta., "Man.," i., p. 153 (1857); Spey., "Geog., Verb. Schmett.," i., p. 412 (1858); ii., p. 288 (1862); Hein., "Schmett. Deutsch," p. 206 (1859); Humph., "Gen. Brit. Moths," p. 24 (1860); Staud., "Cat.," ed. 1, p. 29 (1861); ed. 2, p. 68 (1871); ed. 3, p. 121 (1901); "Hor. Soc. Ent. Ross.," xiv., p. 357 (1879); Rbr., "Cat. Lép. And.," p. 357 (1866); Snell., "De Vlind.," p. 184 (1867); Berce, "Faun. Franç.," ii., p. 189 (1868); Nolck., "Lep. Fn. Estl.," i., p. 127 (1868); Wallgrn., "Skand. Het. Fjär.," ii., p. 65 (1869); Newm., "Ent.," ii., p., 291 (1865); "Brit. Moths," p. 44 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 412 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 68 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 143 (1875); Curò, "Bull. Soc. Ent. Ital.," viii., p. 150 (1876); Frey, "Lep. Schweiz," p. 96 (1880); Oberth., "Et. Ent.," vi., p. 94 (1881); Jord., "Schmett. N.-W. Deutsch.," p. 96 (1886); Failla-Ted., "Nat. Sicil.," vii., p. 230 (1888); Buckl., "Larvæ, &c.," iii., p. 78, pl. xlvii., fig. 1 (1889); Auriv., "Nord. Fjär.," p. 63 (1889); "Iris," vii., p. 151 (1894); Ström, "Danm. Somm.," p. 20 (1891); Rühl, "Soc. Ent.," v., p. 178 (1891); Kirby, "Cat.," p. 828 (1892); Meyr., "Handbk.," p. 321 (1895); Tutt, "Brit. Moths," p. 56 (1896); "Proc. Sth. Lond. Ent. Soc.," pp. 1 *et seq.* (1898); Barr., "Lep. Brit.," iii., p. 21, pl. xc (1896); Dyar, "Can. Ent.," xxx., p. 5 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 70 (1898); Reutti, "Lep. Bad.," 2nd ed., p. 57 (1898). *Dumeti*, Fuess., "Verz.," p. 34, no. 643 (1775). *Quercûs*, Sepp, "Ned. Ins.," ii., st. 4, p. 59, pl. 13—14 (? 1777). *Onobrichis*,* Gladb., "Nam. und Preis.," s.p. (1778); Kühn, "Kurze Anleitung," ed. 2, p. 121 (1783). *Trifolius*, Haw., "Lep. Brit.," p. 83, no. 6 (1803).

Original description.—[Sect.: *Larvae Villosae. Ph. Bombyces Centropunctae.* The larvæ have on the segments short complicated furry hairs. The transformation takes place above ground, in the first two species *(potatoria, rubi)* in soft- and in the other species in hard-shelled cylindrical coverings. The moths are tongueless, have large rounded wings, mostly with a whitish central spot and one or two

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* *Onobrichis*, Linnei, Gladb., "Namen-und-Preissverzeichniss," 1778. With reference to Rösel, Band i., Taf. 35A, "Der rare Quittenvogel." [Reprinted in Kühn's "Kurze Anleitung," &c., ed. 2 (1783), p. 121. Zeller (*Stett. Ent. Zeit.*, xvi., p. 94) called attention to Gladbach's "Name and Price Catalogue," in which an early, though crude, attempt was made to supply a Linnean nomenclature to Rösel and Kleemann; the name *onobrichis* may perhaps be considered inadmissible on the ground of the erroneous addition of "Linnei," but it is to be feared that the right of priority will have to be accorded to some of Gladbach's names, which are properly formed. Werneburg and others refer Rösel's figures (pl. 35A) to the *medicaginis* form of *trifolii* (Prout).]

transverse stripes—*potatoria*, L., *rubi*, L., *quercûs*, L., *trifolii*, *dumeti*, L., and *lobulina*.] Wiesenkleespinner Raupe *(Trifolii pratens.)*. La Chenille du Gazon, * Réaum. Wiesenkleespinner—*B. trifolii* (Schiffermüller). The earliest description of this species is that of Esper, which reads as follows: "*Phalaena (Bombyx)* al. revers. *trifolii*. Der Kleespinner. *Phalaena Bomb.* eling. al. revers. rufis, superioribus puncto albo, lineaque repanda livida, *Syst. Verz. der Schmett. der Wien. Gegend*, Fam. K, *Bomb. trifolii*, Wiesenkleespinner.—Das ist derjenige Falter, den man für die *Ph. dumeti* gehalten, wie ich schon in Beschreibung der letztern Gattungen erwähnt. Nach zuverlässigen Nachrichten haben die Verfasser des *Wien. Verz.* obstehenden Namen von der gewöhnlichen Futterpflanze, dieser Phaläne ertheilt. Ausser Röseln, der sie zuerst in Abbildung geliefert, ist solche den Beobachtungen vieler Kenner entgangen. Man hat sie sogar mit der *Ph. quercûs* für einerley gehalten. Rösel hatte den Unterschied sehr sorgfältig angegeben. Ich weiss seinen ausführlichen Bemerkungen nichts hinzuzusetzen. Doch nach neueren Beobachtungen sind noch einige Umstände beyzufügen. Wir finden die Raupe in Wiesen. Sie nähret sich besonders von dem Wegrich, dem Klee, und andern niederen Gewächsen. Auf Stauden und Bäumen haben wir sie niemalen angetroffen. Doch vermuthlich möchte sie sich in ihrem ersten Alter, wie die Raupe der *Ph. rubi* da enthalten. Man kann sie wenigstens mit Baumblättern gleichfals erziehen. Sie ist schon im May vorhanden, und sonach hat sie sicher den Winter, nach einer oder der andern abgelegten, Häutung in diesem Stande zugebracht. Doch ist sie auch später und vielleicht nach der zweyten Erzeugung den Sommer hindurch vorhanden. In hiesiger Gegend ist sie etwas selten, in Franken aber, besonders bey Uffenheim, häufiger anzutreffen. Der Unterscheid von der Raupe der *Ph. quercûs* ist auffallend genug. Sie ist nicht so geschlank gebaut, und im Verhältniss der Länge um vieles dicker. Die Haare sind kürzer, und etwas steif. Sie ist mehr olivengelb, als fuchsroth gefärbt. Die weisse Seitenstreife stehen auf den Ringen etwas schrege in abgesonderten Parthien. Rösel hat sie zu gerade gebildet. Im jugendlichen Alter, in welchem ich nach der vierten Figur eine Abbildung beygefügt habe, ist sie von sehr veränderter Farbe. Sie ist hellgelb, mit schwarzen Punkten gezeichnet, und gegen die untere Seite weissgrau. Nach ihren Kunsttrieben und natürlichen Eigenschaften kommt sie mit der Raupe der *Ph. quercûs* überein. Sie baut sich nach der Form ein gleiches Gehäuse. Bey dem Anfühlen aber ist dieses sehr rauh von dem eingewebten steifern Haaren. Sie dringen in die Haut, und bleiben an den Fingern kleben. Rösel hat diesen Unterscheid sorgfältig bemerkt. Die Chrysalide ist nach dem Hinterleib grünlich, vorne aber bräunlich gefärbt. Ueberdiess aber ist die Schaale, die sie umgiebt, sehr weich. Die Phalänen Kommen daraus in drey Wochen zum Vorschein. Nach dem Umriss der Flügel sind sie schon von der *Ph. quercûs* verschieden. Sie sind etwas kürzer gebildet, und die Borden an dem Rand wellenförmig gekrüpft, ohngeachtet sie in gleicher Länge stehen, und einen gerade laufenden Rand bilden. Die Grundfarbe ist ein schmutziges Ockergelb, das durch dichte eingestreute Atomen eine dunklere röthlichbraune Farbe erhält. Der Punkt

* This reference to Réaumur makes the species unmistakable, Réaumur's insect being undoubtedly the species known to entomologists as *trifolii*, Esp.

in der Mitte der Vorderflügel ist hellweiss, und braun eingefasst. Die Binde ist ausgeschweift, und von gleicher Breite, zur Seite dunkelröthlich grau eingefasst. Sie ist von bleicher Farb. Das Männchen ist von dunkleren Colorit, und hat blasse starkgefiederte Antennen mit einem weissen Stiel (Esper, *Schmett. Eur.*, pp. 87, 88).

IMAGO.—43·74 mm.—67·5 mm. Anterior wings yellow, reddish-grey, or reddish-brown; a white, dark-edged discal spot; a pale curved transverse line between this spot and the hind margin; a more obscure transverse line between the discal spot and the base; sometimes a pale basal patch; outer area sometimes irrorated with pale scales. Posterior wings unicolorous yellow, reddish-grey, or reddish-brown, sometimes with faint transverse shade. Head and thorax of the same colour as forewings, the abdomen as the hindwings.

SEXUAL DIMORPHISM.—The females are usually much larger than the males, the forewings more extended and rounded at the apex, and somewhat less densely scaled. A number of males give measurements extending from 43·74 mm.—50 mm., a number of females from 46 mm. —67·5 mm. The males have strongly pectinated antennæ, whilst those of the females are comparatively simple, and the general build of the sexes suggests the actual difference of habit—the quick zig-zagging flight of the males, the steadier, heavier flight of the females. The ♂ antennæ are about 12 mm. in length, the plumules about 2 mm.; there are about 65 joints, the plumules hang down (in lop-eared fashion), side by side. The antenna is like that of *L. quercûs* in having opposite plumules of equal length, and in having the strong terminal spike quite on the front of the terminal (slight) bulb, and in pointing forwards parallel with the antennal stem; about 72 transverse rows of hairs to a plumule, those of the two sides not always opposite. The terminal spike is very thick and strong, and the notch half-way up is barely indicated; no trace of scaling on pectinations. The ♀ antennæ are 10 mm. in length, of about 60 joints, scaling irregular as in ♂, plumules about ·3 mm. in length, slightly clubbed, have two end bristles, and the thick spike, which is shorter than the bristles and much thicker, as in the ♂, arises not from extreme end, but from front of spike; it is, however, parallel with plumule and not with shaft of antenna as is that of the ♂. The plumules are clothed on almost all aspects with very fine short hairs (Chapman). The colour of the wings is not usually strikingly different in the sexes (although in both it is exceedingly variable), but the transverse lines of the forewings are usually much more distinctly marked in the males than in the females. The relative proportion of males and females emerging from a number of pupæ in the possession of Standfuss is recorded as follows: 1882—29 ♂s and 25 ♀s, 1893—114 ♂s and 106 ♀s=143 ♂s and 131 ♀s.

GYNANDROMORPHISM. — The following are the only records of gynandromorphic examples of this species that have occurred to us:

α. ♂ left, ♀ right, completely gynandromorphous. The left (♂) side shows the colouring of the var. *medicaginis*, the right (♀) that of *trifolii*; the left palp more strongly developed and clothed with hairs; the left forewing shorter; on left side of abdomen an anal tuft. The entire underside of the ♂ wings yellowish, on the other side, on the contrary, only the base is tinged with yellow. Bred in Zara. In Macchie's coll. (Rogenhofer, *Verh. z.-b. Ges. Wien.*, viii., p. 245).

β. ♂ right, ♀ left. Abdomen like the ♀ but more slender, with extremely accurate trace of the partition concerning the sexual parts. Of the form known as var. *medicaginis*. In Berlin museum; from Berg's coll. (Klug, *Verh.*, p. 367. *Jahrb.*, p. 255, &c.).

γ. Bred early in August. 1882. The right antenna male, strongly pectinated, the left female, quite plain. Wings on right side male, smaller and little lighter, with outer marginal band less distinct than in the majority of specimens. On the upper side the body is equally divided, lighter on the male side than on the other; on the underside of the body the difference in colour is more distinct, on the male side light buff, on the female side deep chocolate, the line dividing the two colours being distinct, so that the insect has the appearance of two specimens cut in two, *viz.*, the right-hand side of a male joined to the lefthand side of a female. The extremity of abdomen looks peculiar with tufted tail of male on right, and rounded anal extremity of female on left. From Crosby (Fraser, *Entom. Mo. Mag.*, 1882, p. 111).

δ. A male specimen in antennæ, wings and coloration, but with a female body, pressure of which caused the extrusion of two or three imperfectly developed eggs (Webb, *Entom. Mo. Mag.*, xxxiv., p. 20).

We have seen Webb's example and noted it as being in appearance a yellow male with (for this sex) abnormally large abdomen, now collapsed.

ε—ζ. Two examples both with the left half ♀ and the right half ♂. In coll. Staudinger. Stdgr. *in litt.* (Schultz, *Illus. Wochenschrift für Entomologie*, ii., p. 413).

η. A hermaphrodite of *P. trifolii* was exhibited at the exhibition of the Entomological Society at Leipzig, in 1894 (Heyne, *Insekten-Börse*, 1894, p. 167).

θ. Right ♂, left ♀. Antenna on the right side ♂, strongly pectinated, left ♀. Wings on right side smaller and lighter than on left. Body divided on the upper side, the ♂ side lighter than the female side of the body, the colour difference is very distinct, the right side being a light chamois, the left a deep chocolate, with a distinct dividing-line. Abdomen on the right side ♂ in form, on left rounded like ♀. Bred in August, 1882 (Schultz, *Illus. Zeits. für Ent.*, iii., p. 168).

ι. Completely halved; antennæ, wings and body on the left ♀, right ♂. From Nordhausen. In coll. Fr. Philipps, Cologne (*in litt.*) (Schultz, *Illus. Zeits. für Ent.*, iii., p. 168).

Variation.—This is probably one of the most variable species in the whole Lachneid superfamily, forming distinct races in almost every locality, and varying to every shade of colour between the palest straw-yellow and the deepest red-brown. The intermediate stages are so exceedingly numerous that one might almost say the species was polymorphic, yet each district has a sort of average form, which is usually easily recognisable. Strangely enough, we have two very distinct races in Britain: (1) The ordinary dark red-brown form characteristic of the central European races. (2) A distinct yellow race closely approximating to the [?extreme southern (Lambessa) and] eastern (Russia and Asia Minor) forms. The former appears to be the general type from the coasts of Lancashire, Cheshire, Devon, and the heaths of the New Forest, whilst the latter appears to be confined to the Kent and Sussex coasts, between Dungeness and Beachy Head, more particularly on the shores of Romney Marsh, about Rye and Lydd. One can only, with such a species as this, give some general tabulation of the aberrations and local races that have been noted, and in each group it must be understood that intermediates intergrade with the more extreme forms. Those we have observed in the British races work out as follows:

Ground colour pale yellow.

1. All the wings unicolorous yellow or yellow-ochreous, absolutely without any markings=ab. *obsoleta-flava*, n. ab.
2. Pale yellow or whitish-ochreous, with the transverse lines including a more or less undefined median band, the central white spot clearly defined; the hindwings grey, often with a slight pinkish tinge; the females inclining to fawn rather than buff=*pallida-flava*, n. ab.
3. Distinct yellow males and females with two well-developed, pale-edged, darker, transverse lines developing into a moderate band in some examples; the hindwings usually with a slight reddish tinge=ab. *flava*, n. ab.

4. Yellow with the transverse median band contracted and broken (in one example observed restricted to a small semicircular costal patch that just includes the typical white median spot)=ab. *contracta-flava*, n. ab.

We have seen no examples of *P. trifolii* from any part of the Palæarctic region quite like the specimens that belong to this group, which, in Britain, appears to be confined to the coasts of Kent and Sussex, between Lydd and Rye. The nearest approach to it is found in *P. eversmanni*, generally, however, considered a distinct species, and *P. trifolii* var. *terreni*. In *P. eversmanni* and *P. terreni* (at least those in British Museum coll.) as in *P. trifolii* var. *flava*, there is the same general tendency to a clear yellow colour, to a restriction of the red (when not altogether absent) to the transverse lines of the forewings, the edge of the white central spot, and to a general suffusion of pinkish leading up to red on the hindwings.

GROUND COLOUR YELLOW-GREY OR BUFF.

1. All the wings yellow-grey without markings=ab. *obsoleta-medicaginis*, n ab.

2. Yellow-grey with pale outer transverse line and darker basal patch=ab. *medicaginis*, F. J. A. D.

3. Yellow-grey with distinct transverse lines and more or less developed median band=ab. *virgata-medicaginis*, n. ab.

4. Forewings buff, outer transverse line reddish edged externally with paler, fringes reddish ; hindwings reddish with a pale transverse stripe=var. *ratamae*, H.-Sch.

5. Forewings buff, outer transverse line and edge of white median spot reddish, outer margin tinged faintly with reddish ; hindwings buff, the pale transverse stripe narrowly shaded with reddish internally and externally shaded with reddish to outer margin=var. *cocles*, Hb. ♀

This is a very distinct group from the above *(flava)*. The forewings of the ♂ are covered with a mixture of coarse yellow-ochreous scales, with some red ones, producing a general dirty yellow or buff appearance ; the transverse lines, the circumscription of the central spot (and sometimes the basal area of the forewings) are generally reddish ; whilst the hindwings approach the redness of the following group in tint. The ♀ is usually yellower, less coarsely scaled, and with the hindwings much more closely approaching the forewings in tint. The group includes the southern races—the "yellow-grey" form named *medicaginis*, the "yellow-ochreous" Spanish *ratamae*, the Algerian "clay-yellow" *mauritanica*. The Sicilian *cocles* ♀, judging by Hübner's figure (335) would belong here, the ♂ (figs. 332–333) is, however, very different, and *cocles* would appear to have the colour difference strongly developed as a secondary sexual character.

GROUND COLOUR FAWN-GREY OR REDDISH-GREY.

1. All the wings unicolorous reddish-grey without any markings=ab. *obsoleta-cervina*, n. ab.

2. Pale reddish-grey with distinct transverse lines, more or less developed median band and reddish-brown hindwings=ab. *cervina*, n. ab.

3. Pale reddish-grey with the transverse band contracted=ab. *contracta-cervina*, n. ab.

This group contains the various aberrations which are by most continental authorities combined erroneously to form the var. *medicaginis*. The sexes are not very dissimilar, and the general appearance of the specimens gives one the impression that they constitute an extreme development of the preceding section. The forewings, however, are essentially clothed with reddish or red-brown scales, but with enough ochreous ones mixed therewith to give them a distinct greyish appearance; the hindwings are usually quite reddish or reddish-brown and typical. This group appears also to include the British examples usually referred to var. *medicaginis*.

GROUND COLOUR REDDISH-BROWN.

1. All the wings unicolorous red-brown with both the transverse lines obsolete in the forewings of both sexes=ab. *iberica*, Gn.

2. Red-brown, with the basal line of forewings obsolete in both sexes=ab. *unilinea-typica*, n. ab.

3. Red-brown, with ill-defined transverse lines but well-marked pale longitudinal nervures=ab. *suffusa-typica*, n. ab.

4. Red-brown, with two paler transverse lines across the forewings and more or less well-defined median band=*trifolii*, Esp.

This and the succeeding group comprise the best known forms in Britain and Central Europe. The tint varies from reddish-brown to a really bright ferruginous-orange (two very fine ♀s of this tint in the British Museum coll.). The ochreous scales are reduced to a minimum and hence the grey appearance of the preceding group is, as a result, unnoticeable.

GROUND COLOUR DEEP FOXY RED-BROWN.

1. All the wings uniformly unicolorous bright foxy red-brown with the markings obsolete=ab. *obsoleta-rufa*, n. ab.

2. Bright foxy red-brown, with conspicuous transverse lines and more or less well-developed median band=ab. *rufa*, n. ab.

3. Bright foxy red-brown, with contracted band=ab. *contracta-rufa*, n. ab.

There are many notable aberrations intermediate between the forms here named: *e.g.*, there is one whole group in which the tendency to ochreous in the fawn-grey tint is very noticeable. We have seen in Webb's collection a fawn-grey ♀ with red transverse lines (ab. *rufo-linea*), the outer edged externally with paler, and with a pale basal patch, other females are intermediate in colour between fawn-grey and red-brown with distinct lines; there is also much variation in the development of the pale basal patch, both in the width and general brightness, as also in the direction of the outer transverse line. The depth of the colour of the hindwings is also, in the red-brown forms, extremely variable. Considerable differences in size also exist; we have given some average measurements under the head of sexual dimorphism, but Agassiz notes an extremely small aberration of only 36 mm. expanse (=ab. *minor*, n. ab.). Gregson notes two females as of a rich deep red-brown colour, and having the usual curved marking almost obliterated, evidently of the *obsoleta-rufa* form. From the Scilly Isles Adkin notes specimens varying from the type as follows: (1) White discal spot with tendency to enlargement and elongation, becoming wedge-shaped. (2) A male of distinctly female coloration. (3) A pale female, especially pallid from line on forewing to margin. Rambur notes (*Cat. Lép. Andalousie*, p. 358): "*Trifolii* is variable in markings and colour, also in the form and width of the wings, especially in the case of the females, which differ also in the form and quantity of scales and hairs with which the wings are covered." He states that he "has a specimen of var. *cocles* in which the outer part of the forewings is entirely covered with scales, whilst in others, as the var. *iberica*, especially abundant at Paris and in central France, these parts of the forewings present more hairs than scales and are everywhere sparsely covered, sometimes also the scales are erect and curved at the tips. The species is very common around Cadiz and Malaga, where almost all the varieties are found." He further adds that "the Andalusian females are identical with the variety *terreni* of the same sex figured by Herrich-Schäffer, and that the var. *ratamae*, as represented with him, has a yellow spot at the anal angle of the fringe; this is too, the colour of the fringe in var. *cocles*, although many of the Andalusian *ratamae* have also the fringe yellow." Staudinger notes that though some of the varieties of this species are very striking, yet the transitions from one form to others are very gradual, and that, from Cadiz larvæ, he bred all transitions from *ratamae* to *iberica*. Moeschler describes a series of transitions from the type to var. *medicaginis* as follows:

a. ♂ dark red-brown without trace of a light band, central spot distinct.
b. ♂ dark red-brown with indistinct internally dark-shaded band, and distinct central spot.
c. ♂ dark red-brown with sharp yellow band that is neither internally nor externally dark-shaded; the central spot scarcely perceptible.
d. ♀ light red-brown, with narrow band, which is largely dark-shaded, central spot small and indistinct.
e. ♂ red-brown with denser yellow dustings, especially towards costa, and distinct internally dark-shaded band; central spot large.
f. ♀ light red-brown with rather uniformly distributed fine yellow scaling. Band externally shading off into ground colour, internally dark-shaded, central spot small but distinct.
g. ♀ red-brown with much yellow scaling, denser on outer margin and broader band, central spot small.
h. ♂ forewings clay-yellow. The margin which, in all the previous forms is lighter, here appears dark red-brown; central spot distinctly margined with red-brown.

Nägeli notes that at Zürich in August, 1893—1894, when the species was extraordinarily common, he obtained ab. *iberica* (entirely brown without band), ab. *medicaginis*, and also albinic examples of a pale ochre-yellow colour without markings, whilst in the ♀ even the white central spot fails. Nolcken states that the specimens from Libau are in both sexes of a red-brown colour, and show no difference from specimens from Sarepta and Germany. Prittwitz says that the Silesian examples are always dull-coloured, the imagines brighter in the south, and adds: "Rambur figures a ♂ (=var. *ratamae*) with straw-yellow forewings, two red-brown transverse lines, a red-brown discoidal spot, and red-brown fringes, the hindwings with a straw-yellow base and central band, yellow nervures and a yellow line before the fringes which broadens out into a yellow blotch before the anal angle. The head, antennæ, thorax and abdomen also straw-yellow. Another ♂ (=var. *iberica*) figured by Rambur is bright cinnamon-brown on the thorax, collar, shoulders, fringes, central band of hindwings and two transverse shades on forewings darker red-brown." Our own notes upon the more striking specimens in the British Museum collection, are as follows: (1) An example labelled "var. *ratamae*, H.-Sch., Frey coll.," with the thorax, abdomen, and forewings buff, the outer transverse line red-brown edged externally with paler, no basal line, white central spot ringed with red-brown, fringes red-brown, shiny; hindwings red-brown, buff at base, fringes concolorous with hindwings. (2) A male, pale reddish-brown, with outer line slightly paler, an oval basal patch with yellow transverse line edged externally with ochreous in contact with patch, white spot edged with darker, fringes concolorous with wings, shiny; hindwings reddish-brown, faint transverse line, fringes concolorous. (3) A ♂ specimen near this, labelled "Greece, Merlin coll.," roughly-scaled, transverse line without dark edging, the white spot also without darker edging. (4) An uniform orange-brown form, with no markings clearly-defined except the white spot in both sexes; from Zeller coll. (5) An excellent pair from "Bremgarten, Frey coll," the ♂ of a very deep red form, with very pale outer line and a very intense white central spot, oval basal mark, the hindwings rather duller red-brown, with transverse line; the ♀ equally red, transverse lines and median spot less conspicuously marked, no shade on hindwings. (6) One ♀, bred 15–8–80, from the Zeller coll., has quite a deeper median band in spite of its being fairly dark in colour, the rather paler outer and basal areas being separated from the more ruddy median band by paler ochreous transverse lines. (7) From "Sarepta, Zeller coll.," there is also a very small smooth male, with well marked outer transverse line and median spot, but no inner line; hindwings with a very faint transverse line. The basal mark in some specimens suggests that of *Lachneis lanestris* in shape, in others it forms quite a basal patch bounded by a distinct line.

a. ab. (et. var.) *medicaginis*, Dr. F. J. A. D., "Bork.'s Rhein. Mag.," i., pp. 363—4 (1793); Ochs., "Die Schmett.," iii., p. 264 (1810); Germ., "Bomb. Spec.," ii., p. 47 (1812); Hb., "Verz.," p. 186 (? 1822); Curt., "Brit. Ent.," expl. pl. 181 (1827); "Guide," p. 142 (1829); Stphs., "Ill.," ii., p. 40 (1828); "Cat. Brit. Ins.," p. 46 (1829); Meig., "Eur. Schmett.," ii., p. 197 (1830); Wood, "Ind. Ent.," p. 21, fig. 42 (1839); Dup., "Cat.," p. 78 (1844); Evers., "Fauna Volg.-Ural.," p. 153 (1844); Wllgrn., "Skand. Het.," ii., p. 65 (1869); "Horæ Soc. Ent. Ross.," vii., p. 117 (1870); xiv., p. 357 (1879); Staud., "Cat.," 2nd ed., p. 68 (1871); 3rd ed., p. 121 (1901); Kirby, "Cat.," p. 828 (1892); Auriv., "Iris," vii., p. 151 (1894); Reutti, "Lep. Bad.," 2nd ed., p. 57 (1898). *Trifolii*, Esp., "Eur. Schmett.," iii., pl. xv., fig. 2, ♀ (1783); Panz., "Fn. Ins. Germ.," xix., pl. 23 (1794); God., "Hist. Nat.," iv., pl. ix., figs. 3—4 (1822).—*Phalaena Bombyx medicaginis.* Alis reversis luteo cinereis, superioribus puncto albo, lineaque repanda albida. Esp., tab. xv., fig. 3, die Raupe. Rarer than *B. trifolii.* ♂. Yellow-grey, brownish at base, the thorax also yellow-brown; the ♀ generally paler, often entirely dirty-yellow. The larva, as also the cocoon and pupa, differs from that of the last species (*trifolii*)—Bork., "Nat.," iii., pp. 89—90; Fuessly, "Neu. Mag.," iii., pt. 2, p. 151, no 80. The insect is called *Bombyx medicaginis* because the larva is very fond of *Medicago falcata* and *Onobrychis* (Dr. F. J. A. D.). DISTRIBUTION:—ASIA: Asia Minor, Armenia, Tura (Staudinger), Smyrna (Speyer). AUSTRO-HUNGARY: Bukovina, rarer than type (Hormuzaki), Taufers and Innsbruck, the prevalent form (Weiler), Epiries, rare (Husz), Upper Carinthia, Salzburg (Nickerl), Buda, rare (Speyer). BULGARIA: Varna, with type (Lederer). FRANCE: Commoner round Paris than the type (Berce), Haute-Garonne, rarer than type (Caradja), Loire-Inférieure, with the type (Bonjour), Auvergne (Sand), Puy-de-Dôme (Guillemot), Aix-les-Bains, very common (Agassiz), Gironde, rare (Trimoulet), Alpes-Maritimes, replaces type (Millière). GERMANY: North-west Germany—Hanau, Giessen, Trier, Elberfeld, &c. (Jordan); Würtemburg—Stuttgard, rare, Tübingen and Reutlingen, common (Seyffler), Lower Elbe (Zimmermann), Erfurt, the var. only (Keferstein), Zeitz-on-the-Elster (Wilde), Rudolstadt, rarely with the type (Meurer); Mecklenburg — Neustrelitz (Schmidt), Dresden, with type (Steinert), Thuringia, rarely with type (Krieghoff); Baden, as common as the type (Reutti); Prussia—Dantzig, rare (Schmidt), Upper Lusatia (Moeschler); Alsace—Val de Ste.-Marie-aux-Mines (Peyerimhoff). GREECE: Parnassus, Milos (Staudinger). ITALY: Dominant form in centre, and south, and in Sardinia and in Corsica, not infrequent in north (Curò), Lombardy with type (Turati); Sicily—Madonie, Palermo, Messina, Ficuzza, and usually supplants the type (Minà-Palumbo and Failla-Tedaldi), Roman Campagna – Sassoferrata, rarer than the type (Calberla). ROUMANIA: Very rare, with type (Caradja). RUSSIA: Volga dist.—Sarepta, but not frequent (Eversmann), southern Russia (Moeschler), Podolsk (Assmuss). SWITZERLAND: Distributed with the typical form (Frey), Berne, commoner than type (Benteli), Zürich, very common (Nägeli).

Staudinger diagnoses the form as: "Alis plus minusve flavido-irroratis," too generalised a description to be of much service, and hardly agreeing with the original description already quoted. Schmidt observes that, by breeding in Mecklenburg, he obtained the var.

medicaginis just as commonly as the type, as well as many intermediate forms. Staudinger observes that he has but few males from Greece, but these are to be referred to the var. *medicaginis*, although one from Milos reminds him of the Sicilian *cocles*. Frey notes the Swiss examples as being paler or yellower than the type. Chapman notes that this form, as represented in Constant's collection, is smaller, paler, and washed out in appearance; Benteli, that the specimens of this form taken at Berne are chiefly males. Curtis notes that *medicaginis* is to be distinguished from *P. trifolii* by the abbreviated fascia at the base of the forewings, and the obscure one across the hindwings, whilst the breadth of that parallel to the outer margin of the forewings is also greater, characters not included in the original description. Standish obtained larvæ near Lyndhurst at the end of June, these were full-fed at the beginning of July, and imagines appeared at the beginning of August. Ingpen also states that, in July, 1827, he obtained larvæ of *trifolii* near Brockenhurst, and bred a single example of the aberration from one of the larvæ, which did not differ from the others that produced *P. trifolii*. Stephens notes examples in the "Brit. Mus. Coll.," from Bristol (we cannot now trace these examples). Rühl very rightly disputes (*Soc. Ent.*, viii., p. 44) the statement of Ochsenheimer "that all the earlier stages of *trifolii* and *medicaginis* are very different."

β. var. *ratamae*, H.-Sch., "Sys.-Bearb.," figs. 152-3 (1851); vi., p. 51 (1852); Staud., "Cat.," 2nd ed., p. 68 (1871); 3rd ed., p. 121 (1901); Kirby, "Cat.," p. 829 (1892); Auriv., "Iris," vii., p. 151 (1894). *Trifolii* var., Hb., "Eur. Schmett.," 264 (1803); Rbr., "Cat. Lép. And.," pl. v., fig. 1 (1858). *Retamae*, Rbr., "Cat. Lép. And.," p. 357 (1866).—*Ratamae*, Sppl. 152-153. Ochraceo-lutea, alis posterioribus et anteriorum ciliis, strigis duabus transversis nec non ambitu stigmatis medii albi ferrugineo-fuscis.—Fine pair sent by Pogge from Spain. ♂ agrees best with fig. 73 of *eversmanni* but the wings rather narrower, the border of forewings straighter and their tips more pointed; the colour ochreous-clay-yellow; the two transverse stripes, the fringes, the circumference of a pure white central spot, and the whole hindwings, red-brown with a slight violet tinge; the hindwings with a faint lighter central stripe, nearer the base than that of forewings. The ♀ agrees very well with figs. 122-123 of *terreni*, the colour of the hindwings reddish-brown; the two transverse stripes on forewings, the circumference of the very small whitish central spot and the fringes rusty-brown. The hinder transverse stripe not so dentated as in *terreni*, and not so light towards the base. The forewings in both sexes a little darker beneath, all with a broad transverse stripe beyond the middle (Herrich-Schäffer). LOCALITIES: MOROCCO: common (Blackmore). SPAIN: Cadiz, Malaga (Rambur), Bilbao, frequent (Seebold).

Rambur notes this form as having a yellow spot at the anal angle of the hindwing, also that several specimens have the fringes yellow. Chapman notes that the examples (from Spain), as represented in Constant's collection, are yellowish-white, with dark median fascia, the white stigma ringed with dark, the inner line dark, hindwings as in *L. quercûs* ♀. Hofmann describes it as: "Forewings yellow, with brown bands; the hindwings brown." Staudinger diagnoses it as: "Alis ant. flavidis, brunneo-fasciatis; alis post. brunneis, sæpius plus minusve flavido-fasciatis. Andalusia—Gades."

γ. ab. *iberica*, Gn., "Ann. Soc. Ent. Fr.," 3, vi., p. 453 (1858); Staud., "Cat.," 2nd ed., p. 68 (1871); 3rd ed., p. 121 (1901); Kirby, "Cat.," p. 829 (1892); Auriv., "Iris," vii., p. 151 (1894); Hofm., "Die Gross-Schmett.," p. 61 (1891); Reutti, "Lep. Bad.," 2nd ed., p. 57 (1898). *Trifolii*, Dup., "Hist. Nat.," iii., 7, 1*b*; *var.*, Rbr., "Cat. Lép. And.," pl. v., fig. 2 (1858).—I only possess the ♀ of this new species, but it is so striking that one cannot doubt its distinctness. It has somewhat the shape of *P. trifolii*, but all the wings are less thickly scaled and notably narrower. The forewings have the apex sharper and the costa straighter. They are of a ferruginous-brown, clear, and slightly transparent. The only mark is a cellular point smaller than in any other species of the group; no trace of lines on either fore- or hindwings, above or below; the hindwings a little paler than the forewings, of a tint slightly flesh-coloured, but unicolorous. These are also proportionally narrower and the apex noticeably prolonged. The antennæ less robust than in *P. trifolii* (Guénée). LOCALITIES: FRANCE: Burgoyne (Constant coll.). GERMANY: Carlsruhe, one example in the park (Bischoff *teste* Reutti). SPAIN: Andalusia (Lorquin *teste* Guénée). SWITZERLAND: Zürich (Nägeli).

Chapman notes that specimens from Burgoyne in Constant's coll. are pale red, unicolorous, with only a central white spot, dark-ringed. Hofmann says: "Quite brown, without bands." Staudinger diagnoses the form as: "Alis omnibus brunneis, non fasciatis."

δ. var. *mauritanica*, Staud., "Iris," iv., p. 262 (1892); Auriv., "Iris," vii., p. 151 (1894). *Mauritannica*, Kirby, "Cat. Lep.," p. 829 (1892). *Cocles* var., Staud., "Cat.," 3rd ed., p. 121 (1901).—From Constantine in Algeria I received through Zach a form of *trifolii*, most specimens of which agree almost entirely with *cocles* from Sicily, but some specimens vary very much; thus one ♀ is almost quite light clay-yellow with a narrow brownish transverse line and a white dark-bordered central spot on the forewings. Afterwards I found larvæ myself at Constantine, and bred quite similar specimens which are to be referred to var. *cocles*. On the other hand I bred from larvæ which were plentiful in May at Lambessa, and were generally to be found on *Artemisia*, a smaller form, many specimens of which are very near to *bathseba*. We have distributed these as var. *mauritanica* which name perhaps might be retained for the Lambessa form. It is true that the specimens vary very much in size, the ♂s 33mm.—43mm., the ♀s from 45mm.—60mm. Most specimens are light yellowish and those with brown ground colour are thickly strewn with yellow scales on forewings so that they look more light than dark—in *bathseba* such a regular thick yellow scattering over the brown never occurs—but it does in many *cocles* from Sicily, so that this var. *mauritanica* is essentially only smaller lighter *cocles* (Staudinger).

Staudinger later refers (*Cat.*, 3rd ed., p. 121) this aberration to *cocles*, possibly not considering it, on mature reflection, to be sufficiently separate to be definitely differentiated by a distinct varietal name.

ε. var. *cocles*, Hb.-Geyer, "Eur. Schmett.," figs. 332-5 (? 1827); Frr., "Neu. Beit.," 44 (1832); Dup., "Hist. Nat.," suppl. iii., p. 89, 167, 2 (1836); Bdv., "Icones," 66, 3, 4 (*circ.* 1840); H.-Sch., "Sys. Bearb.," ii., p. 107 (1845); Staud., "Cat.," 2nd ed., p. 68 (1871); 3rd ed., p. 121 (1901); "Horæ Soc. Ent. Ross.," xiv., p. 357 (1879); Curò, "Bull. Soc. Ent. Ital.," viii., p. 150 (1876); Kirby, "Cat.," p. 828 (1892); Auriv., "Iris," vii., p. 151 (1894).—Hübner's figures (332-333) represent a male, dark red-brown in colour, with a pale brown transverse line beyond the middle crossing both fore- and hindwings, the inner margin darker, shading into ground colour, the central spot white, with a dark border, the nervures of all wings paler, no basal line to forewings; thorax, abdomen and scales at base of inner margin of forewings and at base of hindwings, yellow; fringes of forewings almost of colour of wings, of the hindwings paler. ♀ (fig. 334), pinkish-brown with pale yellowish transverse line, paler nervures, white central spot with dark edge, fringes yellowish. Fig. 335 is more ochreous without pink tinge, otherwise of similar form, the area outside transverse line paler than area within and no basal line to forewings. Herrich-Schäffer diagnoses it as: "Sordide ochracea (mas obscurior) striga alarum omnium pallidiore pone medium limbo parallela," and adds that Hübner's figure is good, that generally the insect is of a paler tint, and the form is probably a local variety of *trifolii*. LOCALITIES: ALGIERS: Bona (Lucas), Oran (Oberthür). ITALY: Central Italy (Staudinger), Sicily (Curò). [GREECE (Curò)]. SPAIN: (Agassiz).

Staudinger diagnoses this form as: "Major, al. crassius flavido-irroratis." Lucas notes that the larva of *cocles* bears a great resemblance to that of *P. trifolii*, but from several larvæ that he obtained at Bona only one imago (♂) emerged. The larvæ fed on "sea-*Genista*" at the end of June, pupated towards the end of July, the imago appearing at the beginning of October. Oberthür records a ♀, taken early in November at Bona. Chapman notes that specimens from Sicily in Constant's coll. are pale, well-marked, with the nervures very pronounced, and with a pale basal patch. Hofmann says of it: "The wings variegated with yellow."

ξ. ab. *romana*, Calb., "Iris," i., p. 156 (1886).—? Without description.

Calberla simply notes: "ab. *romana*, Stdfs.—Die Stammform in Tosc. (M). Auch Aug. (C.). Bei Macerata im Sept. (Z.)" [*Iris*, i., p. 156 (1886)]; whilst another note reads: "Tuscany where it is the typical form (Standfuss), Roman Campagna (Calberla)." It appears to be merely a MSS. name. At any rate we can trace no description, and Standfuss states that he has never described it.

η. var. *semifasciata*, Failla, "Nat. Sic.," vii., p. 331 (1888).—Two specimens only in our collection, may be distinguished by the entire absence of the yellow fascia of the hindwings. It is smaller, but of the *medicaginis* form (Failla-Tedaldi).

θ. ab. *terreni*, H.-Sch., "Sys. Bearb.," ii., p. 107, figs. 120-3 (1847); vi., p. 51 (1852); Ramb., "Cat. Lép. And.," p. 358 (1866); Staud., "Cat.," 2nd ed., p. 68 (1871); 3rd ed., p. 121 (1901); "Horæ Soc. Ent. Ross.," xiv., p. 357 (1879); "Iris," iv., p. 260 (1892); Kirby, "Cat.," p. 829 (1892); Auriv., "Iris," vii., p. 151 (1894).—Sordide ochracea, mas magis stramineis fœmina magis lateritia, alis anterioribus maris apice valde obtusis, posterioribus fœminæ innotatis. Only one ♂ from Frivaldsky, sufficiently different, however, to be separated from *eversmanni*. The body plumper than in German specimens (of *trifolii*), almost plumper than in *eversmanni*; the outer border and apices of forewings are much rounder, the fringes longer, the first transverse line farther from base, and not contracted into an oval, the hinder is much more strongly sinuate and is continued sharply on the hindwings nearer the base; the colour is fainter, dirtier, more straw-yellow, fringes of all wings darker; the transverse lines dirty reddish-brown, not rusty-brown, the basal half of hindwings of same colour, a broad marginal border is only interrupted by the nervures. The underside is straw-yellow, the fringes rather darker, central stripe (which is continued in a straight direction on hindwings) reddish-brown. I do not think I am mistaken in referring to the ♀ figured at 122-123, as this insect; it is like a large ♀ of *G. quercûs*, but has the tips of the forewings much more rounded, the transverse lines much more strongly sinuate, further from the border on the inner margin and absent on the hindwings; colour more rusty-brown, only somewhat yellower towards base of hindwings; on the underside, only the hindwings have a broad darker central stripe and border. Bischoff received this ♀ from the neighbourhood of Constantinople (Herrich-Schäffer, *Sys. Bearb.*, ii., p. 107). To this he adds later: "Specimens which Lederer subsequently received from Brussa as *medicaginis* make me doubt its specific validity, and accept his suspicion that it really belongs to *trifolii*. The specimens agree exactly with my figs. 120-121, but the markings are more reddish, and the curved line on the underside of the hindwings is more acutely angulated on nervure 6. The ♀ scarcely differs from the ♀s of German *trifolii*" (*loc. cit.*, vi., p. 51). LOCALITIES.—ASIA MINOR: Smyrna (Staudinger). SYRIA: Brussa (Herrich-Schäffer); Palestine (Staudinger). RUSSIA: Transcaucasia (Brit. Mus. Coll.). SPAIN: Cadiz, Malaga, several ♀s (Rambur). TURKEY: southern Turkey (Staudinger), nr. Constantinople (Herrich-Schäffer).

Staudinger diagnoses the form in his *Catalog*, p. 121, as: "Alis omnibus flavidis, brunneo-fasciatis, in var. Palestin. plus minusve brunnescentibus; an sp. div. (?)." He also notes that specimens, probably from Smyrna or Brussa, scarcely differ from *cocles*, and later writes (*Iris*, iv., p. 26) that "a third similar form also occurs at Jerusalem, of which Paulus also sent a few bred specimens, which he is inclined to consider a distinct species from the two others (*salomonis* and *trifolii* var. *bathseba*), as he says the larva differs from those of both. I refer them provisionally to *terreni*, H.-Sch., and think it not impossible that this may be a distinct species. *Terreni*, H.-Sch., male is quite light, with a sharp brown transverse band on all the wings, and a second in the basal part of the forewings which carry centrally a large white dot surrounded by dark. The Jerusalem specimens are rather browner than Herrich-Schäffer's figures, otherwise the figure of the female agrees quite tolerably. The male from Frivaldsky's collection, on which Herrich-Schäffer founded *terreni*, came probably from Smyrna, from which I possess a similar male. In Lederer's collection there was a similar pale male from Beyrout, and also another ♂ and two ♀ s which look very different from Mersin, which, however, correspond with each other. These three specimens have prevailingly brown forewings with a comparatively broad white transverse band, not sharply defined on inner side in the ♂, the light transverse band is also distinctly continued on the hindwings (variegated with paler). For the present I consider these also to be aberrations of var. *terreni*." The Transcaucasian *terreni* in the British Museum coll. is a much paler form than those under the same name from Europe, and the fore- and hindwings are without the red tinge of the latter.

ι. var. *maculosa*, Rogenh., "Ver. z.-b. Ges. Wien.," xli., Sitzb. p. 86 (Dec., 1891); Staud., "Iris," iv., p. 348 (1892); "Cat.," 3rd ed., p. 121 (1901); Auriv., "Iris," vii., p. 151 (1894). *Bathseba*, Staud., "Iris," iv., p. 260 (Feb. 1892); p. 348 (1892); Kirby, "Cat.," p. 829 (1892).—*Gastropacha trifolii* var. *maculosa*. A smaller form; the male distinguished on the upper side by a brown median area with a dark central dot. The base and marginal area, pale clay-yellow with darker and often partly chequered fringes. Hindwings uniform red-brown, costa paler. Body and antennæ ochre-yellow; underside ochre-yellow with a rather broad brown common band; fringes dark. ♀, above uniform pale red-brown with a ring-shaped central dot to both wings; resembling a pale ♀ of var. *medicaginis*; the underside paler and without a band. ♂, 37 mm.—41 mm., ♀ 45 mm. Specimens in the Wiskott collection and in the Royal Imperial Museum at Vienna (Rogenhofer). LOCALITIES: Syria, Palestine (Staudinger).

Staudinger independently re-named this insect within a couple of months of Rogenhofer's communication and described it as follows: "*B. trifolii* var. *bathseba*, strongly aberrant small form. Paulus sent a considerable number of bred specimens from Jerusalem. ♂ s 32 mm.—40 mm., ♀ s 38 mm.—52 mm. This, therefore, is the smallest form of *trifolii*, which otherwise is near or identical with many specimens of the very variable *cocles* from Sicily and the ♀ s of which are very little different from *medicaginis* ♂ s, brown and yellow (varied), sometimes almost quite brown in the broad yellowish transverse lines (narrower transverse bands), sometimes almost entirely light-brownish-yellow with brown transverse bands on brownish basal half of forewings. Sometimes the brown hindwings have a sharply marked yellow transverse band. The hindwings are occasionally quite light brownish-yellow, with a very indistinct median shade. On the pale underside on all the wings a dark (brown) transverse line sharply bordered with light outside as in var. *cocles*. The ♀ s of *bathseba* are sometimes very near ♀ s of var. *medicaginis*. On the upper side always light brownish-yellow with brown transverse band edged externally with pale. The dark central spot is, as in the males, generally very weak, sometimes not white-centred and, in a small ♀, both it and the transverse bands are entirely absent. On the underside, the hindwings only bear a rather broad and generally somewhat obsolete brown transverse band like ♀ s of *cocles*, whereas this is generally narrower in those (♀ s) of *medicaginis*. In any case this small form, with broader transverse bands, &c., is so different from *B. salomonis* that no one could take them to be the same species (*Iris*, iv., p. 260). Later Staudinger noted (*loc. cit.*, p. 348) that *bathseba* fell before the var. *maculosa* of Rogenhofer. In the 3rd edition of the *Catalog*, Staudinger diagnoses it as: "Minor, inconstans, trans. ad. var. *coclem*."

COMPARISON OF PACHYGASTRIA EVERSMANNI WITH P. TRIFOLII AND ITS VARIETIES.—Christoph compares (*Stett. Ent. Zeit.*, xxviii., pp. 240—242) *P. eversmanni* with *P. trifolii* and states that although he did not wish to compare the former with the varieties of the latter to prove the specific distinctness of the former, yet *P. eversmanni* showed no transitions to *P.* var. *medicaginis*, &c., adding, however, that "so long as that distinctness depends on a comparison of the imagines of these two related species, so long will *P. eversmanni* be not recognised generally as a distinct species." He, however, goes on to say that he rears the larvæ every year, and this stage alone will give *eversmanni* specific right. Apart from the altogether different aspect of the larva, its mode of life differs very considerably from that of *P. trifolii.* The imago flies in August and first half of September on dry salt steppes. In the latter half of April and in early May, in rather circumscribed localities on the steppes, the young (and at most not half-grown) larvæ are to be found sitting on the bare earth, and less frequently on the stems of plants. The young larvæ at first feed exclusively on young leaves of the hard steppe-grasses, but later refuse this food and are to be reared only on various leguminous plants, *e.g.*, *Astragalus onobrychis*, although, where the larvæ are found, with the exception of *Alhagi camelorum*, such plants do not grow, and the habits of the larvæ in captivity give no clue to their habits in the open; he has never been able to find a full-grown larva of *P. eversmanni* in nature, and he thinks that they possibly retire into the cracks in the ground, often a foot in depth, during the daytime, coming out to feed by night. The larvæ of *P. trifolii* are never to be found in the same localities with those of *P. eversmanni*, whilst they also feed exposed until full-fed, and are easy to find. The larva is described as:

About 70 mm.* long and 8 mm. wide; the head-hemispheres a fine blue-grey; the middle of the head above the mouth-parts yellow-grey, with a short black longitudinal streak, the latter red-yellow. The segmental incisions of a fine light blue. The "head-segment" is bright cherry-red above, margined with yellow-red anteriorly. On the next two segments are found dorsally, on each side, two large not distinctly defined spots of like colour. Along the dorsum runs a whitish band, only distinctly white between the incisions; then follows, as a continuation of the already mentioned red lateral spots, a band (often interrupted by the blue-grey ground colour) bounded towards the sides with velvet-black also only in patches. This black shades, towards the venter, into grey and reddish-grey (almost flesh-colour). On the second and third segments the black is sharply cut off before yellow-white spots, decreasing towards the venter into fine dots; on the next two segments two short obliquely-placed stripes run from the black towards the legs, without, however, reaching them; on the following segment is found, instead of the third oblique line, only an elongated white spot. Venter and legs bright red-yellow; between the legs the red-yellow is enclosed by somewhat broad black rings. The fine yellow-grey hair is somewhat longer than, but just as dense as, in *P. trifolii.* The larva is of uniform thickness throughout, rather more slender than that of *P. trifolii*, and the fine hair is more equal in length than in the latter.

It must be confessed that the life-histories of the two insects run very parallel. We still await a critical comparison of the larvæ, the mere description being of little value in determining the matters of detail on which specific identity (or the reverse) must be decided.

EGG-LAYING.—There appears to be some doubt as to whether or not the eggs are attached. Some sent to us by Mr. Edelsten were laid on a sprig of heather, several on the same sprig, and two or three

* Christoph's note says 7 mm., an obvious misprint.

sometimes near each other, others were laid singly, but all were very slightly attached. Eggs received from Day in August, 1897, had been laid loosely in confinement. Bowles says: "Eggs unattached, smaller than those of *L. quercûs*, shells not smooth as in the latter species, but of uniform dull brown colour and looking rough, almost pilose. I have had a batch hatch in January, but they were kept indoors, but normally they emerge much later—February, March." Reading says that near Plymouth the eggs are deposited singly and without any adhesive matter among the grass on the cliffs and slopes. Newman states that a succession of females extrude their eggs throughout the month of August and during the first ten days of September, the oviposition of each individual female extending to three days and no more; the pale brown eggs are dropped among the herbage without apparent method, always finding their way to the ground. Edelsten notes a batch of eggs laid August 15th, 1897, which commenced to hatch January 20th, 1898, and finished doing so February 26th, 1898. Our evidence, and that of Bowles, Edelsten, W. H. B. Fletcher and others, all tends to show that the eggs do not in England disclose the larvæ until late winter or early spring, and that the larvæ do not hybernate, although most continental authorities state, as a matter of course, that the larvæ go over the winter and are to be found in spring. We suspect the assumption of their hybernation is often based on the fact that the larvæ are to be found in early spring. Wailly notes (*Ent.*, xiii., pp. 63—64) that a few years ago he received from France many larvæ of *P. trifolii*, cocoons, imagines, pairings and fertile eggs being obtained in due course, the latter "instead of hatching during the autumn, appeared at the end of February, the larva having remained fully developed within the egg during several months; some of the eggs were opened during the winter (as were also those of *Antheraea yamamai*) to see the living larva in the egg." Harker's evidence (*Ent.*, xxix., p. 21) that, on the Lancashire coast, the larva does not hybernate, and that the larvæ hatch from the ova in spring, fully supports our own observations.

Egg-parasites.—The eggs are attacked by *Telenomus phalaenarum* (Bignell).

Ovum.—Roughly oval in outline, flattened and centrally much depressed at the micropylar end, much less flattened at its nadir, so that it forms an oval with one end flattened in horizontal section; a slight depression on the upper surface of egg; the egg is of a dark creamy ground colour, marbled with two shades of brown, the darker tending to dull mahogany, these shadings slightly opalescent (less so than the egg of *L. quercûs*); the micropylar end of egg with deep basin, in the base of which is another secondary depression—the micropyle proper—blackish-brown in colour, very finely reticulated, but with none of the dark raised points found on rest of surface [Eggs laid August 5th, 1897, received from Mr. Day and described August 27th]. Whitish-creamy in colour, but so washed with pale brown that most of the ground-colour is obscured; there are also many very deep red-brown irregular patches scattered over the surface; the micropyle also dark; surface covered with the minutest, shiny, metallic-looking, raised black dots placed at the angular points of the fine, irregular, polygonal surface reticulation, which is only just visible under a two-thirds lens (Eggs from Mr. Edelsten, described January 7th, 1898, hatched January 31st, and following days). Bacot notes: "A short rounded oval in outline, slightly flattened at ends, depressed at micropyle (some slight variation in shape of individual eggs); the surface smooth, dull compared with the varnished appearance of the egg of *L. quercûs;* colour, wainscot, mottled with umber-brown, the surface speckled regularly with black points; the micropylar depression deep umber-brown, at bottom of the depression a sculptured rosette of cells, the sculpturing neither deep nor clearly marked. In bulk the eggs are about one-third those of English *L. quercûs;* whilst in general appearance (both shape and colour) they are much nearer to the French races of *L. quercûs*—*meridionalis* and *viburni*—than to the English races." [Described August 19th, from eggs laid August 5th, 1897, and received from Mr. Day].

HABITS OF LARVA.—It is generally reputed on the Continent that this species leaves the egg in autumn and hybernates as a young larva, *e.g.*, Sepp says that eggs in his possession hatched before the winter, namely, at the end of August and in September, and fed as long as food was obtainable. Millière says that the species hybernates in the larval stage in the Alpes-Maritimes, but very small, and that the larvæ do not mature till April and May; and Chapman notes Godart, Boisduval, Dubois, &c., as stating that the eggs hatch in autumn. Rühl asserts (*Soc. Ent.*, viii., p. 44) that it is not normal for the species to hybernate as larvæ at Zurich; that in 1880, 1882, and 1884 he possessed hybernated eggs from which, in April, healthy larvæ emerged, although, at the same time, larvæ existed in great numbers in October on the Greifensee, and from eggs which ♀s laid in captivity in September larvæ emerged in October. He adds: "The autumnal larvæ invariably perish in winter." Prittwitz asserts that it passes the winter as a larva in Silesia, where it is common in the Oder meadows, and Sélys says that, in Belgium, the larva hybernates, being found in May on broom and trefoil, the imagines very rare in July and the commencement of August. Whether this habit be correctly observed or not for the continent, it is quite certain that in Britain the larva does not normally leave the egg until early spring, although Wailly, as we have noted, says that the larva is fully developed within the egg for some months previous to its emergence in February. The larvæ from the same batch of eggs do not hatch simultaneously; Edelsten notes a batch, the hatching period of which extended from January 20th—February 26th, 1898, and some we had continued to emerge for some days after January 30th, when the first appeared. Harker observes that on the Lancashire coast also the larvæ hatch in the spring. The erroneous idea that the eggs normally hatched in autumn in Britain appears to have originated with Barrett (*Substitute*, pp. 40-41), but Reading at once pointed out that the eggs in his possession did not hatch until March, and that the egg stage lasted six months; in spite of this Newman repeated most circumstantially the autumnal hatching of eggs, and stated that the larvæ hybernate near the surface of the earth (*Entom.*, ii., p. 291). Lewin gives one of the earliest notes as to the occurrence of this species in Britain, and writes (*Trans. Linn. Soc. Lond.*, iii., p. 3 (1797): "The larva feeds on trefoil, pupates in June, the imago coming forth the latter end of August. The larvæ are to be met on the uncultivated grassy chalk-hills of Kent, particularly near Darenth Wood; they secrete themselves under stones in the day, and come forth to feed in the evening." Dell states that the young, bright, yellow larvæ are most commonly found on fine grass, eating from the top downwards, but when they have reached about two-thirds their full size they leave the grass, and feed almost exclusively on *Ornithopus perpusillus*, and one is always more fortunate in breeding imagines from bird's foot trefoil than any other plant; they can, he asserts, be starved on the grasses, but thrive on clover of any sort. Mitford notes that on Romney Marsh the larvæ feed in May on the tufts of a very wiry grass, growing on the shingle above high-water mark. Gregson says the young larvæ are very small, and very yellow in colour in March, when they are abundant on the Crosby sandhills. The larvæ are best obtained after 7 p.m. on the star-grass, but on hot close days they may be found stretched out on the bare sand in the afternoon. Walker says that the larvæ should be collected just before dusk, when they are very conspicuous, but they soon take alarm and roll themselves into a ring, but do not, as a rule, drop from the plant on which they rest. Harker says that to breed the larvæ successfully plenty of fresh food and light are required. Turner notes that "at Bolt Head and Starehole Bottom the larvæ are common in April, and appear to be very general feeders, nor was there any clover of any kind growing in the locality in which they occurred. Several were found eating different species of grass, one was seen to nibble bracken, others were found, though not actually feeding, on heather, bramble and violet; one was found eating gorse-blossom, which had apparently been its food for some time, as it ejected several pieces of yellowish-brown frass. The larvæ are very shy, and on one's approach they curl up, often writhing to and fro, and remain thus for a considerable time; several were found sitting on rocks, but by far the greater number were stretched out on dead bracken. After the severe winter of 1894–5, the larvæ did not appear at Salcombe until April 26th (compared with April 14th in 1894), and the specimens found were very small indeed; these, and others found later, were at rest on dead bracken or bare stumps of blackthorn, and it was not until May 1st that they were actually observed feeding." Lane observed half-fed larvæ basking in the sun about 4 p.m. on Whitemoor, Lyndhurst, in May, 1898. Newman says that the larva (after hybernation) is first observed in spring when it is three-tenths of an inch in length; it then rests extended on a blade or stalk of grass in a straight position, and, when it feeds, embraces the food with its feet, and devours from the top downwards, but if disturbed it immediately falls to the ground and rolls itself into a compact, but not very perfect, ring, the two extremities not meeting with precision, but passing each other, and thus giving a one-sided appearance to the ring, and the same characters are observable during the entire period of its growth, whilst after the end of April it feeds up very rapidly, and is fullfed at the end of May or beginning of June. Fowler says that larvæ occur on the "*cribrum*" ground at Ringwood; he finds them in June, when they are usually about an inch long. The larvæ positively swarm in certain seasons in some districts. Sepp collected 85 larvæ on *Calluna vulgaris* in early June, and bred imagines from the beginning of August onwards. Prescott observes that on June 8th, 1857, he obtained 86 larvæ at Blackpool, and saw 400 taken the same day. Bishop notes that on June 16th, 1857, he had collected a large quantity in the Plymouth district, and from the same locality Lethbridge obtained a great number on

June 29th, 1857. Gregson observes the larvæ as very common on the Crosby and Wallasey sandhills on May 3rd, 1856, and Gascoyne states that at the end of May, 1856, on the Sussex coast, he collected 300 in less than an hour, and could have taken a thousand more; they fed well on various grasses, but would not touch trefoil or plantain. Galliers reports larvæ as abundant at Wallasey in June, 1859. Harker observes that he found the larvæ common between June 23rd —30th, 1873, all round the coast of Alderney, but most abundant close to Fort Turaille, where fifty specimens were taken in about two hours, feeding on a tough, wiry grass growing among the sand. Bacot has taken them on Whitemoor before breakfast in several different years, and considers the early morning, with the sun shining on the short heather, the best time to obtain them; yet Hewett observes that the larvæ (half-grown and fullfed) feed only in the evening on the heaths near Lyndhurst, crawling up from their hiding-places among the roots about sunset (earlier if there has been a shower) and sitting on the dead shoots or twigs of *Erica tetralix*. Bowles states that the larvæ were more plentiful than usual at Lyndhurst in 1896; they drink freely, and like moistened food. Réaumur (and several later observers) has stated that only a small proportion ever reach full-growth in captivity, and of those that pupated and emerged almost all were cripples. Adkin says that the larvæ, in the Scilly Isles, usually feed many close together, but isolated ones are often seen; on bare sand they lie stretched out on the ground, but roll into a ring when anyone approaches; on thick heather they usually lie exposed. The larvæ are exceedingly local, not always found in the same place, nor even on the same island. Ebrard notes (*Bull. Soc. Ent. France*, 1868, p. xc) that he has had good success in rearing *P. trifolii*, feeding the larvæ on *Spartium scoparium* in a perforated metal cage, the food being placed in water, and frequently renewed to keep it fresh. Zeller records (*Isis*, 1847, p. 421) larvæ as abundant at Messina, on the sandy peninsula forming the "Haven;" they were found amongst *Juncus acutus* feeding on soft grasses. On Feb. 24th they were of varying sizes, but none full-grown. When there had been rain in the night, they sat on the upper parts of the plants and were very easy to find, but by April they had disappeared (presumably for pupation). The following dates as to larvæ have been collected: larvæ, June and July, in Pomerania (Hering); larvæ, fullfed in New Forest in June (Edelsten), fullfed, in July in Guernsey (Luff); common, June 1st, 1860 on sandhills near Liverpool (Gregson); June 12th, 1860, from near Liverpool (Fenn); June 24th, 1893, in Guernsey (Hodges); June 13th, 1894, about three-quarters grown in South Devon (Prideaux); April 21st, 1895, May 4th—11th, 1897, small, at Formby (Freeman); May 23rd—26th, 1896, at Lyndhurst (Bowles); May 29th—30th, 1896, on Whitemoor, Lyndhurst (Lane); almost fullfed larvæ at Digne, April 15th–30th, 1897, and fullfed larvæ in Fontainebleau Forest, June 21st–29th, 1897 (Tutt); June 17th, 1899, several larvæ on Longy Common, Alderney (Luft), common in the Island of Malta from March 26th, 1901, onwards (Fletcher), &c.

Larva.—In the *first stadium*, the head is large, black, shiny, with traces of white markings on clypeus, inclining to be trapezoidal in shape, a few scattered black hairs. Body short, rather thick and stout (well raised from resting-surface), prolegs rather large, anal claspers very large, tapers slightly from head to anus; 9th abdominal segment long; the prothorax large, scutellum very large and developed into two cushion-like warts, which give rise to long and large black hairs; ear-tubercles very large; prothorax divided into 2 (? 3) subsegments, a very large anterior, and a small posterior (possibly subdivided); the thoracic segments longer (front to back) than the abdominal. The tubercles form large many-haired warts, i and ii are large, and appear to be placed at corners of an imaginary square on thoracic, as well as abdominal, segments, i larger than ii, iii also is a large many-haired wart; iv and v form a subspiracular, many-haired wart, whilst there is a similar supplementary prespiracular wart. The dorsal hairs are mostly black and shiny and slightly serrated, very large and long; many of the lateral hairs are white, finer and smaller than the dorsal. There is a broad, whitish, dorsal band, the dorsal and subdorsal areas are dark chocolate-brown, and the lateral area white, the oblique stripes appear as dark streaks bordered with white, suggesting the origin of the double obliques in *Lasiocampa quercûs*, *Cosmotriche potatoria*, &c. The dorsal band has a chain of yellow spots in it, one of each of the abdominal subsegments is yellow in the line of the white band. This yellow section appears to be that of the 4th subsegment, and the band is much broader here than elsewhere. The yellow spots end on the 7th abdominal. The anterior trapezoidals on the 8th abdominal are large and very close together, on the 9th they are also large. The lateral tubercles on the abdominal segments appear to be the supra- sub- and the prespiracular, the latter very far forwards. In the *second stadium* the head is black, shiny, with a number of stout, black hairs, the clypeus pale cream colour, except for a central (vertical) brown band; the scutellum, not chitinous in appearance, forms two raised cushions, one on either side of the median line, each bearing many long stiff black hairs (*i.e.*, very similar to scutellum in larva of *L. quercûs* in first stadium, except for the size of hairs); the abdominal segments are divided into five subsegments, the thoracic are difficult to determine. The dorsal tubercles well marked (more so than in *L. quercûs* in 1st stadium); i larger and more pronounced than ii, which are not only smaller but less wart-like. The lateral tubercles are very large, especially on thoracic segments (on prothorax they form the large ear-tubercle), and consist of supra- sub- and prespiracular, whilst the basal tubercles are large, and carry several hairs; there are also present several small single-haired tubercles in a line with vii, but on the 1st subsegment; the prespiracular tubercle is on the 1st subsegment; i is on the 2nd subsegment, iii and iv (? and v) on the 3rd, ii on the 4th; it is perhaps not quite correct to state that iv is on the 3rd subsegment, as the subsegments become obscure before they reach the spiracular area (the spiracles are quite indistinguishable in this stadium). The coloration is much as in the 1st stadium —a broad, white mediodorsal longitudinal band, with a yellow blotch in it on each segment, the dorsal area on either side of a leaden or slaty hue, mottled with black, and there are traces of a white subdorsal line; lateral area also slate-coloured, with double oblique white stripes (sloping from head to anus) on abdominal segments 1–8 on the thoracic segments, and on abdominals 8–10 is a broad white lateral band, at same height (so that oblique stripes are possibly due to the splitting up of longitudinal band); the stripes are conspicuous, although not sharply defined. The skin is covered with a coat of minute bristles, and the hairs are serrated rather than thorny (not unlike those of *Trichiura crataegi* only more marked.) No free secondary hairs are yet present on dorsal area, and they are either absent or very sparse on the lateral areas. There is as yet no trace of the lateral and dorsal thoracic markings that are present in *potatoria*, and in a somewhat different form in *quercûs* and *quercifolia* *(Bacot). The *adult larva* is thickly covered with golden-brown hairs on back, which are erected medially on each segment; laterally the brown colour is less distinct, and there are a few black hairs on the thoracic segments, and four little tufts on abdominal segments; area below spiracular line and the venter, dull black, covered with grey hairs. Head variable in colour, thickly covered with black and white hairs, with tiny black spots at bases, dull slaty-blue, shaded with bright orange-red, with a dark band down either side of the clypeus, which, with a border outside it, is whitish-brown; ocelli, small, shining, black, placed on a red-brown patch; prothorax, with a dorsal chitinous-looking black patch mottled with orange-red, bearing a transverse series of tubercles carrying bright reddish golden hairs, two small bunches of black hairs, laterally; meso- and metathorax, with subdorsal groups of black hairs, each divided into three (or four) subsegments; laterally a large round supraspiracular black tuft, and smaller black tuft in spiracular line. Abdominal segments, each divided into four (or five) ill-marked subsegments, each segment bearing a few black hairs on either side of the raised mediodorsal golden-coloured hairs, and, laterally, a small black supraspiracular, and another subspiracular blackish tuft; the abdominal incisions, velvety-black, with bluish-white spots running longitudinally dorsally, and on either side subdorsally; the venter very velvety, each segment showing more or less distinct traces between the prolegs of a reddish medioventral line; the spiracles almost hidden by hairy coat, small, oval, pale, with blackish-red rim. The true legs brownish with black claws; the prolegs reddish with black hooks (Tutt). Réaumur notes (*Mémoires*, i., p.85) the peculiar arrangement of the hairs, by means of which half the hairs from the lateral tubercles tend to be elevated, and the other half depressed, with this peculiarity that part of those that are elevated are applied against the body of the larva, and surround it, whilst the others are more raised and pass the centre of the back, when those on one side meet those arising from the opposite side. Newman thus describes the larva: "Head hairy, scarcely as wide as the 2nd segment, which has three wart-like protuberances on each side of its anterior margin; body almost uniformly cylindrical, the incisions of the segments not distinctly marked, every part of the body being densely clothed with soft hairs; the hairs on the dorsal region tend towards a mediodorsal line, thus forming a mediodorsal ridge or crest, which extends the entire length. Colour of the head purplish-black, adorned with orange markings; the labrum and clypeus are pale, and a pale stripe extends from the latter to the epicranium; colour of the body intense velvety-black, with three longitudinal dorsal series of small snow-white spots, visible only on the incisions of the segments, and

* The larva in 2nd stadium in some respects reminds one of *Cosmotriche potatoria* in 1st stadium, and appears to be nearer this species than to *Lasiocampa quercûs* n this stadium, and to be also a more primitive form than the latter (Bacot).

either when the larva is crawling or, more obviously, when rolled in a ring; hair on the mediodorsal region fulvous-orange, that on the sides fulvous-grey; the 3rd and 4th segments have each a lateral crescentic bright orange marking; anal flap orange, freckled with black; spiracles pale, each having above it an oblique line of a dingy brown colour in the middle, and almost white at both extremities; below each spiracle is a jet black verruciform dot; venter smoky-black, irregularly variegated with orange; legs orange-red with black claws; claspers pitchy-red, inclining to smoke-colour."

VARIATION OF LARVA.—Buckler gives two excellent figures of adult larvæ: (1) Of the ordinary type, with golden dorsum, black transverse medio-segmental lunular marks and black intersegmental rings, and bluish or slaty lateral hairs below the spiracular line (Pl. xlvii., fig. 1). (2) A white-grey form, with brown head and yellow clypeus, and brown anal claspers. The dorsal and ventral areas are covered with greyish-white hairs, white mediodorsal and supraspiracular lines, and black intersegmental rings between the abdominal segments, the thoracic segments divided into three, and the abdominal into four, subsegments (Pl. xlvii., fig. 1a). Adkin says that in the Scilly Isles about 5 per cent of the larvæ have greyish-white hairs instead of yellow.

PUPATION.—The cocoon is made slightly under the surface of the ground; it is quite concealed by fragments of grass, moss, soil, &c.; pupation takes place in confinement at the end of June and July, but depends somewhat on food supply (Bowles); the pupal period lasts about three weeks (Hewett); the larvæ spin up just beneath the surface of the sand, and they must, in confinement, be kept slightly damp, both larvæ and cocoons have strong urticating properties (Jones); the larvæ have no certain rule as to where their cocoons shall be placed, some spin them on the surface of the ground among roots and moss, others go under the earth from one to six inches (Reading); the larva burrows, found several cocoons some with, others without, a loose cocoon of earth outside the cocoon proper (Bingham). One found at Bobbie, in the Vaudois in August, 1901, was spun under the ledge of an overhanging mass of rock; it was partly hidden in a crack and with little loose outside spinning, and at least 6 ft.—7 ft. from the ground (Tutt); spun under the surface of the sand, which abounds where this species occurs, and frequently slightly attached to the roots of the grasses on which the larva feeds (Newman); spins up in confinement among moss (Hodgkinson).

COCOON.—There is a considerable quantity of flossy silk on outside of cocoon by which it is attached to objects usually on surface of ground. The cocoon proper is within this, varies somewhat in shape, the more regular ones being similar to those of *Lasiocampa quercûs*, *L.* var. *callunae*, &c. Some that were measured worked out as follows: rather over $\frac{15}{16}$ in. in length, $\frac{7}{16}$ in. in width; rather over $\frac{13}{16}$ in. in length, $\frac{3}{8}$ in. in width; $\frac{7}{8}$ in. in length, $\frac{9}{16}$ in. in width. The inner cocoon is yellow-brown in colour (one was dark brown and much rounder in shape), fairly stiff and hard, yet much thinner and less tough than that of *L. quercûs*: it is composed of closely felted silk, with a number of short hairs (chiefly on outer surface) mixed with the silk; the inside smooth, papery in texture, somewhat glazed; in two cocoons the inner layer almost white, in others of same tint as outer case; the inner coating cannot be separated from the remainder of cocoon as in that of *L. quercûs*. Edelsten notes: "The cocoon is oblong in shape, yellow in colour, attached by white silken threads, that of *L. quercûs* being larger, more elongated, dark-brown, very firm and coriaceous in texture, and smooth inside." Bacot notes: "Cocoon of the usual 'eggar' shape, oval, golden-brown in colour, slightly swollen centrally." On the emergence of the moth, the cocoon is usually opened at one end by an irregular fracture which is sometimes longitudinal, small pieces of the brittle structure of the cocoon being broken off on either side. Sometimes the loosened piece is circular and turned back lid-like, reminding one of the pseudo-lid of the cocoon of *Lachneïs lanestris*. In others a circular opening is made, rather to one side and not at the end, and the disturbed material appears then to be pushed back all round the opening. There is sometimes an abundant staining at the emergence-end, suggesting the use of a fluid at the time of escape of the moth.

ABNORMAL COCOONS.—Newnham records (*Ent. Rec.*, i., p. 236) the occurrence of two pupæ of this species in one cocoon. Clark notes (*Entom.*, xxi., p. 111) a single cocoon with two exits, the exit end of the cocoon thinner than the rest of the cocoon.

COMPARISON OF COCOONS OF PACHYGASTRIA TRIFOLII AND LASIOCAMPA VAR. VIBURNI.—These cocoons are superficially very similar, but that of *P. trifolii* is much thinner and the two coats are not distinct, the inner being a mere varnish as though coated with white of egg (Bacot).

PUPA.—Three pupæ gave the following measurements: ♂ greatest length $\frac{13}{16}$ in., greatest width * $\frac{3}{8}$ in.; ♂ length $\frac{11}{16}$ in., width * $\frac{3}{8}$ in.; ♀ length $\frac{3}{4}$ in., width * $\frac{7}{16}$ in.—♀. The female pupa is short, stout, and dumpy, widest at the 4th abdominal segment (end of wing-cases), tapers rapidly from here to the blunt rounded anus and more gradually to shoulders, from here it curves bluntly round to head; the face-parts project ventrally but the venter otherwise almost flat from head to anus; much curved dorsally; distinctly constricted at metathorax and first abdominal; leg- eye- and antenna-cases prominent; these and wings dark umber-brown, lighter on thorax, the abdomen whitish-yellow with a broad dark mediodorsal line or band, darker at anus; spiracles large and prominent, blackish-brown; proleg scars on sixth and seventh abdominal segments; anus rounded, blunt, shows scars of anal claspers, thickly covered with short, scattered bristles: abdominal incisions very marked. ♂. The male pupa more slender and much paler than that of ♀; the wings, antennæ, legs, head and thorax light reddish-brown, rather paler on thorax; the abdomen pale yellow; spiracles black; the wing-cases very transparent, the covered abdominal segments visible through them; rather concave in outline dorsally at 4th and 5th abdominal segments; the cremaster as in ♀ pupa but the bristles more numerous (Bacot).

FOOD - PLANTS. — Grass, elm, hornbeam, bramble (Réaumur), *Artemisia* (Staudinger), *Spartium*, *Genista*, and other *Leguminosae* (Rambur), *Ononis spinosa*, *Cytisus laburnum*, some few species of grasses (Rössler), *Calluna vulgaris* (Sepp), *Retama monosperma* (Walker),

* The width of the pupa is almost the same as that of the cocoon, the pupa filling up (in this direction) almost the whole of the available space in the cocoon. The pupa is usually somewhat shorter, however, than the length of the cocoon (Bacot).

Plantago minor (Prideaux), *Anthyllis vulneraria*, *Lotus corniculatus*, hawthorn, sallow (Jones), *Trifolium pratense*, *Medicago falcata* (Stephens), star-grass (Ellis), *Genista ? cinerea* (Bromilow), grass, *Ornithopus perpusillus*, clover of any sort, oak, willow, bramble, furze (Dell), most species of willow and trefoil (Walker), blackthorn, oak (Luff), walnut (Turner), heath, plum (Edelsten), *Medicago lupulina* (Curtis), *Statice armeria* (B. Adkin), white and red trefoil, plantain, young furze-shoots, bramble, etc., and, in confinement, oak, beech, ash, poplar, willow, whitethorn and blackthorn (Reading), raspberry (Hawker). Butler notes that larvæ in May, 1894, failed on clover and broom, but fed up well on sallow, and imagines emerged August 1st—22nd, 1894. Jones observes that the food-plant in the Wallasey district is almost exclusively *Anthyllis vulneraria*, but that the larva also eats *Lotus corniculatus*, whilst sallow and hawthorn are poor substitutes; Bowles says that young larvæ feed freely on heather, whilst in confinement they nibble grass and clover, but feed up quickly and freely on young strong shoots of plum or sallow, but slowly on older leaves; he also states that he knew a case in which the larvæ were reared on Virginia creeper in a London garden. *Hippophaes rhamnoides* (Snellen).

Parasites.—*Gravenhorstia picta*, Drewsen and Boie (Mitford, &c.), *Cryptus migrator*, Fab. (twelve males from one cocoon) (Bignell), *Ophion obscurus*, Fab. (Bairstow), *Ophion undulatus*, Gr. (Hartlieb), *Anomalon giganteum*, Grv. (Rondani), *Exochelum circumflexum* var. *giganteum* (Hartlieb and Ratzeburg).

Habits and Habitat.—The moths emerge in the early afternoon and the males fly before dusk (in a cage they ruin themselves almost as soon as the wings are dry). The ♀s are very hard to breed perfect, a large proportion being deformed (Bowles). Rühl says that in the Zürich district the males fly by day in damp meadows, and Gregson notes capturing a male thus flying on August 17th, 1844, and another flying at night with *Agrotis vestigialis* on the Lancashire coast. The imagines are not often seen on the wing, but the males are taken on the gas-lamps in September at Gibraltar (Walker). Millière notes females as attracted by light in the Alpes-Maritimes, and Kaye took the species on the gas-lamps on the fore-shore at St. Heliers, whilst we found males flying into the lighted rooms of the Albergo del Camoscio at Bobbie between 9 and 10 p.m., August 14th—17th, 1901. Nägeli notes both sexes in great abundance at electric light at Zürich in the middle of August, 1893, also very abundant at electric light at Berne in 1893 (Hiltbold), and at the electric lights in Aix-les-Bains in 1896 (Agassiz). The female of *P. trifolii* readily attracts the males, and large numbers of the latter sex may be obtained by this means. Harker asserts, however, that the males mostly fly from 7 p.m.—8 p.m., that the flight of the males is very swift, strong, undulating or jerky, and that they can only be assembled about 8 p.m. on favourable evenings. Jones also reports numbers being taken by assembling on the Cheshire sandhills, whilst Noye captured 13 males on August 18th and 19th, 1849, when assembling to a fresh ♀ about half-an-hour before sunset, near Land's End, and Jennings notes that in 1860, in Jersey, a bred female attracted a ♂ *L. quercûs*. A female bred by Lowe, September 1st, 1886, at St. Sampson's, attracted a male (which he caught) although in suburbs of the town. Occasional specimens of the imago found by searching among the low grass at Crosby on August 22nd, 1880 (Walker). In Britain the species is more abundant in some years than others, and this would appear to be the case on the Continent, *e.g.*, at Wildungen (Speyer), Carlsruhe, unusually plentiful in 1888 and 1893 (Gauckler), Weissenburg (Huguenin), &c. Its habitats are exceedingly various; on the Lancashire and Cheshire coasts it is confined to the sandhills near the sea, where it specially affects the willow beds (Ellis), on Romney Marsh it occurs on the shingle just above high-water mark, on the Devon coast it is found on the cliffs and slopes facing the sea, and in Dorset, Bankes says that it is noticeably attached to the coast, being found on heaths and sandy tracts near the sea. In the Channel Islands the species is often found on the cliffs, the larvæ feeding on the flowers of furze, often, however, on the lower ground near the shore, and also on the commons inland (Luff), and at Land's End also on the cliffs (Noye); it occurs on the heaths in the New Forest and we obtained larvæ on very similar ground in the Forest of Fontainebleau. At Digne we found it on the broom over all the lower mountains around the towns; whilst Rühl records it as occurring in Switzerland in damp meadows, and Prittwitz notes it as occurring in the Oder meadows in Silesia. In Denmark it is, as is usually the case with us, confined to coast districts, but in the Netherlands frequents dry places—dunes, heaths, &c.—and heaths are given as its sole habitat in Upper Lusatia. Constant notes it as much more abundant in the chalky districts of the Saone-et-Loire than in other parts of the department, and Lewin states that it used to occur in plenty in chalky fields near Darenth. It certainly is occasionally a sub-alpine species, and Hinterwaldner gives it as occurring up to 4,300 feet in the Tyrol, whilst we have taken it in the Pellice valley up to about 3,500 feet, and suspect it occurs there at a greater elevation.

Time of appearance.—August appears to be the normal time of its appearance in England, but Bowles states that with him it rarely appears in confinement until September. It is worthy of remark that in Algeria, its most southern habitat, the imagines are only recorded for October and November, whilst Staudinger records a male from Milos on October 4th. Imagines in August in Pomerania (Hering), middle of August at Berne (Benteli), August in the Alpes-Maritimes (Millière), from July 17th to September 5th in various parts of Hungary (Fritsch), imagines bred in August, 1895—1898, from larvæ taken in Scilly Isles, also end of July and beginning of August, 1899, from pupæ found June 22nd (Adkin), imagines wild on sandhills near Liverpool, August 17th, 1844, August 15th, 1845, &c. (Gregson), August 17th and 19th, 1845, bred from Land's End larvæ, and seven others August 1st—18th, 1847, of which one ♀, hatched August 18th, 1847, attracted on the coast near Land's End 6 males on one day, and 7 males on another (Noye); imagines bred August 4th—8th, 1859, from larvæ collected June 15th at Horndean (Fenn), imagines captured August 16th, 1871, in Scilly Isles (Jenkinson), imagines found wild by searching, August 22nd, 1880 at Crosby (Walker), imagines bred August 8th—September 6th, 1881, from larvæ collected June 2nd, near Liverpool (Bower), imagines bred August 17th, 1882, &c., from larvæ obtained between May 10th—June 19th in the Isle of Purbeck (Bankes), bred in 1883—August 30th, two ♂s, September 3rd, one ♀, September 8th, 9th, one ♂ each day; in 1886—

August 21st, one ♀, September 1st, one ♀; in 1896—September 11th, one ♂; from August 28th into September, 1897, bred several of both sexes in Guernsey (Lowe), August 22nd, 1892, on lamp on foreshore at St. Heliers (Kaye), bred several August 1st—22nd, 1894, larvæ from Liverpool district (Butler), bred many August 12th, 1895, to end of month from Mullion near Penzance (Daws), bred August 3rd—6th, 1897, from larvæ collected June 1st, 1897 at Formby (Whittle), imagines bred August 5th—14th, 1897, from larvæ collected June 19th on the Formby sandhills (G. O. Day), imagines bred August 10th—19th, 1898, from larvæ collected June 8th—14th in the New Forest (Edelsten) [June 13th, 1899, a ♀ imago in New Forest (Fowler) (possibly an error)]. August 14th—17th, 1901, at light, from 9—10 p.m., at Bobbie, in the Pellice valley (Tutt).

LOCALITIES.*—CHESHIRE: All coast sandhills from Blackpool to Wallasey (Ellis), New Brighton (Harker), Wallasey (Galliers), Crosby (Gregson), Waterloo sandhills (Moss), Birkenhead (Ragonot). CORNWALL: The Lizard (Marshall), Scilly Isles (B. Adkin), Penzance district, Mullion, common (Daws), Land's End (Noye). CUMBERLAND: North part of the Cumberland coast (Dawson *teste* Barrett), near Keswick, very rare (Beadle). DEVON: Plymouth (Rogers), Devonport (Harvie), Bolt Head, Starehole Bottom, Salcombe (Turner), Whitsand Cliffs, Bovisand (Dell), Teignmouth, Blandford (Stainton). DORSET: Isle of Purbeck (Bankes), Bloxworth (Cambridge), Poole, Studland, Swanage (Bouskell), Winfrith, Parley Heath, Poole Heath (Dale). GLAMORGAN: Tenby (Hutchinson). GLOUCESTER: formerly nr. Bristol (Stephens), Cirencester (Harman). HANTS: I. of Wight—Nettlestone, Long Barton (Ingram); Lyndhurst (Bowles), White Moor (Lane), Southsea (Forsyth), Brockenhurst (Stephens), Horndean (Fenn), Ringwood (Fowler). KENT: Romney Marsh—Lydd to Rye (Mitford), [? Folkestone Warren (Knaggs)], in plenty, formerly, nr. Darenth (Lewin), nr. London, formerly, rare (Stephens), [Ramsgate (Stainton.)] LANCS: All the coast sandhills from Blackpool and Lytham to Wallasey (Ellis), Lytham (Stainton), sandhills near Liverpool (Gregson), Blackpool (Prescott), Formby (G. O. Day). SUSSEX: Sussex coast (Gascoyne), Eastbourne (Stainton), Crowhurst (Bloomfield), Rye to Lydd (Tutt). [Want confirmation—DURHAM: nr. Durham, larvæ abundant (Wood, *Ent. W. Int.*, i., p. 151) (? *Anthrocera trifolii*). MIDDLESEX: Hampstead, one (Rowland-Brown). SUFFOLK: Aldborough (Bloomfield)].

DISTRIBUTION.—AFRICA: Algeria—Collo, rare (Seriziat), Morocco, common (Blackmore), Tangier (Walker). ASIA: Amasia, Tokat, Brussa, Smyrna (Speyer), The Taurus—Karli, Boghas (Röber), Gözna (Holtz), Mersina (Lederer). AUSTRO-HUNGARY: Bucovina, distributed (Hormuzaki), Pressburg (Rozsay), Bohemia, sparingly (Nickerl), Stanislawow (Werchratski), Galicia—Holosko, nr. Lemberg (Nowicki), Brünn, (Müller), Bregenz, Kessen, Salzburg (Fritsch), Buda, common (Speyer), Tyrol, not common, to 4,300ft. (Hinterwaldner), Taufers, Innsbruck (Weiler), Hermannstadt (Czekelius), Eperies, rare (Husz), Chemnitz (Pabst), Glockner, Fiume (Mann), Lavantthal—Val Popena (Höfner). BELGIUM: rare—Rochefort, Namur (Selys), Hasselt (Mathieu), Han (Hippert), Ostend (Lambillion). BULGARIA: Varna (Lederer). CHANNEL ISLANDS: Jersey (Jennings), Guernsey and Sark, all round coast (Luff), Alderney coast—Fort Touraille (Harker). DENMARK: Common in coast districts (Bang-Haas). FRANCE: not rare (Berce), West of France, Eure-et-Loir, Châteaudun, Paris, Pyrenees, St. Sauveur, Vernet (Guénée), Fontainebleau, Digne, &c. (Tutt), Aix-les-Bains (Agassiz), Aube (Jourdheuille), Auvergne (Sand), Haute-Garonne, common (Caradja), Dept. Var (Cantener), Maas, Moselle, Meurthe (Speyer), Morbihan (Griffiths), Gironde (Trimoulet), Doubs (Bruand), Aude (Mabille), Loire-Inférieure (Bonjour), Saone-et-Loire—Autun, rare (Constant), St. Quentin (Dubus), Alpes-Maritimes (Millière), Caussols, common (Bromilow), Seine-Inférieure—Pont-de-l'Arche (Dupont), Burgoyne, St. Martin Lantosque (Constant coll.). GERMANY: distributed (Heinemann), north-west Germany almost everywhere (Jordan), Baden—general, at Freiburg, Herrenwies and Carlsruhe, common (Reutti), Rhine Palatinate (Bertram), Würtemberg (Seyffler), Giessen (Dickore), Lower Elbe dist. (Zimmermann), Upper Hartz to 2,200ft., Waldeck—Wildungen, common (Speyer), Halle-Dessau, Dölau (Stange), Munich, rather common (Kranz).

* Meyrick says (*Handbook*, p. 321): "Kent to Devon, Warwick to Lancashire, local." We know no Warwick records whatever.

Rudolstadt, rather common (Meurer), Mecklenburg—Sulz-Neustrelitz, Wismar (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia, rare (Schütze), Dresden (Steinert), Thuringia, not rare (Krieghoff), Gotha, &c. (Knapp), Prussia—Königsberg, Gilgenburg, Willenburg, Dantzig (Schmidt), Rastenburg (Klups), Silesia (Wocke), Upper Lusatia—Niesky to 574ft. (Moeschler), Nassau (Rössler), Ratisbon (Schmid), Dessau, not rare (Richter), Alsace (Peyerimhoff), Wernigorode (Fischer), Pomerania—Fort Preussen, Krekow, Memitz, Vogelsand, Grambow, &c. (Hering), Brunswick, not rare (Heinemann), Hanover, not rare (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl). GREECE: Corfu, Syra, Tinos (Erber *teste* Staudinger). ITALY: throughout, fairly common (Curò), Sicily, type form very rare (Minà-Palumbo and Failla-Tedaldi), Roman Campagna, very common (Calberla), Lombardy (Turati), Modena, not rare (Fiori), Menaggio (Forbes), Messina, Macerata (Zeller), Piedmont—Bobbie (Tutt). MALTA (Fletcher). NETHERLANDS: in most provinces (Snellen), Breda (Heylaerts), Gooyland (Sepp). ROUMANIA: very common, Grumazesti, Kloster-Neamtz, Slanic, Comanesti, Dulcesti, Jassy, Tultscha, Turn Severin (Caradja). RUSSIA: Baltic Provinces (Sintenis), Libau (Bienert), Sarepta (Nolcken), Moscow dept. (Albrecht), Crimea (Melioransky), South Russia (Moeschler), Transcaucasia—Helenendorf, Delijan, Kasikoparan (Romanoff), Lenkoran (Speyer). SCANDINAVIA: common in southern Sweden, found to about 60° N. lat., northern limit Upland (Aurivillius), Norway—Christiania (Siebke), rare in south-eastern Norway, not occurring in Finland (Reuter). SPAIN: Andalusia—Cadiz, Malaga (Rambur), Teruel (Zapater), Galicia (Velado), Barcelona—Calella (Cuní y Martorell), Catalonia (Martorell y Peña), Gibraltar, common (Walker), Bilbao, common (Seebold). SWITZERLAND: distributed (Frey), Weissenburg (Huguenin), Grisons—Chur, Bergell (Killias), Zürich dist. generally distributed (Rühl), Berne (Benteli), Valais, not rare on the slopes of the lower region—La Croix de Martigny, foot of Mt. Ravoire, Fully, Sion, Salquenen, &c. (Favre and Wullschlegel), Basle (Knecht), Thurgau nr. Dusnang (Eugster), Bremgarten (Frey), Aargau—Oftringen, Lenzburg, Aarburg (Wullschlegel), Bechburg, (Riggenbach-Stehlin), Schüpfen (Rothenbach), Cant. Glarus valleys (Heer), St. Blaise Neuveville (Couleru), St. Gallen, (Täschler), near Schaffhausen (Trapp). TURKEY: Gallipoli (Mathew).

Genus: LASIOCAMPA, Schrank.

SYNONYMY.—Genus: *Lasiocampa*, Schrk., "Fauna Boica," ii., Abth. 2, p. 154 (1802); Germ., "Bomb. Spec.," sect. ii., p. 47 (1812); Leach, "Edinb. Ency.," ix., p. 132 (1815); Oken, "Lehrb. Zool.," p. 708 (1815); Curt., "Brit. Ent.," iii., expl. pl. clxxxi (1827); Stephs., "Illus. Haust.," ii., pp. 38, 40 (1828); "List. Br. An. Br. Mus.," p. 46 (1850); Meig., "Eur. Schmett.," ii., p. 196 (1830); Wood, "Ind., Ent.," p. 21, fig. 43 (1839); Humph. & Westd., "Brit. Moths," p. 58 (? 1843); Palm., "Zool.," v., p. 1656 (1847); Walk., "List. Lep. Ins. Brit. Mus.," vi., p. 1427 (1855); Sta., "Man.," i. p. 153 (1857); Ramb., "Cat. Lép. And.," pp. 353, 357 (1866); Kirby, "Eur. Butts. & Moths," p. 139, pl. xxix., figs, *1a–e* (1880); "Cat.," p. 827 (1892); "Handbook," &c., iv. p. 120 (1897); Buckl., "Larvæ," &c., iii., p. 56, pl. xlvii., figs. 2, *2a*, *2b* (1889); Ström, "Danm. Sommerf.," p. 20 (1891); Auriv., "Iris," vii., p. 151 (1894); Meyr., "Handbook, &c.," p. 320 (1895); Barr., "Lep. Brit.," iii., p. 25, pl. xci (1896); Dyar, "Can. Ent.," xxx., p. 5 (1898); Tutt, "Proc. Sth. Lond. Ent. Soc.," pp. 1—11 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 70 (1898); Staud., "Cat.," 3rd ed., p. 120 (1901). *Phalaena (-Bombyx)*, Linn., "Sys. Nat.," 10th ed., p. 498 (1758); 12th ed., p. 814 (1767); "Faun. Suec.," 2nd ed., p. 293 (1761); Poda, "Ins. Mus. Græc., p. 85 (1761); Müll., "Fn. Frid.," p. 39 (1764); "Zool. Dan. Prod.," p. 117 (1776); Esp., "Schmett. Eur.," iii., p. 81, pl. xiii., figs. 2—6; xiv., figs. 1—2 (1783); Vill., "Linn. Ent.," ii., p. 125 (1789); Bkh., "Sys. Besch.," pp. 84, 464 (1790). *Phalaena*, Scop., "Ent. Carn.," p. 194 (1763); Hfn., "Berl. Mag.," ii., p. 398 (1766); Geoff., "Fourc. Ent. Par.," p. 260 (1785); Don., "Brit. Ins.," iii, pp. 83, 85, pl. 103—104 (1794). *Bombyx*, Fab., "Sys. Ent.," p. 562 (1775); "Spec. Ins.," ii., p. 175 (1781); "Mant. Ins.," ii., p. 112 (1787); "Ent. Sys.," iii., 1, p. 423 (1793); [Schiff.,] "Schmett. Wien.," p. 57 (1775); Hb., "Larv. Lep.," iii., Bomb. ii., Veræ P. *a.2* (*circ.* 1800); "Eur. Schmett.," iii., figs. 172, 225 (*circ.* 1800); text p. 144 (? 1805); Ill., "Syst. Verz. Wien.," n. Ausg., i., p. 109 (1801); Schrk., "Faun. Boica," ii., Abth. 1, p. 275 (1801); Haw., "Lep. Brit.," 1, p. 81 (1803); Latr., "Consid. Gen.," pp. 362, 441 (1810); God., "Hist. Nat. Lép. Eur.," iv., p. 95 (1822); Bdv., "Eur. Lep. Ind Meth.," 48 (1829); "Icones," p. 157, pl. lxvi., figs. 1—2 (*circ.* 1840); "Icon. Chen.," pl. 5, figs. 1—2 (*circ.* 1840); "Gen. et Ind. Meth.," p. 69 (1840); Dup., "Hist. Nat. Lép. Eur.," supp. iii., p. 92 (1836); "Icon. des Chen.," ii., pl. iv., fig. 1 (*circ.* 1840); "Cat. Méth.," pp.

77—8 (1844); Boh., "Vet. Ak. Hand.," p. 133 (1848); Newm., "Zool.," vii., p. 27 (1849); "Ent.," ii., p. 139 (1865); "Brit. Moths," p. 43 (1869); Gn., "Ann. Soc. Ent. Fr.," (3), vi., p. 442 (1858); (4), viii., p. 405 (1868); "Lép. Eure-et-Loir," p. 82 (1875); Trim., "Cat. Lép. Gir.," p. 27 (1858); Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 69 (1871); "Hor. Soc. Ent. Ross.," xiv., p. 358 (1877); Snell., "De Vlind.," p. 185 (1867); Berce, "Faune Franç.," ii., p. 190 (1868); Nolck., "Lep. Fn. Estl.," i., p. 127 (1868); Wallgrn., "Skand.-Het. Fjär.," ii., p. 60 (1869); Cuní y Mart., "Cat. Lep. Barc.," p. 69 (1874); Curò, "Bull. Soc. Ent. Ital.," viii., p. 150 (1876); Frey, "Lep. Schw.," p. 97 (1880); Gerh., "Berl. Ent. Zeits.," xxvi., p. 127 (1882); Lampa, "Ent. Tids.," p. 41 (1885); Jordan, "Schmett. N.-W. Deutsch.," p. 96 (1886); Hinchliff, "Ent.," xix., p. 272 (1886); Battersby, "Ent.," xx., p. 109 (1887); Rühl, "Soc. Ent.," v., p. 178 (1891); Tutt, "Brit. Moths," p. 54 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 58 (1898); Agassiz, "Mitt. Schw. Ent. Ges.," x., p. 248 (1900). *Bombix*, Latr., "Hist. Nat.," xiv., p. 178 (1805). *Bombyx (-Lasiocampa)*, Latr., "Genera," &c., iv., p. 219 (1809); Led., "Verh. z.-b. Wien.," ii. Abh., p. 75 (1853). *Gastropacha*, Ochs., "Die Schmett.," iii., pp. 139, 266 (1810); x., p. 191 (1834); Evers., "Fauna Volg.-Ural.," p. 154 (1844); H.-Sch., "Sys. Bearb.," ii., p. 101 (1847); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 26 (1851); Speyer, "Geog. Verb.," i., p. 413 (1858); ii., p. 288 (1862); Hein., "Schmett. Deutsch.," i., p. 201 (1859); Fuchs, "Stett. Ent. Zeit.," xli., p. 129 (1880); Auriv., "Nord. Fjär.," p. 63 (1889). *Pachygastria*, Hb., "Verz.," p. 186 (? 1822).

The genus *Lasiocampa* was used by Schrank (*Fauna Boica*, ii., pt. 2, pp. 153—155) in a heterogeneous sense, and includes the types of many different genera. It reads as follows:

Lasiocampa.—Antennæ bipectinate; the pectinations inclined towards one another. Two palpi, shaggy, almost shorter than the nose-shaped frontal tuft. Tongue small. Wings at rest deflexed, pointed-roof-shaped—*quercifolia*, *ilicifolia*, *pruni*, *pini*, *potatoria*, *rubi*, *quercûs*, *roboris*, *trifolii*, *dumeti*, *rimicola* (=*catax*, Esp. iii., tab. xvi., figs. 1—5), *lanestris*, *catax*, *neustria* and *castrensis*.

By a process of elimination already described (*antea*, vol. ii., pp. 449—451) this heterotypical genus has, by the separation of the species belonging to later genera, at last been retained solely for the *quercûs* group, the latter species having been named by Curtis as the type. Aurivillius, by a method of reasoning quite different from ours, has come to the same conclusion (*Iris*, vii., p. 149). Since Curtis was the first to restrict *Lasiocampa* to the *quercûs* group, we give his generic diagnosis, which reads as follows:

Lasiocampa, Schr., Germ., Leach.—*Gastropacha*, Och.—*Bombyx*, Linn., Fab., Latr., Haw.—Antennæ inserted towards the hind part of the head, nearly straight, setaceous, strongly bipectinated in the males, each branch being ciliated and producing a rigid bristle near the apex, inclining upward; serrated in the females. Maxillæ and mandibles none. Palpi 2, small, short, hairy; 3-jointed, 1st and 2nd joints robust, the former the longest, 3rd minute ovate. Males smaller than the females. Head short. Eyes small. Thorax large, not crested. Abdomen of the males attenuated and divided at the apex; robust and subovate in the females. Wings entire, deflexed when at rest. Tarsi 5-jointed. Claws and pulvilli distinct. Caterpillars with 6 pectoral, 8 abdominal, and 2 anal feet; cylindrical and hairy, curling themselves up when disturbed. Pupa enclosed in an obtuse oblong cocoon of very close texture. Type of the genus—*Bombyx quercûs*, Linn.

Although Curtis cited *quercûs* as the type of *Lasiocampa*, he retained *medicaginis* and *trifolii* (the type of Hübner's *Pachygastria*) in the same genus, whilst Aurivillius (*Iris*, vii., p. 149) recognising the important structural differences between these and their allies retained the name *Lasiocampa* in a tribal sense, and grouped (*loc. cit.*, pp. 150—151) the species enumerated therein, according to their peculiarities but without naming the genera thus created. He placed, however, only two species in the same group as *quercûs*, *viz.*, *grandis*, Rog., and *serrula*, Gn. The former was described by Rogenhofer as a variety of *P. trifolii*.

The synonymy and original description of these species are as follows:

L. grandis, Rogenhofer, "Ver. z.-b. Ges. Wien.," xli., p. 86 (Dec., 1891); Staud., "Iris," iv., p. 348 (1892); Auriv., "Iris," vii., p. 151 (1894). *Salomonis*, Staud., "Iris," iv., p. 259 (Feb., 1892).—*Gastropacha trifolii* var. *grandis*. ♂. Forewings reddish-yellow to red-brown with small whitish central spot and a narrow sinuate pale yellow band bordered with dark on inner side; hindwings little paler; underside rather paler, especially the hindwings, with a common sinuated narrow band. ♀, more tending to yellowish, resembling many dark ♀s of *G. quercûs* with a larger central spot. ♂ 61—65 mm., ♀ 80 mm. (Rogenhofer). Aurivillius refers *sapiens*, Staud., "Iris," iv., p. 260 (1892) to this species as a variety (*Iris*, vii., p. 151).

L. serrula, Gn., "Ann. Soc. Ent. Fr.," (3), vi., p. 454, pl. x., fig. 2 (1858); Oberth., "Etudes d'Ent.," vi., pl. iii., figs. 6 *a*—*b*, p. 75 (1881); Kirby, "Cat.," p. 829 (1892).—♀ only, the species more distinct than *iberica*. Shape of *trifolii*; superior wings wider than those of ♀ *P. trifolii*, the outer margin cut less obliquely and the fringes longer; the forewings pointed, of a pale "gris-noisette," sprinkled with reddish scales; the elbowed line very distinct, forming a series of deep regular teeth at each nervule, it is only a little darker than the ground colour, slightly paler outside, beyond which it is margined with reddish scales; the cellular point very large, very round, white without dark margin. The inferior wings are almost concolorous with the superior, the base and a slight trace of a transverse band a little paler. The underside is somewhat near *cocles*, but the ferruginous band of the inferior wings is toothed like the elbowed line of the superiors, although a little less markedly. The body is unicolorous; the antennæ like those of *trifolii*. Reported from Andalusia by Lorquin. Pierret stated that the specimen described from his collection was at the time unique (Guénée).

Some exceedingly interesting experiments have been carried out on the various races of *Lasiocampa quercûs*, the species being one of those that lends itself very readily to experiment, inasmuch as it appears in very distinct local forms in various parts of its geographical range. Merrifield has shown (*Trans. Ent. Soc. Lond.*, 1892, pp. 38—39) that the colour of the imagines of this species is affected by differences of temperature applied during the pupal stage. The experiments were as follows:

I.—Some recently changed pupæ and fullfed larvæ of the type form, obtained from the same hedge at Windsor:
   1. Pupæ placed at 80° F. after they had turned about a week, but some at a somewhat later stage. The resultant imagines emerged in from 29—40 days, and were very light-coloured.
   2. Eighteen pupæ (same batch) placed at a low temperature, 47° F.; fifteen emerged in from 39* to 71 days, and these show on the whole a tendency (more particularly in the light band) to become darker as the length of the pupation period, due to exposure to the low temperature, increases.

II.—Pupæ of *L.* var. *callunae* obtained from Aberdeen and Perth:
   1. A few Aberdeen pupæ, placed at 80° F.; two imagines emerged from 27 to 46 days; the imagines a great deal lighter than usual, especially the ♀, which can scarcely, if at all, be distinguished from the southern form.
   2. A lot of pupæ from Perth, similarly forced, produced three ♂s and two ♀s. These are darker, but light for *L.* var. *callunae*.
   3. Another batch of pupæ from Perth, divided into—
      a. The first set, forced at 80° F., five ♂s and five ♀s, appearing in from 29 to 42 days, the resultant imagines rather light.
      b. The second set, placed in the open air, emerged in June and early July; the imagines, six ♂s and nine ♀s, varied but little, but the males especially were darker than those of section *a*, the pupæ of which had been forced.

Merrifield concludes that in *L. quercûs*, at least, the higher temperature tends to produce lighter specimens than those kept at a lower temperature; this particularly applies to the males, the females varying less, but, in both sexes, the forced ones have a reddish tint which is

* Had possibly been pupæ some time before the experiment was commenced.

wanting in the others. In some cases the effect of temperature is so considerable, that some of the forced *L.* var. *callunae* would, as regards colouring, in the absence of data, pass for *L. quercûs*, whilst the *L. quercûs* that was 71 days in pupa at the lower temperature, is very dark for the typical form.

The experiments made by Bacot and Warburg in crossing various races of *L. quercûs*, have proved exceedingly interesting. The races that have been used for the purpose of these experiments are as follows:

1. *L.* var. *sicula*, Staud., the most specialised race of this species; ♂s with a russet- rather than chestnut-brown ground colour, a very narrow, straight, transverse band to forewings, and a wide orange-yellow hind marginal area extending from the band to the fringe of the hindwings; ♀s a little smaller, somewhat darker, otherwise very like our British ochreous forms, all the wings uniformly tinged with reddish, the marginal area of the hindwings pale unicolorous.

2. *L.* var. *meridionalis*, Tutt, usually known as the south of France form of *quercûs*. This is the most extreme form, in which the ♂s have very narrow transverse yellow bands on fore- and hindwings, and dark ground colour; ♀s yellow, with scarcely a trace of reddish in ground colour, the forewings duller than hindwings.

3. *L.* var. *viburni*, Gn., ♂s scarcely distinguishable from var. *meridionalis*, the transverse bands slightly wider on both fore- and hindwings; ♀s generally exhibiting a reddish tint in ground colour. [The great difference between var. *meridionalis* and var. *viburni* occurs in larval stage.]

4. *L. quercûs* (ab. *latovirgata*), ♂s with rather wider transverse bands, the ground colour somewhat redder; ♀s vary considerably from yellow- to reddish-ochreous.

5. *L.* var. *callunae*, Palm., ♂s with very dark ground colour, with well-marked, but not specially broad, transverse band, often with a yellow patch at base of forewings; the transverse band of hindwings rather distant from margin, and turning down rather sharply at anal angle; ♀s much darker than in other forms.

The parents from which crossings were obtained were as follows:

1. *L.* var. *meridionalis* (mixed families). 2. *L.* var. *meridionalis* (a single family). 3. *L.* var. *viburni* (a single family). 4. *L.* var. *viburni* (from collected larvæ). 5. *L. quercûs*, from Dorsetshire. 6. *L.* hybr. *meridionalis* × *viburni*, from white-haired larvæ. 7. *L.* hybr. *meridionalis* × *viburni*, from brown-haired larvæ. 8. *L.* var. *callunae*, from Aberdeen. 9. *L.* var. *sicula*, from Sicily. Mr. Warburg had also crossed *meridionalis* × *callunae* and obtained ova.

The actual crossings obtained by Bacot in 1897 were 23 in number, of which, however, 6 were duplicate. Of the remaining 17, 4 were pairings between moths of the same races, 13 being crosses between different races. These were as follows:

♂ *meridionalis* × ♀ *viburni* (July 1st); ♂ *viburni* × ♀ *quercûs* (July 10th); ♂ (*meridionalis* × *viburni*, from white-haired larva*) × ♀ *quercûs* (July 10th); ♂ × ♀ *meridionalis* (July 18th); ♂ (*meridionalis* × *viburni*, from brown-haired larva) × ♀ *meridionalis* (July 19th); ♂ *viburni* × ♀ *callunae* (July 19th); ♂ (*meridionalis* × *viburni*, from white-haired larva) × ♀ *viburni* (July 19th); ♂ (*meridionalis* × *viburni*, white-haired) × ♀ *meridionalis* (July 19th); ♂ (*meridionalis* × *viburni*, brown-haired) × ♀ *viburni* (July 25th); ♂ × ♀ (*meridionalis* × *viburni*, white-haired) (July 28th); ♂ *quercûs* × ♀ *meridionalis* (July 28th); ♂ × ♀ *viburni* (July 31st); ♂ (*meridionalis* × *viburni*, from brown-haired larva) × ♀ (*meridionalis* × *viburni*, from white-haired larva) (August 3rd); ♂ × ♀ (*meridionalis* × *viburni*, from white-haired larva) (August 3rd); ♂ (*meridionalis* × *viburni*, from brown-haired larva) × ♀ *meridionalis* (August 7th); ♂ × ♀ (*meridionalis* × *viburni*, both from brown-haired larvæ) (August 9th); ♂ *meridionalis* × ♀ *viburni* (August

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* The larvæ of the first crosses between *viburni* and *meridionalis*, in all cases divided into two series, following the larval forms of the parent, *viz.*, one series white-haired, the other brown-haired. When progeny resulting from this cross have been used, the particular larval form from which the insect came is indicated.

12th); ♂ (*meridionalis* × *viburni*, from brown-haired larva) × ♀ *viburni* (August 12th); ♂ *sicula* × ♀ *meridionalis* (August 24th); ♂ *sicula* × ♀ (*meridionalis* × *viburni*, from brown-haired larva) (August 20th). In 1898 a cross of ♂ [(*meridionalis* × *viburni*, white-haired) × (*meridionalis* × *viburni*, white-haired)] × ♀ *sicula*, was obtained.

Bacot notes that there was perfect fertility between all the forms with which he experimented, his losses occurring chiefly in the larval stage, and being possibly largely due to overcrowding. Warburg's experience suggests that the brown-haired larvæ of *L. meridionalis* × *viburni* produce a very small proportion of ♀s, the white-haired larvæ of this cross more than the normal proportion.

We have carefully examined the specimens bred by Warburg and Bacot. To us the most interesting of the crossed imagines appear to be the following:

1. *L.* hybr. *bacoti** (=*meridionalis* × *viburni*).—*a.* The ♂s (30) are scarcely distinguishable from the male parents (the progeny is from four pairings); the females are distinctly yellower than the ♀ parents, which are more than usually red even for *viburni* (Warburg coll.). *β.* 5 ♂s, all showing rather more than a tendency to the widening of the transverse bands of fore- and hindwings; two have them somewhat wider even than any *viburni* examined, and in this respect approach British *quercûs* (Bacot coll.).

2. *L.* hybr. *warburgi* (=*quercûs* × *meridionalis*).—*a.* 3 ♂s and 4 ♀s, the former quite of the broad-banded English *quercûs* type; the ♀s also show this broadening of the transverse bands (Bacot coll.). The larvæ also showed the predominant characteristics of the English *quercûs* strain (Bacot). *β.* 4 ♂s and 8 ♀s, the offspring distinctly like British *L. quercûs* in both sexes, the ♂s with the characteristic tendency to wider bands; the ♀s less red and more yellow than the ♀ parent (Warburg coll.). *γ.* 11 ♂s, no ♀s; the offspring small; the outer marginal area weak in colour compared with the ♂ parent; the transverse bands narrow (Warburg coll.).

3. *L.* hybr. *intermedia* (=*sicula* × *meridionalis*).—*a.* 3 ♂s, 1 ♀. The ground colour rather nearer the darker tint of *meridionalis* than the more russet hue of *sicula*; the transverse band of forewing definite and narrow; the hindwing with the orange marginal area of *sicula* altered to the brown marginal area and narrow yellow transverse band of *meridionalis;* the ♀ retains the russet tint of *sicula*, but has not the distinct pale outer marginal area of that form (Bacot coll.). *β.* 2 ♂s and 1 ♀ emerged the first year, the males of russet hue of *sicula*, but the hind marginal area of hindwing surrounded with brown as in *meridionalis*; 2 ♂s and 2 ♀s of same batch emerged second year, one weakly pigmented ♂ of above form, the other ♂ with full yellow marginal area to hindwings as in *sicula*; ♀s small, and had evidently been ill-nurtured (Warburg coll.).

4. *L.* hybr. *prouti* (=*sicula* × *quercûs* (Paris)).—*a.* 8 ♂s and 10 ♀s; the ♂s almost identical with *sicula* except for a gradual fading of transverse band of forewings into the marginal area, and a slight trace of a marginal brown shade edging the orange marginal area of hindwings; the ♀s distinctly of the ♀ parent form, yellow, and quite unlike the warmer tinted ♀ *sicula* (Warburg coll.). *β.* 21 ♂s and 7 ♀s. All the specimens comprising this brood larger, otherwise the ♂s very like the last in ground colour, and follow the ♂ parent; the outer margin of hindwing rather less orange-yellow and more shaded with brown externally, and hence nearer *quercûs.* The ♀s also yellow, nearer *quercûs* than *sicula*, although there is a distinct trace of the warmer *sicula* hue than in ♀s of preceding brood. 3 ♀s (of same brood), emerging after second year in pupa, are very dark reddish-ochreous, the outer marginal areas of hindwings scarcely differing in tint from the rest of wings (Warburg coll.).

5. *L.* hybr. *complexa* [=*sicula* × (*meridionalis* × *viburni*, brown-haired larva)].—8 ♂s and 2 ♀s; the males have distinctly wider transverse bands to forewings than *sicula*, the ground colour showing trace of the *sicula* tint, but on the whole both bands and colour are nearer those of *meridionalis* × *viburni* than of *sicula ;* the hindwings in all the specimens with distinct brown marginal border, in three quite as well defined as in *viburni*; the ♀s follow the ♀ parent (*meridionalis* × *viburni*).

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* In the imaginal stage, the cross *bacoti* is practically indistinguishable from the parent forms *viburni* and *meridionalis.* The interest in this cross and in the parent forms lies in the characters presented by the larvæ.

6. *L.* hybr. *inversa* [= (*meridionalis* × *viburni*, whitehaired, 2nd gen.) × *sicula*].—2 ♂ s and 4 ♀ s. The males peculiar, one being very near the ♂ parent, with well-developed narrow bands, the other with the transverse band on the forewing restricted and not quite reaching the costa; that on the hindwing absent, the marginal area (including normal position of band) being very dark buff and almost unicolorous, the fringes paler; the ♀ s incline rather to *meridionalis* × *viburni* than *sicula* (Bacot coll.).

7. *L.* hybr. *complicata* [= ♂ (*sicula* × *meridionalis*) × ♀ [(*meridionalis* × *viburni*) × (*meridionalis* × *viburni*)]].—2 ♂ s of most bizarre appearance; a peculiar mixing of the dark chocolate and russet tints of the males of *meridionalis* and *sicula* respectively, the transverse band on the forewing being reduced to a narrow line, that on the hindwing still narrower and tending to obsolescence (Warburg coll.).

In these crossings there appears to be a distinct tendency for the progeny to follow the male parent. This, however, is much modified by the particular race from which the parents come, a ♀ *quercûs* influencing the progeny more than a ♀ *meridionalis* or ♀ *viburni*, and these more than a ♀ *sicula*. One suspects that the *callunae* and *quercûs* forms are the oldest and most generalised, and *sicula* the newest and most specialised, and that the tendency in crossing is for the progeny to revert to the oldest form. Bacot, on larval characters, considers that the British *quercûs* is the most ancestral form, and finds in the hybrid larvæ more marked tendencies in the direction of *quercûs* and *callunae* when one or other of these is one of the parent forms.

Giard touches on the question of pœcilogony in *Lasiocampa quercûs*, *L.* var. *viburni*, *L.* var. *callunae* (*Ann. Soc. Ent. France*, lxiii., pp. 128—135). The two last-named he notes as the southern and the northern representatives of *L. quercûs*. He writes: "Although it is almost impossible to separate the adults of these three forms, Guénée has discovered that the young caterpillar of *L.* var. *callunae* differs from that of *L. quercûs*, but that the divergence diminishes after the first moult and finally disappears.* One may attempt to see in this dissimilarity of the larvæ in the early state a proof of the primitive separation of the two species; but the habitat differs sufficiently to explain this divergence. One of the two forms, without doubt *L.* var. *callunae*, represents the first ancestral larva,** which is modified in *L. quercûs* and *L.* var. *viburni*, and this species may truly be considered as a pœcilogonic † form slightly modified in the adult stages."

The larval hairs have already been referred to (*antea*, vol. i., p. 100) as showing considerable urticating properties, the finely-pointed urticating hairs getting under the skin and setting up considerable mechanical irritation which frequently lasts for several days (*vide* also South, *Ent.*, xviii., p. 5; Long, *loc. cit.*, xix., p. 45, Connon, *Ent. Rec.*, iii., p. 20, &c.). The colour of this urticating fur is largely characteristic of the various races of the species, and, in inbreeding and crossing the different forms, Bacot has noted many important results bearing on the broader questions of heredity. He describes the larvæ of the various races on which he experimented as exhibiting the following characteristics in their adult forms:

* Not by any means does the difference always entirely disappear, see Bacot's notes almost directly following.

** Recent work suggests *quercûs* larva as the oldest form, larvæ of *viburni* and *callunae* both being more specialised although in different directions.

† Insects that have dissimilar larvæ, at different points of their geographical distribution, at different seasons of the year, or under different conditions of nutrition, whilst the adults are very similar to each other, and present very slight modifications, are said to be pœcilogonic (*i.e.*, exhibit the phenomenon of pœcilogony).

1. *L. quercûs* (English): Dorsal (urticating) fur dull white to pale dusky-brown. Head dull indigo.
2. *L.* var. *callunae* (Scotland): Dorsal fur dull brown. Head dull indigo.
3. *L.* var. *meridionalis* (Cannes): Dorsal fur pure white. Head, orange-red.
4. *L.* var. *viburni* (Cannes): Dorsal fur red-brown. Head orange-red.
5. *L.* var. *sicula* (Sicily): Dorsal fur red-brown. Head orange-red.

Bacot further notes: "In the English races, the head of the adult larva is of a deep indigo-blue, occasionally tinged with orange on the cheeks; in the continental forms the head is normally orange-red, the clypeal marks being whitish; the latter are usually faint or absent in larvæ of the English races. Adult continental larvæ appear to be more densely haired than English. In the early stadia the difference is much greater, the south of France larvæ assuming the adult plumage in the 2nd or 3rd stadium, while those of English parentage do not attain the full development of hairs, until at least one if not two moults later. Larvæ of *L.* var. *meridionalis* and *L.* var. *viburni* are indistinguishable before the growth of the urticating fur; the divergence of the coloration then becomes more marked at each successive ecdysis. The larvæ of the English races are more variable than those of the French, the variable points being the greater or less development of the oblique stripes and the development of the blue shading laterally; the blue is generally stronger in English larvæ, and the dorsal fur of the latter varies from dull white to pale brown, &c. Other interesting points mentioned by Bacot (*Ent. Record*, xiii., pp. 114—116 *et seq.*) are the rapidity with which larvæ of *L.* hybr. *meridionalis* × *callunae* fed up—three to four months from hatching to spinning (August to November, 1897)—followed by a pupal stage of from 20—30 months, all but one or two finally dying. He also notes that when the English race is crossed with a foreign race, the former stamps its peculiarities most markedly on the progeny. When *L.* var. *meridionalis* and *L.* var. *viburni* are crossed, the resulting larvæ, as we have already noted, divided into two distinct groups following the parents—one with white urticating fur, the other with golden-brown—there were no intermediates. When *L.* hybr. *bacoti* (*meridionalis* × *viburni*) is crossed with either of the parent races, the larvæ tend sometimes to revert wholly to the form characteristic of the race with which the cross is paired, at others to split into two moieties—one white-haired, the other golden-haired. The most remarkable general result is that by crossing two forms (*meridionalis* and *viburni*) occupying the same geographical area, we get a separation of the larvæ into two groups following the parental types, whilst in crossing two forms (*meridionalis* and *callunae*) occupying far distant geographical areas, we get a blending of the parental larval peculiarities, and what may be termed intermediates between the two forms. Full details of the modifications obtained in the various broods have been published *Ent. Record*, xiii., pp. 143—144.

The following is a summary of the results obtained by the crossing of the two south of France forms, *meridionalis* and *viburni*, and their progeny. There appears to have been some little doubt* whether the first, 1896, cross should be called *viburni* × *meridionalis* or

* Bacot's original notes (*Ent. Rec.*, xiii., pp 114 *et seq.*) are written *viburni* × *meridionalis*, leaving one to assume that the parentage was ♂ *viburni* × ♀ *meridionalis*; as a matter of fact the parentage was ♂ *meridionalis* × ♀ *viburni*, and this is used in Warburg's notes (*loc. cit.*, pp. 237 *et seq.*).

meridionalis × *viburni*, but this does not alter the general result, *viz.*, that the larvæ derived from four full batches of eggs, with ♂ *meridionalis* × ♀ *viburni* parentage, divided, as just noted, into two approximately equal portions, one with red-brown, the other with white, urticating fur, with no intermediates. The larvæ of the second generation, *i.e.*, larvæ obtained from eggs laid by imagines produced from this cross, resulted as follows:

Pairing between moths from larvae of white-haired variety.—Four larvæ lived to adult age, all of which were white-haired.

Pairing between moths from larvae of brown-haired variety.—These all unfortunately died before reaching adult plumage.

Pairing between moths from larvae of the two varieties, viz., ♂ *brown-haired* × ♀ *white-haired.*—All the larvæ, when half-grown, tended to follow the larval form of ♀ and be white-haired; only two became adult, and these had the urticating fur almost white, yet not pure white, being faintly tinged with a dusky hue.

Pairing between a ♂ *from white-haired larva* × ♀ *L. var. viburni.*—This cross produced larvæ with red-brown urticating fur.

Pairing between a ♂ *from larva of brown-haired variety and a* ♀ *L. var. meridionalis.*—This brood split up into two moieties, one half with white and the other with brown urticating fur; six became adult, of which three had white and three brown fur.

Equally interesting are the results obtained by crossing var. *sicula* with the French races. Of these Bacot notes:

Pairing between ♂ *L. var. sicula and* ♀ *L. var. meridionalis.*—All the larvæ were of the *L.* var. *sicula* or *L.* var. *viburni* form, *i.e.*, with red-brown urticating fur.

Pairing between ♂ *L. var. sicula and* ♀ *L. (meridionalis* × *viburni, from brown-haired larva).*—All the larvæ of this brood were of the *L.* var. *viburni* or *L.* var. *sicula* form, *i.e.*, with red-brown urticating fur.

Pairing between ♂ *L. brood (2nd gen. L. meridionalis* × *viburni, from white-haired larva) and* ♀ *L. var. sicula.*—The larvæ were of the *L.* var. *viburni* or *L.* var. *sicula* form, except that the fur was, judging from memory, slightly paler than usual for the larvæ of these in their normal forms.

To the British lepidopterist the results obtained by crossing the English races—*quercûs* from Dorsetshire, and *callunae* from Aberdeen—with the French races will probably prove still more interesting. Of these Bacot notes:

Pairing between ♂ *L. quercûs* (*English*) *and* ♀ *L. var. meridionalis* (*Cannes*).—In the early instars the larvæ followed the ♂ stock, but at the 4th instar the majority closely approached the French form as regards the colour of the urticating fur, although in a few it was slightly dusky. The subdorsal band, however, was more strongly marked than was usual with the Cannes larvæ at this stage. When full-grown they followed the English stock in having dusky white urticating fur, but their heads, as was also the case in the 4th instar, show strongly the influence of the French race, being shaded, in some larvæ strongly, with orange-red.

Pairing between ♂ *L. var. meridionalis (Cannes) and* ♀ *L. var. callunae (Aberdeen).*—When young, the larvæ chiefly resembled young larvæ of *L.* var. *callunae*, but at the 3rd and 4th instars the influence of the ♂ parent became predominant, and when in penultimate skin the urticating fur, as well as the longer hairs, was pure white. In their last skins, however, the *L.* var. *callunae* strain again became apparent, the urticating fur being of a pale pinkish-brown, while the lateral hairs were pale reddish-brown, and a few of the long dorsal hairs remained pure white. The heads of these larvæ when full-grown were of various shades, from a bright brick-red, slightly mottled with deep indigo, to a form in which indigo was the ground colour, and only a slight mottling of the red was present. The face marking agreed with that of the French race.

Pairing between ♂ *L. var. viburni and* ♀ *L. quercûs (English).*—Only one larva of this pairing lived to assume its final skin. It then had pale brown urticating fur, evidently a blending of the parental characters.

Pairing between ♂ L. var. viburni and ♀ L. var. callunae.—The young larvæ closely resembled those of *L.* var. *callunae* in their early instars; in the penultimate skin they were much nearer to *L.* var. *viburni*, differing only in a few points. Thus the long dorsal hairs were either fewer in number or less brilliantly white than in *L.* var. *viburni*, and faint traces of the chain of white mediodorsal tufts were still present. In their last skin all the long hairs of the larvæ became dusky. The colour of their heads varied, but all showed mottling of red and indigo in varied proportions.

With regard to the white spots which are present in the centre of the subdorsal area of the meso- and metathoracic segments, Bacot notes (*Ent. Rec.*, ix., p. 287) that they "are developed from the ends of the last and largest of the orange transverse bands which cross the dorsal area of these segments, and which, together with similar stripes on the abdominal segments, give the young larva its characteristic appearance. After the first larval moult, the ends of these bands on the meso- and metathoracic segments become very much lighter, and upon the larva attaining its adult stage these cream-coloured ends are left as disconnected spots, due to the loss of the orange transverse bands, or their obliteration by the dorsal hairs. Young larvæ of *Cosmotriche potatoria* possess similar bright yellow spots in the same position, but, in this species, they are distinctly marked as spots in the first skin, and, although clearly marked in the fourth skin, have not undergone and do not undergo any further development, at least before hybernation." Whilst making some observations on the larva of *L. quercûs* in August, 1896, Bacot was greatly puzzled as to the significance of these spots, but, whilst examining larvæ of French *L.* var. *meridionalis* and *L.* var. *viburni*, he noticed that at or about the fourth stage the spots in question developed into a prominent white oval spot with rather pointed ends, and with a circular orange centre. This combination of the two colours, he says, was too remarkable to be overlooked, and immediately called to mind the manner in which the ocellated spots of the larva of *Eumorpha (Choerocampa) elpenor* are developed. He adds: "I at first thought that these spots on the larva of *L. quercûs* might be the remnants of identical ocellated spots transmitted from a common ancestor, but my notes on the larva of *E. elpenor* showed that, in this species, the ocellated spots were situated on the first and second abdominal segments from swellings in the subdorsal line, and not, as in the larva of *L. quercûs*, on the meso- and metathoracic segments. I think, however, that the spots in question are really the remnants of ocellated spots that probably had a protective value as warning markings in the ancestral larval form of *L. quercûs* and *Cosmotriche potatoria;* and I would point out that imperfect or rudimentary ocellated spots are present on the metathoracic segment of both *Eumorpha elpenor* and *E. porcellus;* also that a large black ocellated spot, with two blue pupils, is present on the third thoracic segment of the larva of *Daphnis nerii*, while the larvæ of *Deilephila gallii* and *D. euphorbiae* have a series of large yellowish spots on the subdorsal area of all the segments from the mesothorax to the eighth abdominal."

The cocoon is of the well-known "eggar" shape; in fact, it is the cocoon of *L. quercûs* that has given the group the popular name of "eggars." The imago does not remove a definite lid portion from the cocoon on emergence, but softens the material that binds the silk and hardens the cocoon by a distinctly alkaline fluid coming from the head. The southern races appear to spin, as a rule, lighter (*i.e.*, more yellow) cocoons than the northern forms, but this is possibly due, in part, at least, to the drier conditions under which they are spun, much variation often occurring, and damp distinctly tending to produce darker coloured puparia, although one suspects that the food must also considerably influence the result, the darkening of the cocoon being largely dependent on the final excretions of the larva, which we know are used to harden the silk. Latter states (*Trans. Ent. Soc. London*, 1895, pp. 407—8) that the cocoons of *Lasiocampa quercûs* var. *callunae*, *Lachneis lanestris* and *Cochlidion limacodes*, have many points in common, and that all these have similar appliances for escaping. The cocoons are all tough, more or less cylindrical with rounded ends, one of which is raised as a lid at the time of emergence. The boring organ is of a totally different kind from that existing in the Dicranurids, and is not formed either by labial prongs or modified maxillary palpi, nor does the anterior portion of the pupa form a "shield" to the head and eyes of the imago. On the contrary, by carefully denuding the head by brushing and blowing, it may be seen that the head is far more turned down, so as to bring the mouth-parts into a more backward position, while the median frontal portion of the head between the eyes is produced forward into a prominent and sharply-pointed umbo or boss (*loc. cit.*, pl. ix., fig. 9*b*) of great strength, and capable of being used as a powerful awl in opening the lid of the cocoon. There are slight differences in the details observable in the three species named. *L.* var. *callunae* and *L. lanestris* have the boss developed to a less degree and less sharply pointed on the head of the pupa also (*loc. cit.*, pl. viii., fig. 8), while in *C. limacodes* the converse holds good, the boss being far sharper and stronger in the pupa than in the imago (*loc. cit.*, figs. 10—12); indeed, the pupal boss is the only hard structure in the otherwise fragile and delicate pupa-case of this species, &c. Criticising this statement, Chapman says (*Ent. Rec.*, xiii., p. 299) that *L. quercûs* var. *callunae*, he believes, "breaks off a lid as do *Cochlidion limacodes* and *Lachneis lanestris*, but more often it fractures very irregularly, and often into several pieces; but it is a fracture rather than caused by a solution, although Latter says that the imago produces much alkaline liquid. In all three cases the force producing the fracture is the pressure, which the inflation of the imago enables it to exert from 'within from end to end of the cocoon.' The 'sharply-pointed umbo' merely determines the starting-point of the fracture, *i.e.*, it increases the strain immensely at one particular point, and as soon as fracture commences there it at once runs round the whole lid. Mr. Latter is quite right in supposing that the lid of *C. limacodes* is ruptured by the pupa, *i.e.*, by the imago within the pupa-skin, since, like all Incompletæ, the unruptured pupa emerges from the cocoon. The sharp point of the pupa does not act, as Mr. Latter expresses it, 'as an awl,' but makes the pressure the whole pupa is exerting a little more strenuous at one point, tending to an angular bending of the cocoon at that point, and so beginning the fracture. When a 'pupa incompleta' has to force its way through meshes of silk, as in most

Tortricids, *Cossus*, &c., an awl-like effect probably occurs, but in all cases of lids, as for instance in Sesiids, the process is probably the same as that which occurs in *Cochlidion limacodes*. Most people are, I think, familiar with the effect of a very localised interference being *per se* harmless, but determining at once that a strain should produce powerful effects."

The males of *L. quercûs* show in a most marked degree the phenomenon known as "assembling." Mathew notes the ♂s coming up to a newly-emerged ♀ at Barnstaple 6 or 7 at a time, and Blaber records 22 males attracted by a ♀, August 1st, 1887, at Crowborough Beacon, the box containing the ♀ being placed on a gorse bush. The attractive odour of the ♀ is very persistent, and lasts for several days. Williams notes it (*Ent. Rec.*, x., p. 106) as lasting from July 11th—20th; Mousley observed a large number of ♂s attracted by a small piece of ♀ abdomen, which was impaled on a thorn in a hedge, the ♂s crawling up the stem on which it was placed until they reached it, when they flew away. Vicary records that in 1875, at Newton Abbot, a male was seen hovering over a pupa, which later produced a ♀ moth; Robinson notes a ♀ that attracted several males after it was dead; and Arkle observes that Murray placed 3 ♀s in a perforated zinc case on July 19th, 1894, when only 2 males were attracted, owing to its being late, 5 p.m., on Witherslack Moss; the ♀ was removed on the 20th, when the satchel was taken to the Isle of Man on a collecting expedition till the 23rd; Witherslack was visited again on the 24th, and though no other ♀ had been in the satchel since the 20th, numbers of ♂s were attracted to it and crawled inside; on the 26th others were attracted at Clougha Pike, and "troops" on the 27th at Witherslack, and on the 29th two at Halton Moss. So much for an empty satchel! On the other hand, Doubleday insists that a virgin ♀ of *L. quercûs* seldom lives a week, and generally ceases to be attractive to the males after 3 or 4 days. Hamm observes (*E. M. M.*, xxxi., p. 74) that, on July 7th, 1894, he had a ♀, took it out, but failed to attract a single ♂, although the weather was apparently everything that could be desired; yet, on the 15th, the bag in which he had carried the female, 8 days previously, was a great source of attraction to many males, which must have been drawn by an odour that had been transmitted to the bag by the female when she was carried therein. Zeller records (*Isis*, 1847, p. 422) that he had a ♀ *L.* var. *spartii* (=*sicula*), which he killed and set, and that two months afterwards a ♂ *Pachygastria trifolii* was attracted to the trunk in which the ♀ was contained. He refused to consider it a mere coincidence, in spite of his firm belief that *P. trifolii* and *L. quercus* var. *spartii* were quite distinct species. We have already noted (*anteà*, p. 3) the rearing of a hybrid between these species. That the sense by means of which the males detect the females resides in the antennæ appears to be certain.

The imagines of *L. quercûs* are much less frequently taken at light than are those of some of the allied species—Eutrichids, &c.—yet Dewey records it as coming in abundance one night in July to the electric light at Eastbourne (although the sex is not mentioned). Jones captured females at light at Eltham on August 14th, 1866, and July 9th, 1874, and Christy one at Wicken, July 20th, 1890.

Cases of parthenogenetic reproduction in *L. quercûs* are on record. Weir bred a ♀ in 1879, and states that no ♂ could have paired with her, yet a number of eggs were laid which proved fertile and larvæ from these were feeding in September, 1879. Griffiths notes *(in litt.)* that, in 1870, he bred a ♀ (from Ilfracombe larva) and that she laid many ova which produced larvæ that unfortunately died during hybernation; copulation, he asserts, could only have taken place by a wild ♀ through the gauze covering, which Griffiths considers not very likely. [See also Mory, Tardy, &c.. (*antea*, vol. i., p. 29); Napier, *Science Gossip*, 1868, p. 71; Laddiman, *Ent.*, xi., p. 271.]

Gynandromorphism is exceedingly prevalent in this species, and we have given *(postea*, pp. 45—47*)* a large number of recorded examples. Crosspairing is recorded between this species and *P. trifolii* by Standfuss and a single hybrid was bred(*vide, antea*, p. 3), but, considering the excitement of the males at the time of pairing, one would have expected greater results in this direction; thus Johnson records two males in their eagerness uniting (*Ent. Record*, v., pp. 198—9), and Hewett gives (*in litt.*) two similar experiences when assembling with *L.* var. *callunae*, on Rhombald's moor, one case occurring on June 9th, 1895, and a second case on June 17th, 1895; so great was the excitement of the males on this occasion, that, as they came up in numbers "against the wind" to four virgin females taken to the Moor, they were so fearless that they could be freely handled whilst endeavouring to copulate with the females, and crawled excitedly over the box in which the ♀s had been carried as well as on the coat in which the box had been placed. As bearing on this Durrant notes (*in litt.*) that he once took a male *L. quercûs in cop.* with a female *Cosmotriche potatoria*, but was unable at the time to appreciate the value of the eggs obtained. Pierce observes that the male genitalia of *L. quercûs* consist of a pair of backward hooks, that appear to be a modification of the harpes, and a single very strong hook (the uncus), almost at the extreme end of the abdomen and all exserted.

The distribution of the species included in the genus *Lasiocampa* works out as follows: *L. quercûs*—Europe, northern and western Asia; *grandis*—Syria, Palestine; *serrula*—Spain, Algeria, Egypt [not uncommon near Alexandria (Baker)].

LASIOCAMPA QUERCUS, Linné.

SYNONYMY.—Species: *Quercûs*, Linn., "Sys. Nat.," xth ed., p. 498 (1758); xiith ed., p. 814 (1767); "Faun. Suec.," 2nd ed., p. 293 (1761); Poda, "Ins. Mus. Græc.," p. 85 (1761); Scop., "Ent. Carn.," p. 194 (1763); Müll., "Fn. Frid.," p. 39 (1764); "Zool. Dan. Prod.," p. 117 (1776); Hfn., "Berl. Mag.," ii., p. 398 (1766); Fab., "Sys. Ent.," p. 562 (1775); "Spec. Ins.," ii., p. 175 (1781); "Mant. Ins.," ii., p. 112 (1787); "Ent. Syst.," iii., 1, p. 423 (1793); [Schiff.,] "Schmett. Wien.," p. 57 (1775); Esp., "Schmett. Eur.," iii., p. 81, pl. xiii., figs. 2-6, pl. xiv., figs 1-2 (1783); Geoff., "Fourc. Ent. Paris.," p. 260 (1785); Vill., "Linn. Ent.," ii., p. 125 (1789); Bkh., "Sys. Besch.," iii., pp. 84, 464 (1790); Don., "Brit. Ins.," pp. 83, 85, pl. ciii-civ (1794); Hb., "Larv. Lep.," iii., Bomb. ii., Veræ. P. *a*. 2 (? 1800); "Eur. Schmett.," iii., figs. 172, 225 (*circ.* 1800); text p. 144 (? 1805); "Verz.," p. 186 (?1822); Hb.-Gey., "Eur. Schmett.," iii., figs. 349, 350 (*circ.* 1830); Ill., "Syst. Verz. Wien.," n. Ausg. 2, p. 109 (1801); Schrk., "Faun. Boica," ii., Abth. 1, p. 275 (1801); ii., Abth. 2, p. 154 (1802); Haw., "Lep. Brit.," 1, p. 81 (1803); Latr., "Hist. Nat.," xiv., p. 178 (1805); "Gen. Crust. et Ins.," iv., p. 219 (1809); "Consid. Gén.," pp. 362, 441 (1810); Ochs., "Die Schmett.," iii., p. 266 (1810); Germ., "Bomb. Spec.," p. 47 (1812); Leach, "Edin. Ency.," ix., p. 132 (1815); Oken, "Lehrb. Naturg.," p. 708 (1815); God., "Lép. Eur.," iv., p. 95 (1822); Dup., "Icon. des Chen.," pl. iv., fig.

1 (*circ.* 1840); "Cat. Méth.," p. 78 (1844); Curt., "Brit. Ent.," iii., expl. pl. clxxx, (1827); Stephs., "Illus. Haust.," ii., p. 40 (1828); "List Br. An. Br. Mus.," p. 46 (1850); Bdv., "Eur. Lep. Ind. Meth.," p. 48 (1829); "Icon. Chenilles," pl. v., figs. 1-2 (*circ.* 1840); "Gen. et Ind. Meth.," p. 71 (1840); Meig., "Eur. Schmett.," ii., p. 196 (1830); Dahlb, "Jaktt. Skand. Fjär.," p. 29, figs. 11-14 (1837); Wood, "Ind. Ent.," p. 21, fig. 43 (1839); Humph. and Westd., "Brit. Moths," p. 58 (? 1843); Evers., "Faun. Volg.-Ural.," p. 154 (1844); H.-Sch., "Sys. Bearb.," ii., p. 106 (1847); Heyd., "Lep. Eur. Cat. Meth.," 3rd ed., p. 26 (1851); Led., "Verh. z.-b. Wien.," ii., Abh. p. 75 (1853); Sta., "Man.," 1., p. 153 (1857); Gn., "Ann. Soc. Ent. Fr.," (3), vi., p. 442 (1858); (4), viii., p. 405 (1868); "Lép. Eure-et-Loir," p. 82 (1875); Speyer, "Geog. Verb.," i., p. 413 (1858); ii., p. 288 (1862); Hein., "Schmett. Deutsch.," p. 205 (1859); Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 69 (1871); 3rd ed., p. 120 (1901); "Hor. Soc. Ent. Ross.," xiv., p. 358 (1877); Newm., "Ent.," ii., p. 139 (1865); iii., p. 27 (1866); "Brit. Moths," p. 43 (1869); Ramb., "Cat. Lép. And.," p. 357 (1866); Snell., "De Vlind.," p. 185 (1867); Berce, "Faun. Franç.," ii., p. 190 (1868); Nolck., "Lep. Fn. Estl.," i., p. 127 (1868); Wallgrn., "Skand. Het. Fjär.," ii., p. 60 (1869); Cuní y Mart., "Cat. Lep. Barc.," p. 69 (1874); Curò, "Bull. Soc. Ent. Ital.," viii., p. 150 (1876); Frey, "Lep. Schweiz," p. 97 (1880); Kirby, "Eur. Butts. and Moths," p. 139 (1880); "Cat.," p. 827 (1892); "Handbook," &c., iv., p. 121 (1897); Lampa, "Ent. Tids.," vi., p. 41 (1885); Jordan, "Schmett. N.-W. Deutsch.," p. 96 (1886); Hinchliff, "Ent.," xix., p. 272 (1886); Battersby, "Ent.," xx., p. 109 (1887); Buckl., "Larvæ," &c., iii., p. 56, pl. xlvii., figs. *2a-b* (1889); Auriv., "Nord. Fjär.," p. 63 (1889); "Iris," vii., p. 151 (1894); Rühl, "Soc. Ent.," v., p. 178 (1891); Carad., "Iris," viii., p. 91 (1895); Meyr., "Handbook," p. 320 (1895); Thomps., "Ent. Record," viii., pp. 125, 158 *et seq.* (1896); Tutt, "Brit. Moths," p. 54 (1896); "Ent. Record," viii., p. 299 (1896); xiii., p. 114 (1901); "Proc. Sth. Lond. Ent. Soc.," 1898, pp. 1 *et seq.* (1898); Barr., "Lep. Brit.," iii., p. 25, pl. xci (1896); Dyar, "Can. Ent.," xxx., p. 5 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 70 (1898); Reutti, "Lep. Baden," 2nd ed., p. 58 (1898); Agassiz, "Mitt. Schw.," x., p. 248 (1900); Bacot, "Ent. Record," xiii., pp. 114 *et seq.* (1901); Warbg., "Ent. Rec.," xiii., pp. 237 *et seq.* (1901). *Roboris*, Stephs., "Ill. Haust.," vii., p. 41 (1828). *Familiaris*, Newm., "Zool.," vii., p. 27 (1849); "Ent.," iii., p. 27 (1866).

ORIGINAL DESCRIPTION. — *Quercûs. P. Bombyx* elinguis, alis reversis ferrugineis: striga flava, punctoque albo.* Mouff., *Ins.*, 187, f. 2; Goed., *Ins.*, 1, t. 7; List., *Goed.*, f. 88; Rai, *Ins.*, 142, n. 2; Merian, *Eur.*, 1., t. 10; Alb., *Ins.*, t. 18, f. 25; Reaum., *Ins.*, 1., t. 35; Roes., *Ins.*, 1., phal. 2., t. 35; Wilk., *Pap.*, 22, t. 3, *a*, 11, 12; Vddm., *Diss.*, 59. Habitat in *Quercu*, *Betula*, *Pruno spinosa*. Larva lævis, pilosa, grisea, nigro annulata, alboque maculata (Linné, *Syst. Nat.* xth. ed., p. 498).

IMAGO.—50mm.-75mm. in expanse. ♂. Anterior wings, rich chestnut-chocolate- or red-brown, with a white dark-edged discal spot towards costa; a transverse yellow band or fascia between this spot and outer margin, very variable in width; posterior wings similar but without discal spot. ♀. Ochreous or tawny instead of chocolate-brown. Head, thorax and abdomen of the same colour as the wings.

SEXUAL DIMORPHISM.—There is a very great difference in the sexes of this species—in size, shape, colouring, habits, &c. The males are smaller, more strongly built, and much more active than the females. They are of a deep chocolate-, or rich red-brown colour, whilst the females are pale ochreous in tint (and only as rare aberrations assume the male colour). The ♀ abdomen is large and (before the eggs are laid) very heavy; the wing-area

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* In the xiith ed. of the *Sys. Naturae*, and in the *Fauna Suecica*, Linné adds: "Litura flava ad basin alæ superioris." This may be a direct reference to *var. callunae*, although *quercûs* frequently possesses the basal patch.

of this sex is accordingly great, and its slow and steady habit of flight is very different from the rapid, zigzagging flight of the males. The male antenna is described by Chapman as follows: Length, 8mm. in a small specimen, 12mm. in a large one, joints bearing pectinations, 58 in one antenna 11mm. long, 69 in another 8mm. long, and 78 in one 12mm. long. The first joint of the antenna is very large, 0·7mm. wide, 0·4mm. long, or 0·7mm. if the cylindrical process (·35mm. wide) that projects into the cranial socket to form the articulation be included. This joint is rounded, globular if its unequal diameters allow that word to be used. It is clothed with long hair-scales. The next joint (second) is larger and squarer than those that follow, but is rounded on its basal aspect towards first joint, and swells out somewhat (urceolate) towards third joint, it also has strong brushes of hair-scales. The third joint is a little wider than the fourth and carries a mere rudiment of a plumule. On the fourth joint, the plumule is as long as the width of the joint (about ·3mm.). The pectinations reach full length about the 25th joint, and diminish again about twenty to twenty-five joints from the end, at this point the shaft of the antenna has dwindled to about half its thickness at the base. The shaft is circular in section, the dorsal $\frac{3}{4}$ occupied by scaling irregularly disposed, so that no definite rows can be made out. The scales are narrow and bifid, the two points rounded and blunt. The ventral $\frac{1}{4}$ is occupied by the origins of the pectinations; joints somewhat oblique. The pectinations (plumules) are about 1·4mm. long, the hairs on the inner surface are arranged in rows transversely to the axis of the plumule. Each row begins at the middle line of the ventral aspect of the plumule and passes outwards. The rows on each side of the middle line may be opposite to or alternate with each other on different parts of the same plumule, but the alternate arrangement seems the normal one; an actual middle line is almost free of hairs but may have some single scattered hairs. Each row may contain 8 to 10 hairs, one of the largest plumules has on either side about 53 rows. The individual hairs are about ·037mm. in length. Supposing half the plumules are big enough to have only half the number of hairs of the longest, then the total hairs on an antenna would be about $70 \times 2 \times 2 \times 53 \times 10 \div 1\frac{1}{2} =$ very nearly 100,000. The end of the plumule is perceptibly but not markedly swollen or clubbed. The hairs on this portion are rather shorter and thicker than on the shaft, more like small spines, they rather escape from their regular alignment, are not perhaps quite so numerous and invade a little the lateral (or almost outer) area of the plumule. The proximal side of the club is rounded off and the distal a little produced, and, quite at the side of the extremity, but what may be really the true end curved round, carries the strong spine, so that this lies parallel with the shaft of the antenna and points in the same direction. It is rather longer than the thickness of the shaft of a plumule (·055mm.) about ·06-·07mm. Its width at base is about one-fifth of its length, and at three-fifths of its length it has a notch as if for a hair base. Just beyond this is a strong bristle, about half the length of the spine. The other hairs in the neighbourhood belong rather to the regular series of hairs. The ♀ antenna is of approximately the same length, and has the same number of joints as that of the ♂. The form of the basal and other joints is similar, and so is the scaling. The colour is pale, corresponding with that of the insect generally. The great difference between the antennæ of the two sexes is in the comparatively small size of the plumules forming the pectinations in the ♀. In the latter, these gradually increase in size through the first 10 or 12 joints, and diminish, but much less markedly, in the last 10 or 20, but chiefly in thickness, maintaining a fair length up to the tip. It is not uncommon to find them irregular in the later joints, the segments carrying more or less than two plumules of irregular shapes, and being themselves larger or shorter than is due to their position, but with a tendency, or perhaps due to a tendency, for joints to fuse together. In the main part of the shaft of the antenna, the two plumules arise (as in the ♂) from the inner lower aspect of each segment, the origins not quite touching each other, and occupying about half the length of the segment; their direction is at an angle of about 45° to the direction of the antennal shaft, and of about 80° or 90° to each other. In length they are about 1·3 times the length of an antennal segment, or about 0·35mm.; they are fusiform in shape, 0·13mm. in diameter at their origin, 0·19mm. rather before the middle, and then taper to the extremity; they terminate in a spine or strong bristle about 0·08mm. long, which is in line with the plumule, and, in fact, completes its fusiform outline, assisted by two and sometimes three more hair-like bristles, of much the same length as the spine. The general surface of the plumules is covered with very small hairs rather closely set, about 0·01mm. in length, with a few fine hairs rather longer; there is also on the outer aspect of each plumule a hair-like bristle, like the supporting ones at the tip, at about the middle of its length (*in litt.*).

Gynandromorphism.—Few species have more recorded gynandromorphous examples than this, and yet a great number undoubtedly exist in collections that have not been recorded. Thus we met with the first 4 described hereunder in Webb's collection only one of which appears previously to have been recorded. Those we have noted are as follows:

α. Antennæ male, abdomen male, almost entirely male hindwings; forewings female in shape and almost female in coloration and scaling (From Gregson coll.).

β. Right antenna, right side of thorax, right pair of wings, all female; left antenna, left side of thorax and left pair of wings all male; the abdomen apparently male.

γ. Antennæ male, general size and build of male, abdomen male; fore- and hindwings distinctly female, with base of hindwings rather dark coloured (From Bond coll.).

δ. Antennæ intermediate (but nearer male), shape intermediate, wings rounded (as if a large ♀ had the forewings drawn in), the costa of the forewings for about one-third their length male in appearance, rest of forewings of female coloration; the hindwings male with longitudinal streaks of female colour; abdomen intermediate (From the Hopley collection). [This would appear to be the example exhibited by Bond at the meeting of the Ent. Soc. of London, Feb. 3rd, 1868, and described as having the colour of both sexes in longitudinal bands on the wings.]

ε. ♂ right, ♀ left; incompletely gynandromorphous, body and antennæ ♀; right wings male, the forewing in the middle area from the base outwards narrow towards the outer margin, broadly yellow-spotted, the hindwing only towards the outer margin from the middle onwards with an uniformly broad yellow stripe, underside bright yellow. Left side ♀; on the outer margin of hindwing two brown spots, not visible beneath. In Vienna Museum. From Mazzola's collection (*vide* Ochsenheimer, *Die Schmett.*, iv., p. 190).

ζ. Right wings and antenna ♀, left ♂. Bred by Hettlinger [Hettlinger, *Rozier. Journ. Phys.*, pl. xxvi., pp. 268—271 (1785)].

η. ♂ left, ♀ right. Incompletely gynandromorphous. Body and right side ♀, left ♂. Hindwings beneath brown with yellow outer margin. Forewings ochre-yellow (♀). Left antenna scarcely stronger, both with chestnut-brown pectinations. In Vienna Museum, from Mazzola's collection (*vide* Ochsenheimer, *Die Schmett.*, iv., p. 190).

θ. Abdomen, thorax and three wings apparently ♀, the fourth wing, both in colour and size, a mixture of both sexes; antennæ with pectinations shorter than in ♂, yet much longer than in ♀; abdomen without eggs, yet in life as stout as an ordinary ♀, later it voided a thick dark brown fluid, and became shrivelled. Bred 1855 by Dorfmeister (*Stett. Ent. Zeit.*, 1868, p. 183; *Mitt. Ver. Steierm.*, iv., p. 69).

ι. Incompletely gynandromorphous. Abdomen filled with eggs. One antenna ♂, the other ♀. Bred by Dorfmeister, 1856 (*Stett. Ent. Zeit.*, *loc. cit.*; *Mitt. Ver. Steierm.*, iv., p. 69).

κ. Incompletely gynandromorphous. ♂ with ♀ colouring; body and upper side of all the wings fine ochre-yellow, without transverse band, only towards the hind margin the chestnut-brown ground-colour shines slightly through, although absolutely covered by yellow hairs. The fringes entirely of a pure bright yellow. The central spot of the forewings, which is normally dark-margined, is yellowish-white, without bordering. Underside uniform ochre-colour, without band. Antennæ yellow, with chestnut-brown "lamellæ" (pectinations). In the Nickerl collection, Prague (Nickerl, *Verh. zool.-bot. Ges. Wien.*, 1872, p. 732).

λ. A female, the reproductive organs, however, being but imperfectly developed. Bred. Differing from its sisters of the same brood, it failed to attract any males by 'sembling,' although favourably exposed for that purpose" (Griffiths, *Science Gossip*, 1875, p. 270, fig. 167).

Bacot and Prout agree that the figure looks like a slightly crippled typical ♀, with central area of forewings and basal two-thirds of hindwings slightly darkened.

μ. Gynandromorphous, so that left half is ♂, right ♀. Bred 1884, Vienna. In the possession of Joseph Müller, Vienna (Wachtl, *Wien. Ent. Zeit.*, 1884, p. 290, tab. v., fig. 3).

ν. Left wings, left antenna, thorax and abdomen ♀; right antenna and wings ♂. On the right forewing stripes of ♀ colouring, also in hind area of hindwing; abdomen externally entirely ♀, but when anatomically examined the sexual glands were found to be completely arrested; the excretory passages and external copulatory parts also purely ♀. "Kittdrüsen" and "appendix gland" of the receptaculum seminis are wanting. Bred 1883 from larva (Bertkau, *Archiv Naturg.*, 1889, p. 77; *Sitzber. d. Niederrh. Ges.*, 1888, p. 67).

ξ. A genuine mixture of the two sexes, the ♀ form, however, predominating; antennæ neither decidedly ♂ nor ♀; the right wings show a regular mixing of the sexes; the left wings are female, with only a few ♂-coloured areas; the abdomen, in form, size, and colour, ♀, containing eggs; the external organs female, yet the anal aperture very different from that of the ordinary ♀. In the museum at Geneva (*c.f.*, Guénée, *Mém. Soc. Phys. et Hist. Nat. Génève*, xxi., pp. 418—422, fig. 8; *Mém. Boston Soc. Nat. Hist.*, ii., 1871 78, pp. 411- 412).

ο. Incompletely mixed. What is ♂ on the upperside of the wings is ♀ on the underside, and *vice versâ*. In coll. Bornemann. Magdeburg (*c.f.*, Ribbe, *Deutsch. Ent. Zeits.*, 1889, p. 186, pl. iv., fig. 5).

π. Male with very much yellow dusting, so that it resembles a light ♀. In possession of Herr Bernard, Dantzic. Bernard *in litt.* (Schultz, *Illus. Woch. für Ent.*, ii., p. 414).

ρ. A ♀, with the absolutely dark-brown colour of the ♂. Caught at Dantzic. In possession of the above-named (Schultz, *loc. cit.*).

ς. ♂, which has exactly the colour of the ♀. In coll. Gleissner, Berlin [*c.f.*, *Berl. Ent. Zeit.*, 1888, Sitzungsberichte, p. (5)].

τ. Incompletely gynandromorphous. In shape of wings ♂, in colour ♀ on upperside. On underside ♂ and ♀ colouring irregularly mingled. Form of body, as also antennæ, neither ♂ nor ♀, but intermediate; antennal pectinations about one-half shorter than those of the ♂. Bred at Freiburg (Silesia). In coll. Wiskott, Breslau (Wiskott, *Festschr. Ver. Schles. Ins.*, 1897, p. 119).

υ. Incompletely gynandromorphous. Antennæ, form of body and wings neither definitely ♂ nor ♀; rather intermediate between the two. Colour on upperside predominantly ♀; right hind- and left forewing purely ♂, left hind- and right forewing ♀, with intensely dark-brown ♂ rayed markings. The underside of all the wings shows an asymmetrical mingling of ♂ and ♀ colour. Bred at Hanover. In coll. Wiskott (Wiskott, *loc. cit.*, p. 119).

φ. Incomplete. Left (smaller) side of wings is, as also is the right (larger) side, predominantly ♀ coloured. Yet they show, on the outer margin of forewings, running from apex towards base, interrupted about the middle by the yellow ground colour, a stripe of ♂ colouring some 2½mm. broad; there is likewise a further streak of the same brown colour a few millimètres further inwards on the forewings. The left hindwing is quite similarly marked; this also has on the costa two strokes of the dark ♂ colour, and in addition there are two stripes thereof. Body and genitalia ♀, likewise both antennæ with small ♀ pectinations In coll. Daub., Carlsruhe. Described by Gauckler of Carlsruhe (Schultz, *Illus. Woch. Ent.*, ii., p. 414).

χ-ψ. Two gynandromorphous examples with the sexes mixed in Staudinger's collection. Staudinger *in litt.* (Schultz, *Ill. Wochenschr. für Ent.*, ii., p. 414). [One of these is no doubt the one described by Westwood, see *aa* below (Prout)].

ω. A gynandromorphous example of *L.* var. *callunae.* The left side is male, of the usual rich, glossy, dark chocolate tint, with the ordinary orange-yellow stripes, but the antenna on this side is provided with pectinations of only one-half the usual length; the right side is ♀ with ordinary ♀ antenna, and decidedly larger fore- and hindwings but the colour is also rich chocolate, not quite so deep, nor so glossy as on the male side, but of a very rich colour, while the yellow stripe, though present on the forewing, is absent from the hindwing, producing altogether a novel and startling effect. The abdomen is much shrunken and twisted, and divided in sex, a clasper being clearly visible on the male side (Barrett, *E. M. M.*, xxxi., p. 219).

aa. A curious mixture of both sexes. The forewing on the right side alone being unisexual (♀); anterior half of the left forewing also ♀ in colour, but this wing is small in size, as in the ♂, and its hinder half curiously mottled with the colours of the two sexes: left hindwing with costal one-third ♀ in colour, the inner two-thirds ♂, with two large, pale, oval discoidal spots; right hindwing with outer two-thirds the colour of a light ♂, with four pale submarginal spots, its inner one-third ♀, but with a red-brown spot; antennæ shorter and less pectinated than in the ♂, thorax and base of abdomen broad as in the ♀, but the abdomen is small, conical, and shorter than in the ♂. In Staudinger's collection, Dresden (Westw., *Thesaurus Ent. Oxon.*, p. 189, pl. xxxv., fig. 14).

ββ. Gynandromorphous, showing the chocolate wings and feathered antenna of the ♂ on the left side; on the right side the wings are buff, and the antenna is simple as in the ♀, the abdomen thicker, and not tufted as on the other. Bred by Gunner John Wilson, of the Royal Artillery, Woolwich (*Proc. Ent. Soc. Lond.*, 1868, p. xxxviii).

γγ. Incomplete, predominantly ♀. Both forewings ♀, the right hindwing ♂, the left ♀, with broad ♂-coloured stripes. Antennæ short, alike in form and colour, midway between ♂ and ♀, stronger than in the ♀, weaker than in the ♂, the pectinations shorter than is normal in the latter sex. Thorax ♀ in form, abdomen ♂ but with ♀ scaling. In the Pilz collection. *In litt.* (Schultz, *Ill. Zeits. für Entom.*, iii., p. 168).

δδ. Halved, left ♂, right ♀. Left pair of wings ♂, the right ♀. Left antenna ♂, right ♀. The hairs on the thorax also halved, the left side of ♂-coloured brown, the right of the yellow tint of the ♀. Body ♀ but more slender than is usual in this sex. From Myslowitz. In the Phillips' coll., Cologne. *In. litt.* (Schultz, "*Ill. Zeits. für Ent.*," iii., p. 169).

εε. Left ♀, right ♂; incomplete. Left wings ♀, right ♂. Both antennæ ♀. Body ♂ with hairs on right side dark brown, on left side light yellow. Thorax right side ♂-, left side ♀-coloured. From Brunswick. In the same coll. *In litt.* (Schultz, "*Ill. Zeits. für Ent.*," iii., p. 169).

ζζ-ηη. Two examples of var. *callunae*, ♀ in size and general build, exactly of ♂ coloration, having the spots and yellow bands as in ♂, but with the body and antennæ ♀. York dist. One in Hewett's, the other in Capper's, collection (Hewett, *in litt.*).

VARIATION. — The study of the variation of this species is exceedingly interesting and difficult. Besides the large number of colour aberrations, in which individual specimens may vary from the dark chestnut-brown of the most extreme male forms to the yellow of the most extreme female forms, the character of the pale transverse band also varies, from a narrow line to a wide band that may spread to the outer margin of the wing, and offers a basis of variation for a great number of local forms, which are often further specialised by a marked increase or decrease in size. Some of these local races are further remarkable for the fact that they show more or less constant peculiarities in their life-histories and fixed characters in their larvæ, the whole tending to make the working out of the special features of some of these races exceedingly difficult. The vars. *sicula*, *callunae*, *meridionalis* and *viburni* are especially interesting, and Warburg and Bacot have done much good scientific work in crossing these and other extreme forms with each other and with the type. The most remarkable of the colour aberrations is probably that which Cockerell named ab. *olivacea-fasciata*. The difference in size, too, is sometimes very remarkable. Breyer figures (*Ann. Soc. Ent. Belg.*, vii., pl. iii., fig. 2) an aberration with much narrower forewings than is usual, and this he considers to have been caused by insufficient nutrition. As to the effect of food on the size of this species, the following notes by Fuchs are interesting. He states (*Stett. Ent. Zeit.*, xli., p. 120) that he attempted to rear a winter brood on pine, and, for this purpose, obtained a number of larvæ from birch after they had commenced to hybernate in the autumn of 1866, that he brought them into a warm room, and placed them on pine, after which two moulted and went on feeding, one pupating at the end of January, 1867, the other in the middle of February, the imagines appearing on February 25th and March 25th after pupal periods of four and six weeks respectively. Compared with the local (Lower Rheingau) form, these specimens were fairly normal in size (wing of ♂ 28mm., ♀ 35mm.), the pale transverse bands narrowed on all the wings, and sharply cut off from the ground colour. Bieger also experimented (*Ent. Nachr.*, viii., p. 244) in the direction of rearing the larvæ of *L. quercûs* on pine-needles. The larvæ hatched in the middle of August, and the three first stadia had their ordinary course, the moults taking place September 11th and 24th and October 10th, bringing them to the normal hybernating stage. He wanted to force them indoors, but they persisted in forsaking their food and laying up for hybernation, so he let them have their way and placed them in the cold. At the end of February they were brought indoors again, and on March 10th certain individuals had reached the last stadium, and he concluded that these must, therefore, have moulted a fourth time in autumn. The last did not reach the final stage till April 16th; by May 14th all had pupated, and imagines appeared June 22nd to mid-July. The ♀ s scarcely differ from the ordinary form of this sex; the ♂ s all have the light basal spot on the forewings, which, he says, is wanting in specimens from hybernated pupæ.* The basal area of the ♀, both on the forewing and hindwing, has an angular bend, and is considerably redder, especially on the hindwing. The ♀ s resemble those of *callunae* as received from Staudinger, whilst the ♀ s from hybernated pupæ from ordinary food-plants are, on the whole, darker. Our British var. *callunae*, which usually feeds as a larva from the June of one year until the

* This, of course, is not generally the case. Most of the imagines of var. *callunae* have this basal spot, although hybernating as pupæ

August of the next, *i.e.*, some 14 months, and then remains as a pupa from August to June, *i.e.*, some 10 months, is, in nature, usually much larger and more intensely coloured than the typical form that goes through all its changes in a year. Bearing on this, Standfuss says (*Handbuch*, &c., p. 57): "*L. quercûs* of the north German lowlands expands, ♂ 55mm.—57mm., ♀ 67mm.—70mm.; in the mountains of central Germany—Hartz, Bohmer-Wald, Riesengebirge, &c.—it becomes the larger var. *callunae*, Palmer, ♂ 59mm.—62mm., ♀ 73mm.—75mm., whilst the Lapland examples reach, ♂ 63mm.—65mm., ♀ 77mm.—86mm. The lowland examples spend only one year from egg to imago, the mountain form takes two, whilst in the northern latitudes three are taken." (Standfuss parallels this with *Sterrhopterix hirsutella* which takes two, and *S. standfussi* which takes three years, the latter being the larger.) "In the lower mountains of the Riesengebirge, between Bolkenheim and Hirschberg, one finds examples with one- or two-year cycles side by side. Parallel with this, one may mention that, at Fürstenstein, in Silesia, also, the markedly different forms *Selenephera lunigera* (with hybernating larva) and *S. lunigera* var. *lobulina* (with hybernating pupa) occur side by side, although the specific identity of the latter is less certain than that of the former since the larva of *S. lobulina* var. *lunigera* also shows certain differences." British specimens of var. *callunae* are often larger than the extreme measurements given by Standfuss, and Morton notes (*in litt.*) larvæ from Arran that fed up on birch, and produced male specimens averaging 69mm., and females 82mm.; these show the discal white spot with a tendency to become diamond-shaped or triangular, and the males have very distinct yellowish epaulettes. He also states that a ♀ *L.* var. *callunae* in Mrs. Fraser's collection measures 84mm., and further notes that the largest ♂ from Glen Lochay is 63·5mm., and the largest ♀ from Rannoch 78·5mm. Butterfield observes that a brood fed on dry oak-leaves produced some remarkable specimens, small, dark, and many crippled. We have already stated that whilst our typical south British *L. quercûs* goes through its metamorphoses in 12 months, the var. *callunae* takes normally two years, yet occasionally it happens that larvæ of both forms will feed up quickly if the temperature be suitable, pupate, and emerge in winter or early spring. Standfuss considers this to depend upon the eggs being subjected to a high temperature whilst the embryo is undergoing development, and states that he has proved this to be the case with *Lasiocampa quercûs* and *Laria l-nigrum*, these insects going through to the imaginal stage without any hybernation either as larva or pupa. The following notes written mainly by Continental lepidopterists are not without interest. Hormuzaki says (*Verh. z.-b. Ges. Wien*, 1895, p. 252): "The specimens from Czernowitz do not appear to differ at all from the ordinary German form; a single ♂, however, from the alpine region of the Suhard mountains (over 1700m.) belongs probably to a local form, being larger, much darker (coffee-brown colour), with broad bands, &c. This specimen, according to Caradja (*Iris*, viii., pp. 91—92), agrees with two from the Carpathians, and falls midway between var. *alpina*, Fr. and var. *roboris*, Schrk." Caradja notes (*loc. cit.*) that the species is very scarce in the plains and lower slopes of the Carpathians, but is much commoner above the tree limit, *viz.*, at an altitude of 1500m.—1800m., where he saw it in abundance in August on the Tschachléu and Nagy-Schandor. Unfortunately he did not notice at the time that the Carpathian form differed from all those hitherto described, and only brought away the two males to which we have just referred. He says that they have the deep, dark chocolate colour of var. *alpina*, combined with the extraordinarily broad yellow bands of ab. *roboris*. As he found full-grown larvæ in August, at the same time as worn imagines, he has no doubt the Carpathian form takes two years to reach maturity. Steinert says that at Dresden some specimens go over the winter as pupæ, and that these often produce very light brown specimens thinly scaled and poorly marked. The south European forms are exceedingly interesting, and have become much more so because of the great amount of excellent work that Warburg and Bacot have done with them. The most marked of these races is var. *sicula*, russet-brown in tint, a narrow yellow transverse band across the forewings, and an entirely orange-yellow hind-marginal area to the hindwings. The south of France varieties, *meridionalis* and *viburni*, are much alike, with narrow yellow transverse bands to both fore- and hindwings, but whilst the former is produced from larvæ with white urticating fur, the larvæ of the latter have the fur red-brown. The central European forms are less interesting; there is the form with narrow transverse yellow bands to fore- and hindwings—ab. *spartii*, Hb., if of dark chestnut-brown colour, and typical *quercûs* if ferruginous. The former (ab. *spartii*) is superficially very like var. *viburni*, Gn., with which it is united by Staudinger, but is obtained from normal larvæ, and occurs as an aberration, never forming a local race in central Europe. There is also the wider-banded form in which the yellow spreads somewhat towards the outer margin, and may be considered as the most usual form in Britain. This culminates in the ab. *marginata*. There are other forms allied to these, which will be dealt with in detail, and the mountain and moorland forms will also be fully described. Guénée differentiated *L.* var. *viburni* and Parisian *L. quercûs*, and noted what he considered some more or less constant characters (*Ann. Soc. Ent. France*, 1868, p. 410). Warburg notes (*in litt.*) that possibly the only character mentioned by Guénée that holds absolutely is that the fringes of the hindwings of var. *viburni* are concolorous, whilst those of *L. quercûs* are reddish, with only the extremities straw-coloured. Between var. *viburni* and var. *meridionalis*, Warburg notes the following usual but not constant differences: "In ♂ var. *meridionalis* (from Cannes) the anal angle is fuller, covering the abdomen more completely (when set in the same way); the central spot is generally larger; the transverse band on the forewing joining that on the hindwing (when set with the inner margins in line) and not converging much towards the costa as it usually does in var. *viburni*, in which the band on forewing generally falls outside that on the hindwing (the band is the most constant criterion). In the ♀ var. *viburni* the bands are more differentiated from the ground colour, giving a brighter, more contracted look." There is a distinct tendency for odd aberrations of var. *meridionalis* and var. *viburni* to assume slightly the russet tint characteristic of var. *sicula*, and also for a weakening of the brown outer marginal band of the hindwings, but the most extreme aberration in this direction is far removed from var. *sicula*, which does not appear to occur in southern France even as a chance form. Another extreme male aberration occurring with the type, var. *viburni*, &c., is the ab. *marginata*, n. ab., in which the outer marginal areas of the fore- and hindwings are yellow, the pale transverse band having spread on both wings to the outer margin. This is figured by Hübner (*Eur. Schmett.*, fig. 270) and the form is erroneously referred to ab. *roboris*, Schrk., by Humphreys and Westwood (*Brit. Moths*, pl. xi., figs. 9, 13); it appears to occur as a rare aberration everywhere with the type in central (and southern) Europe. Another male form (=ab. *guillemotii*), exactly parallel with var. *sicula* in its markings (narrow transverse band to forewings, and yellow outer marginal area to hindwings), is occasionally found, but the normal dark ground colour distinguishes it at once from the russet-tinted var. *sicula*. The typical males of *L. quercûs* from the lowlands of central Europe have, on the whole, a wider transverse band to the forewings than that of any other race, except, perhaps, var. *alpina* (and those aberrations in which it is continued to the outer margin). The southern forms are all narrow-banded on the forewings, var. *sicula* especially so, and although var. *meridionalis* has perhaps a narrower band than var. *viburni*, both have it characteristically narrow, and var. *callunae* is, on the whole, a narrow-banded form. There is also a greater tendency towards the development of the yellow basal patch, so characteristic of most examples of var. *callunae*, in British *L. quercûs*, than in the continental races, the epaulette-marking being far from common in examples from central Europe. Typical Parisian *L. quercûs* are very similar to English ones. There also appears to be a fairly wide range in the colour variation of British females of *L. quercûs*, extending from pale yellow-ochreous to reddish-ochreous, and with a general tendency to uniformity in the colour of the fore- and hindwings; there is frequently a distinct difference of tint between the fore- and hindwings of *L.* var. *callunae* (which are generally much darker, and more suffused than in *L. quercûs*); this comparative difference in the fore- and hindwings is also noticeable in the ♀s of var. *viburni* and var. *meridionalis*, whilst in tone the former is somewhat redder than the latter. In var. *sicula* the ♀s have a more uniform coloration between the fore- and hindwings, and are much redder and more suffused than either of the other southern forms. A Swiss ♂ from Vogt, in Warburg's collection, has the outer marginal area of all four wings yellow, as in Hübner's fig. 270. Two other Swiss males from Flims have broad whitish-ochreous transverse bands on all the wings (? var. *alpina*). Other Swiss examples from Geneva are not unlike the narrow-banded ab. *spartii*, whilst German males from various localities are indistinguishable from British. As for the direction of the inner edge of the transverse band of the forewings there is great variation. Commencing always at about the same point on the costa, it may be perfectly straight to the inner margin, oblique towards the anal angle, slightly angulated outwardly near costa, curved regularly from costa to inner margin, &c. A somewhat similar range of variation is observed in the ♀s, and the outer marginal areas in this sex are more frequently of a paler tint than the rest of the wings and concolorous with the band, whilst others have distinct narrow pale transverse bands only. There is often a tendency for the males to have the nervures pale in the outer marginal areas, and in the ♀s this is often extended to the nervures of the inner half of the wing. There is considerable difference in both sexes in the size of the central white spot of the forewings, and in the ♀s this is frequently surrounded by a very dark rim, which makes it exceedingly conspicuous. The variation in the width of the transverse band has led to considerable difficulty with the named forms; this has been especially so with regard to the form named *roboris* by an anonymous writer (Dr. F. J. A. D.) in the *Rhein. Magazin*, in 1793, and discussed later. Esper described (*Schmett. Eur.*, iii., p. 81) two forms occurring in central Europe: (1) With the transverse bands narrow and restricted (? = ab. *spartii*, Hb.). (2) With the outer edge of the transverse bands extending towards the margin of the wing and encroaching on the ground colour. This latter form Dr. F. J. A. D. (*Rhein. Mag.*, i., p. 362) named *roboris*, and in this was followed by Schrank. Much still remains to be learned with regard to the Sicilian, southern Italian, and Spanish forms of the species, most of the literature relating thereto being very unsatisfactory, and it is difficult to determine from the published facts at disposal exactly what forms are obtained in Sicily. Minà-Palumbo and Failla-Tedaldi write (*Nat. Sic.*, vii., p. 231 (331 by error)): "*Bombyx quercûs* occurs from June to September; the type form has been met with by Ghiliani, Mann, and Zeller. The var. *spartii* is more frequent, and occurs from September to November. It is darker, with a straight yellow fascia on all the wings, and has been recorded by Bellier, Mann, and Zeller, Bellier making it a distinct species on account of the alleged different colour of the antennæ, which, however we are not able to distinguish, nor does the character appear to be sufficiently important for the erection of a species. The var. *sicula* is the dominant form. The var. *roboris*, Schr., also occurs, this form being larger, with the yellow fascia of the anterior wings broader." We suspect by *spartii* these authors really mean var. *viburni* or var. *meridionalis*, whilst their description of *roboris* applies well enough to this form so far as the transverse band is concerned. We do not know, however, whether the russet colour of var. *sicula* is found in the other forms were mentioned, or whether these agree in ground colour with the dark chestnut-brown of true var. *meridionalis*, ab. *roboris*, &c. The British examples tend much to local races. The males from Potton are not unlike the ab. *spartii*, figured by Hübner, from Germany, but have a slightly wider band and a faint yellow shade that spreads as it were from the middle portion of the transverse bands on fore- and hindwings, suffusing and narrowing the outer marginal areas, and destroying the striking contrast so observable in var. *meridionalis*, in this respect rather approaching var. *viburni*. The females are distinctly different inasmuch as the fore- and hindwings are of the same reddish-ochreous tint that characterises only the hindwings of the French races, and the band on the hindwings inclines to obsolescence and tends to blend with the ground colour of the marginal area. The white median spot of the forewings is distinctly larger, whiter, and not ringed so darkly. This tendency to the spread of the yellow of the bands on both fore- and hindwings, in the males from Cambridge and other British localities, is strikingly characteristic, narrowing much the chestnut outer marginal area of the forewings and often reducing it on the hindwings to a rather narrow marginal chestnut band (=ab. *roboris*). In the female the tendency is for the outer marginal area to assume the colour of the band entirely in both fore- and hindwings (a characteristic seen most strongly in the ♂ in ab. *marginata*, and also in var. *sicula* but only in the hindwings). Bacot says: "I speak with some hesitation as to the imagines, as my series are not very long. The differences are most apparent in the males. *L.* var. *sicula* differs more markedly from any of the other forms that I know than they do among themselves, and, so far as my experience goes, is very constant. The ground colour of the males is russet-brown, the band on the hindwings is orange-yellow, and extends to the margin, while that on the forewings is narrow, the former feature being characteristic of the females as well. *L.* var. *viburni* and *L.* var. *meridionalis* I am unable to distinguish. The males have a ground colour of a soft but rich deep red-brown, and the yellow band on the forewings is much straighter than is usual with the British races. Some variation exists in regard to the width of the band, but I have never seen a trace of the epaulette markings that are tolerably frequent in *L.* var. *callunae* and not infrequent in English *L. quercûs*, nor have I ever seen a forewing band of the Cannes races so waved as they usually are in the English specimens, nor a hindwing band extended to the margin of the wing as in *L.* var. *sicula*. Males of *L.* var. *callunae* are often, if not usually, of a deeper ground colour than English *L. quercûs* or *L.* var. *meridionalis*. The forewing band is waved and the hindwing band is sharp, not fading into the ground colour towards the margin as is frequently, but not invariably, the case with *L.* var. *viburni* and *L.* var. *meridionalis*. English *L. quercûs* are the most variable in the imaginal as in the larval state. It seems useless to lay down even the loosest rule. My own short series of nine males shows a wide variation. One taken during July at Lyme Regis would easily pass unnoticed in a series of *L.* var. *callunae*. Several have the epaulette marking, while others have no trace, most of the specimens have the forewing band waved, but two have it much straighter than the others, and with one of these it is quite as straight as in the Cannes varieties. Two, in the width of the hindwing band and its tendency to suffuse the ground colour as far as the margins, approach *L.* var. *sicula* as does another specimen in regard to the ground colour, which is of a russet-brown. I am rather inclined to consider that our English race is the nearest to the ancestral stock, and that the variation is largely due to climatic causes, although it is possible that some of the variation towards the southern races may be caused by inroads of fresh blood on our southern and eastern coasts." Among the more or less unclassified notes that we have collected relating to aberrations of this species are the following: A male emerged at Chester with the right lower wing absent (Arkle); Selys, Foucart, and Bristowe record females nearly of the colour of the male, and Sumner bred one nearly as dark as a ♂ in July, 1894, whilst similar ones (referable to var. *callunae*) are in the "Doubleday" collection; Turner notes a female from Carlisle with the base suffused with male coloration, and the submarginal area subdiaphanous; males from

Angmering are rather dark, with the light area well defined (Dollman); males from Bognor vary considerably in the width of the yellowish band (Trimen); a male with nearly colourless hindwings from Eastbourne (Prout); an aberration with angulated hindwings (Agassiz); Johnson reared a ♀ from Stockport, the base of each wing thickly covered with dark scales, but these rapidly decrease in quantity towards the centre, leaving a very broad band, almost entirely devoid of scales round the outer margins of the wings; the fringes, however, are perfect and distinct; the larva was collected in 1895, the imago emerged June, 1896. Adkin describes a similar female, in which the outer half of each wing is devoid of scales, but with fringes perfectly developed; Kershaw notes, in 1869, a ♀ from Ashton-under-Lyne with transparent wings and brown fringes, also a bred male almost black in tint and only barred on the upper wings. Frings records a very small female obtained in 1888 from the Alps, which had small forewings and almost unscaled hindwings. Newman has a male with the forewings entirely of a dull smoky colour, the transverse band also dull brown, and the hindwings of a very distinct pale brown (bred from a Darenth larva); Edelsten notes a ♂ aberration at Enfield with the hindwings yellow from band to fringe, and Dale says that females bred from Polegate larvæ vary so that scarcely two are of the same tint, and, in 1878, one was bred nearly as dark as a male; whilst Leivers observes that the males from Notts are normal in tint, but the females vary considerably in the depth of the ground colour. Arbuthnott notes a ♀ of var. *callunae*, taken July 16th, 1897, at the head of Glen Rosa, Isle of Arran, with the coloration of the male; and Hewett records another ♀ *callunae* exactly of male coloration, having the spots and yellow bands as in ♂, but with body and antennæ of ♀, to which sex it assimilates in size, a similar specimen being in the "Capper" collection. He writes that "the ♀s in the York district appear to be decidedly more variable than the ♂s; three males with yellowish-white bands (?=ab. *alpina*) also taken, but not in good condition; one female uniform straw-colour, another without yellow band to hindwings, and a male also without yellow band to hindwings; all the examples captured on Rhombald's Moor." With regard to dubious *callunae* forms, Nicholson writes that those from the heaths at Ringwood are intermediate; Burrows notes the Penzance males as inclining to the var. *callunae* form, and Studd that the Oxton specimens have all the characters of var. *callunae*, but never go over to a second year, and are never found on bramble but always on whitethorn. Porritt separates the type as a coast form in Yorkshire and Lancashire, and var. *callunae* as a moorland form. Briggs observes that the Lynmouth examples are in appearance a fine, well-marked form of var. *callunae*, but that they have the *L. quercûs* habit; he bred a ♀, July 21st, 1899, to which, on the 23rd, a ♂ was attracted; he also captured ♀s on August 2nd, 1898, and July 28th, 1899; Bacot notes with regard to this that on the moors above and about 6 miles from Lynmouth he has taken larvæ in August that pupated and passed the winter as pupæ and emerged in early June of the following year, *i.e.*, with definite *callunae* habit. Heinemann notes (*Ent.*, ii., p. 236) a pair of *quercûs* that are intermediate between typical *L. quercûs* and var. *callunae*, the transverse yellow band in these turns a little down at the anal angle, but not so evidently as in var. *callunae*, the colour of the female darker than in typical *L. quercûs*, but paler than in var. *callunae*. Gregson describes certain aberrations as follows: "A male, expanding 1″ 6‴, light buff-brown in colour, with distinct shoulder marks; two large bright light red males; a small dark male, expanding $1\frac{3}{4}$ in., without any shoulder mark; one male with dark female colouring; another male wanting the usual curved markings through the wings; a male and a female with only a faint indication of marking upon the hindwings, and one large female entirely without any markings on the hindwings, whilst another female is of a dark olive-green-brown colour without any markings except a faint indication of the pale central spot, and yet another with male colouring of a deep, rich, brown tint, with waved striga well defined and shoulder marks fairly defined." These latter, he adds, all belong to the generally recognised *roboris* of Stephens.* The males, he observes, "sometimes have the transverse line across the forewing straight, not curved, whilst in one female it is curved circularly, and in one male so turned that the costal point is outwards, whilst in all the southern specimens possessed, the dark portion of the wings is cut somewhat, but slightly, angularly, so as to point inwards." Stephens' *roboris*, referred to by Gregson, appears to be typical *L. quercûs*, whilst his *L. quercûs* has a yellow epaulette at base of forewings, and is referable to var. *callunae*. The specimens from St. Anne's-on-Sea (Lancs. coast) have the habit of *quercûs*, whilst on the upperside the ♂ imagines follow var. *callunae*, and on the underside *quercûs*. The basal patch, or epaulette marking, already referred to, which is a very generalised Lachneid mark, appears in almost all examples of var. *callunae*, from whatever district they come, and to be generally absent in most specimens of *L. quercûs*, yet Prout has undoubted *L. quercûs* from Southend with it, and Hering notes that, in Pomerania, the males—from larvæ full-fed and pupating in June, the imagines emerging the next month, and, therefore, with the *quercûs* habit—always have a yellow patch at the base of the forewings, a character almost equally marked in the St. Anne's-on-Sea *L. quercûs*, to which we have already referred. Warburg and Bacot's examples of var. *meridionalis* and var. *viburni* from southern France have no trace of the marking.

The following is an attempt to tabulate the most frequent aberrational forms of the males of this species:

GROUND COLOUR REDDISH OR FERRUGINOUS.

1. With narrow, almost straight, oblique, yellow (or ochreous) transverse band to forewings, and narrow band to hindwings=*quercûs*, Linn.
2. With narrow, curved, yellow (or ochreous), transverse band to fore- and hindwings=ab. *curvata*, n. ab.
3. With broad transverse band to fore- and hindwings=ab. *latovirgata*, n. ab.
4. With normal transverse band to forewings, the transverse band of hindwings extending to outer margin=ab. *semimarginata*, n. ab.
5. With transverse band to fore- and hindwings extending to outer margin=ab. *marginata*, n. ab.
6. With yellow blotch at base of forewings=ab. *basipuncta*, n. ab.

GROUND COLOUR CHESTNUT-BROWN.

1. With narrow, almost straight, oblique, yellow (or ochreous), transverse band to forewings, and narrow band to hindwings=ab. *spartii*, Hb.

* We have examined these, and find that they belong to var. *callunae*, Gregson evidently erroneously using *roboris*, Stephens, as a synonym of var. *callunae*. Stephens' *roboris* is typical *quercûs*, whilst the *quercûs* of the same author is *callunae*.

2. With narrow, curved yellow (or ochreous), transverse band to fore- and hindwings=ab. *spartii-curvata*, n. ab.

3. With broad transverse band to fore- and hindwings=ab. *roboris*, F. J. A. D.

4. With normal transverse band to forewings, the transverse band of hindwings reaching to outer margin=ab. *guillemotii*, Trim.

5. With transverse band to fore- and hindwings extending to outer margin=ab. *spartii-marginata*, n. ab.

6. With yellow blotch at base of forewings=ab. *spartii-basipuncta*, n. ab.

GROUND COLOUR DEEP PURPLISH- OR CHOCOLATE-BROWN.

1. With narrow, almost straight, oblique, yellow (or ochreous), transverse band to forewings, and narrow band to hindwings=ab. *purpurascens*, n. ab.

2. With narrow, curved, yellow (or ochreous), transverse band to fore- and hindwings=ab. *purpurascens-curvata*, n. ab.

3. With broad transverse band to fore- and hindwings=*purpurascens-latovirgata*, n. ab.

4. With normal transverse band to forewings; the transverse band of hindwings reaching to outer margin=ab. *purpurascens-semimarginata*, n. ab.

5. With transverse band to fore- and hindwings extending to outer margin=ab. *purpurascens-marginata*, n. ab.

6. With yellow blotch at base of forewings=ab. *purpurascens-basipuncta*, n. ab.

GROUND COLOUR RUSSET-BROWN.

1. With narrow, almost straight, oblique, yellow (or orange) transverse band to forewings, and narrow band to hindwings=ab. *brunnea*, n. ab.

2. With narrow, almost straight, oblique, yellow (or orange) transverse band to forewings, and broad band to hindwings=ab. *sicula-latovirgata*, n. ab.

3. With narrow, almost straight, oblique, yellow (or orange) transverse band to forewings, the transverse band of hindwings reaching to outer margin=var. *sicula*.

4. With transverse band to fore- and hindwings extending to outer margin=ab. *sicula-marginata*, n. ab.

The principal aberrational forms of the female found in Britain may be grouped as follows:

GROUND COLOUR YELLOW OR PALE YELLOW-OCHREOUS.

1. Unicolorous yellow or yellow-ochreous, with no transverse markings=ab. *obsoleta*, n. ab.

2. Yellow or yellow-ochreous with a pale transverse band crossing fore- and hindwings=ab. *virgata*, n. ab.

3. Yellow or yellow-ochreous with the outer area of hindwings paler to margin=ab. *semimarginata*, n. ab.

4. Yellow or yellow-ochreous with the outer area of fore- and hindwings paler to margin=ab. *marginata*, n. ab.

GROUND COLOUR DULL OCHREOUS.

1. Unicolorous dull ochreous, with no transverse markings=ab. *ochracea-obsoleta*, n. ab.

2. Dull ochreous with a pale transverse band crossing fore- and hindwings=ab. *ochracea-virgata*, n. ab.

3. Dull ochreous with the outer area of hindwings paler to margin=ab. *ochracea-semimarginata*, n. ab.

4. Dull ochreous with the outer area of fore- and hindwings paler to margin=ab. *ochracea-marginata*, n. ab.

GROUND COLOUR FAINT REDDISH-OCHREOUS.

1. Unicolorous ochreous, faintly reddish, with no transverse markings=ab. *rufescens-obsoleta*, n. ab.

2. Ochreous, faintly reddish, with a pale transverse band crossing fore- and hindwings=ab. *rufescens-virgata*, n. ab.

3. Ochreous, faintly reddish, with the outer area of hindwings paler to margin=ab. *rufescens-semimarginata*, n. ab.

4. Ochreous, faintly reddish, with the outer area of both fore- and hindwings paler to margin=ab. *rufescens-marginata*, n. ab.

GROUND COLOUR BROWN.

1. Unicolorous brownish (approaching somewhat male coloration) with no transverse markings=ab. *brunnea-obsoleta*, n. ab.

2. Brownish, with a pale transverse band crossing the fore- and hindwings=ab. *brunnea-virgata*, n. ab.

3. Brownish with the outer area of hindwings paler to margin=ab. *brunnea-semimarginata*, n. ab.

4. Brownish, with the outer area of both fore- and hindwings paler to margin=ab. *brunnea-marginata*, n. ab.

The following are the chief described forms of this species with, as far as possible, the original description of each form. Some of these are highly specialised local races, and the details of their life-histories have considerable bearing on the nature of species and so have been described, as far as possible, in full.

a. ab. *tenuata*, Fuchs, "Stett. Ent. Zeit.," xli., pp. 120—123 (1880); Kirby, "Cat.," p. 828 (1892); Auriv., "Iris," vii., p. 150 (1894); Staud., "Cat.," ed. 3, p. 121 (1901).—The yellow transverse band is narrower in both sexes, especially on the hindwings, in which, towards the anal angle of the ♂, it appears almost as if broken. The transverse band does not fade into the dark brown ground colour of the margin but is sharply divided therefrom; the marginal colour being as dark as that of the basal area. In these general characters both sexes agree. The forewings of ♂ 28mm. from base to tip (*i.e.*, of about normal size), the colour somewhat darker than usual, of a deep chestnut-brown, whilst near the base on the costal margin is a small, but conspicuous, yellow spot (a character shown by no local ♂s). The yellow transverse band is broader on the forewings than on the hindwings and is sharply defined exteriorly. Although a male taken locally has a similar appearance, and has a transverse band on the forewings still narrower than that of var. *tenuata*, yet it differs from the latter in having the brown marginal area outside the centre of the transverse band lighter than in this form,* and not of the uniform dark chestnut-brown characteristic of the ab. *tenuata*. The differences in the hindwings are still more important, for the yellow band is farther from the margin, is less bent, very narrow, and at the hinder angle so constricted that it appears broken, whilst the broad marginal band which is distinctly separated from the yellow band is just as dark brown as the basal area. In this respect, ab. *tenuata* is exactly the opposite of var. *sicula*. . . . The underside of var. *tenuata* differs from that of typical *L. quercûs* in that the latter has the yellow band increased in width, only the apex remaining brown, whilst on the hindwings the yellow stretches to the fringes: in ab. *tenuata*, the margin of the hindwings is a broadly brown band but the brown is somewhat lighter than that of the upperside, and the broad transverse yellow band is, therefore, not so sharply separated. The ♀ var. *tenuata*, whose forewings measure 35mm., is dark, with distinct narrow yellow bands on all the wings, sharply divided from the brown ground colour; the forewings have yellow nervures especially in the basal area; the hindwings are uniform dark yellow-brown to the fringes (which are yellow), the ground colour only interrupted by the sharply-defined, yellow, transverse band (Fuchs).

This aberration was the result of an experiment in which Fuchs gave the larvæ pine for food, and, under artificial conditions, induced them to feed up in the winter, the examples here described emerging in early spring (*anteà*, p. 48). Comparing the ab. *tenuata* with the other varieties of *L. quercûs*, Fuchs states that the ab. *tenuata* is nearest to the ♀ ab. *catalaunica*, which is, however, not so dark as the ♂; from the ab. *catalaunica* ♀, the ab. *tenuata* ♀ differs in having a distinct transverse band on the hindwings which is hardly visible in ab. *catalaunica*. In the latter, there is, associated with the dark yellowish-brown basal area, a somewhat paler marginal band, the colour of which is only a little lighter where it crosses the transverse band. Staudinger refers, with a query, var. *dalmatina*, Gerh. (*Berl. Ent. Zeit.*, 1882, p. 128), to this form, diagnosing it himself as: "Alis omnibus anguste flavo-fasciatis."

* The descriptions are very suggestive that the typical male of the district =the wider banded ab. *roboris*, F. J. A. D., and that the narrow-banded ab. *tenuata*, is somewhat near ab. *spartii*, Hb.

β. ab. *catalaunica*, Staud., "Cat.," ed. 2, p. 69 (1871); ed. 3, p. 121 (1901); Hofm., "Gross-Schmett. Eur.," p. 61 (1887); Kirby, "Cat.," p. 827 (1892); Auriv., "Iris," vii., p. 150 (1894);—Obscurissima, ♀ maris colore, al. ant. fascia angustissima flava, al. post unicoloribus (fascia subnulla). Catalonia (Staudinger). DISTRIBUTION.—Italy: Roman Campagna—Monterotondo (Calberla). Spain: Catalonia—Barcelona (Cuní y Martorell), Pyrenean districts (Martorell y Peña).

Staudinger modified somewhat the diagnosis in the 3rd edition of his *Catalog*, p. 121, where he writes: "♂, obscurissimus, al. ant. fascia angustissima flava, al. post. unicoloribus [fascia subnulla]; ♀, maris colore; cum trans." Chapman notes that the examples in Constant's collection are not very different from the type, the yellow band of the forewings narrow, and that of the hindwings obscured a little.

γ. var. *dalmatinus*, Gerhard, "Berl. Ent. Zeits.," xxvi., p. 128 (1882); Kirby, "Cat.," p. 828 (1892). *Dalmatina*, Auriv., "Iris," vii., p. 150 (1894). *Tenuata*, pars, Staud., "Cat.," 3rd ed., p. 121 (1901).—The yellow band on the forewings is only narrow, not gradually shading off towards the hind margin, and is continued as a still narrower one on the hindwings. The fringes of the hindwings brown, only the external margin shows a quite narrow yellow edging (Gerhard).

Staudinger (with doubt) refers this to ab. *tenuata*, Fuchs. It is as likely from the description to be referable to ab. *spartii*, Hb., unless, indeed, the brown fringes of the hindwing with a narrow yellow margin on the outermost edge is a specialised character of the Dalmatian race.

δ. ab. *spartii*, Hb., "Eur. Schmett.," iii., figs. 173 ♂, 224 ♀ (*circ.* 1800); text p. 143 (? 1805); "Verz.," p. 106 (1822); Gn., "Ann. Soc. Ent. Fr.," (3), vi., p. 44 (in part) (1858); *loc. cit.* (4), viii., p. 403 (in part) (1868); [? Bell., "Ann. Soc. Ent. Fr.," (3), viii., p. 688 (1860);] Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 69 (1871); 3rd ed., p. 121 (1901); [? Curò, "Bull. Soc. Ent. Ital.," viii., p. 151 (1876); Sordelli, "La Farfalle," p. 121 (1885); ? Lampa, "Ent. Tids.," vi., p. 41 (1885); ? Minà-Pal., "Nat. Sic.," vii., p. 331 (1888);] Hofm., "Gross-Schmett.," p. 53 (1887); Kirby, "Cat.," p. 827 (1892); Auriv., "Iris," vii., p. 150 (1894); Tutt, "Ent. Rec.," viii., p. 302 (in part) (1896); xiii., p. 113 (1901); Reutti, "Lep. Bad.," 2nd ed., p. 58 (1898) [*nec* Freyer, Treitschke, Boisduval, Duponchel, Herrich-Schäffer, etc].—Dark rust-brown, the antennæ at the tip yellowish-white, with light rust-brown pectinations; the forewings with a white spot in the middle, and a narrow, almost straight, pale ochreous-yellow stripe beyond; the hindwings near the margin, with a light ochreous-yellow stripe, and fringes of the same colour. Locality: Germany (Hübner). The ♂, fig. 173, is of a deep chestnut-brown, with narrow transverse bands to fore- and hindwings, that on forewings oblique from costa to inner margin, and almost straight, the white central spot well defined. The ♀, fig. 224, is ochreous with a brownish tint, the area within the transverse line, *i.e.*, to base, darker than the outer marginal areas on all the wings; a distinct pink or reddish tinge in the darker parts; the inner edging of the pale band on forewings is distinctly reddish, the white spot very distinctly outlined in dark.

Hübner's *spartii* is a simple aberration of *L. quercûs*, occurring in Germany (and elsewhere) with the type, and showing the transverse band on the forewings narrow and nearly straight and with no tendency to gradually extend its area outwardly towards the hind margin. It is difficult to know how Guénée fell into the error of supposing it was the Sicilian form, unless he was misled by the earlier authors, but after giving (*Ann. Soc. Ent. France*, 1858, p. 441) a good description of Hübner's figures 173 and 224, noting the ♂ as being of "a deep violet-brown tint, with a very narrow, almost straight, and clearly defined transverse band to the fore- and hindwings, that on the latter approaching the outer margin rather more than in typical *L. quercûs*," he goes on to include the Sicilian form (afterwards named *sicula* by Staudinger) under this title, and his further details (*loc. cit.*, p. 442) suggest strongly that he had no clearly definite notion of the differences existing between the southern races, all of which he erroneously united under the name *spartii* which Hübner had, as we have said, given to a German aberration. This he recognised, to some extent, in 1868, when he again dealt with the *quercûs* group (*Ann. Soc. Ent. France*, 1868, pp. 403 *et seq.*), this time with considerable success, although he still states that the typical *spartii* of Dahl and Hübner is only found in Sicily, a remarkable statement when one suspects that Guénée must have seen Hübner's work, and that Hübner, in his description of *spartii* (*Eur. Schmett.*, text p. 144) writes: Heim.: Deutschland; einzeln noch, in mehreren Gegenden." On the other hand, there is the suspicion that Guénée believed that Hübner's *spartii* did represent a southern form, for he described his Provençal *viburni* as a form of *spartii*, a result possibly that led Staudinger erroneously to sink the southern var. *viburni* as synonymous with the German aberration *spartii*. It must be confessed that the imagines are not unlike, but whereas *spartii* comes from quite typical *quercûs* larvæ, the larva of *viburni* is quite specialised and distinctive. We know, now, that Hübner's *spartii* (from Germany) and Guéneé's *viburni* (from southern France) are quite distinct forms, and that the former is simply a narrow-banded aberration of the type, that might occur anywhere in central or western Europe, indeed Spuler says (*Lep. Bad.*, 2nd ed., p. 58) that in Baden it occurs "sparingly everywhere in hot summers, in the female sex only approximations, in the male the typical aberration." Lampa refers (*Ent. Tids.*, 1885, p. 41) certain northern examples to ab. *spartii*, Hb., diagnosing them as: "Darker, the yellow transverse band narrow," and recording them from "Sweden, East Gothland, Norrbotten, Lapland." One suspects that these examples are likely to have the *callunae* habit rather than that of *spartii*, which is so nearly allied to the type, although they might just possibly have had to be referred to the Linnean type, which is also a narrow-banded form, and very probably Scandinavian, but the type is described as ferruginous in colour.

ε. var. *meridionalis*, Tutt, "Ent. Rec.," xiii., p. 113 (1901); Bacot, *loc. cit.*, pp. 114 *et seq.* (1901); Warburg, *loc. cit.*, pp. 237 *et seq.* (1901). *Quercûs*, Gn., "Ann. Soc. Ent. Fr." (3), vi., p. 44 (1858); *loc. cit.* (4), viii., p. 403 *et seq.* (1868); Mill., "Cat. Lép. Alp.-Mar.," p. 141 (1875); Warburg, "Ent. Rec.," viii., p. 316 (1896).—♂. Deep chocolate-brown, with a comparatively narrow and very definite yellow transverse band to both fore- and hindwings, that on forewing dropping from costa in a short curve (convex to base of wing on its inner margin) before turning slightly outwards, and then running to the inner margin, where there is another very slight curve towards base; on the hindwings the band forms a regular curve almost parallel to hind margin from the costa direct to the anal angle; the outer margins of both fore- and hindwings almost as dark chocolate-brown as basal areas; the white median spot of forewings very bright, moderately large; fringes of the forewings concolorous with the outer area, fringes of the hindwings varying from concolorous with outer margin to bright yellow; tendency for nervures on outer marginal area of hindwings to be yellowish; antennal shaft paler than pectinations. ♀. Forewings yellow-ochreous, transverse band narrow, definite, same direction as in male, and slightly dark-tinted on inner margin, median white spot surrounded with a dark ring. Nervures rather paler in outer marginal area than the ground colour. Hindwings of a redder ochreous tint; a definite transverse band, the outer area rather paler, the nervures therein still rather paler than the ground colour. LARVA: Head orange-red in colour; dorsal urticating fur pure white (Tutt).

This race was named in order to do away with the circumlocution continuously involved in calling it the south of France form of *L. quercûs*. The nearness of the imagines of this form to those of *L.* var. *viburni* would make it impossible to discriminate the two forms, which also occur in the same district, but the larval distinctions are most marked and the peculiarities are maintained when the forms are inbred in confinement. *L.* var. *meridionalis* is Guénée's Provençal *quercûs*, and his remarks thereon are fully quoted in our account of *L.* var. *viburni* (*posteà*).

ζ. var. *viburni*, Gn., "Ann. Soc. Ent. Fr." (4), viii., pp. 403 *et seq.* (1868); Tutt, "Ent. Rec.," xiii., p. 113 (1901); Bacot, "Ent. Rec.," xiii., pp. 114 *et seq.* (1901); Warbg., "Ent. Rec.," xiii., pp. 237 *et seq.* (1901). *Spartii*, Staud., "Cat.," 2nd ed., p. 69, in part (1871); 3rd ed., p. 121, in part (1901); Mill., "Cat. Lép. Alp.-Mar.," p. 80 (1874); ? Curò, "Bull. Soc. Ent. Ital.," viii., p. 151 (1876); Dbldy.-Robson, "Young Nat.," iv., p. 157 (1883); ? Minà-Pal., "Nat. Sic.," vii., p. 331 (1888); Kirby, "Cat.," p. 827, in part (1892); Warburg, "Ent. Record," viii., p. 316 (1896). *Scopariae*, Millière, *in litt.*—*Spartii-viburni*. ♂. D'un brun café ou violet brûlé, trèsmat. Moyen. Ailes un peu carrées. Ces bandes moins jaunes aux premières ailes; celle des supérieures étroite, bien coupée des deux côtés, droite, avec un sinus à chaque extrémité; celle des inférieures arquée - coudée, aussi étroite qu'aux supérieures et nettement détachée de l'espace terminal, qui est brun avec la frange fauve. Jamais de tache humérale. Antennes d'un brun rouge à sommet blanc. ♀. Grande, à ailes larges, ni courtes ni oblongues, mates, d'un jaune ocracé réchauffé de brun violet; à nervures plus claires ou concolores; base et disque des inférieures d'un brun violet; bandes nullement dentées quand elles sont visibles; frange des inférieures roussâtre avec l'extrémité seule d'une teinte paillée (Guénée). Egg: Oval in outline, only slightly longer than wide; a deep and dark-coloured depression on upper surface, the micropyle a distinct blackish dot in very regular depression at one pole of egg, a minute dot at opposite pole; dull-greyish or stone colour, with a slight purplish tinge and darker markings (under microscope greyish-white, irregularly marbled with purplish and fuscous-brown); the surface covered with distinct polygonal pitting; the markings decidedly opalescent; the micropylar depression composed of a number of very close cells of a deep purplish-brown hue, which form concentric rings about the tiny stella forming the central point of the depression; this depression surrounded by a faint, irregular, ochreous-fuscous patch, less defined and characteristic than in the egg of *callunae*; the remainder of the shell at this end is sparingly sprinkled with small fuscous marblings, some distinctly ochreous; the black points at the corners of the polygonal reticulation very minute at poles, not noticeable on other parts of the eggs. [The eggs examined are all very uniform in their markings and coloration; the purplish spots remind one of the coloration of the marblings of a yellow-hammer's egg.] (Tutt). Larva: *First instar*: Head, round, black, shiny, division of lobes distinct, covered with fine hairs, mouth-parts yellowish, some white markings on lower part of face. Body: cylindrical, prolegs long, lifting body well off surface when crawling; prolegs placed well under body, but anal claspers very widely apart; prothorax wider than head, meso- and metathorax narrower but much longer than prothorax, and rather longer than the abdominal segments, which are almost equal; the prothorax divided into two large subsegments, the meso- and metathorax and abdominal segments into six subsegments each; scutellum large, smooth, but much specialised, divided centrally to form what resemble two large, flat, oblong, orange-coloured tubercles; tubercles on dorsal area much specialised, forming wart-like cushions covered with hairs; four of them may be homologised as i and ii on either side, but others are supplementary (secondary tubercles); the pair representing i on abdominal segment 8 are raised into an ill-developed hump; the lateral tubercles less specialised, not so flat (superficially more like the Liparid larval type of wart), raised, and emitting numerous hairs; iii distinct, iv + v almost postspiracular, a supplementary prespiracular on abdominal segments placed very far forward; also numerous small supplementary hair-bearing tubercles; the prespiracular (ear) tubercles of prothorax very large, and appear to be the least modified of any. The ground colour of larva slate or dull blue, legs and prolegs yellow; a faint but dark mediodorsal line on thoracic and hinder abdominal segments (strongest on 8th), very narrow; an ill-defined whitish blotch on both sides of median line on those segments in which it is present; a faint, interrupted, white, lateral line just above bases of prolegs; on the dorsum of each segment is a longitudinal series of bright yellow or orange transverse spots, pale yellow on the meso- and metathorax, and four in number (two short, one long, then another short); on the abdominal three (one short, one long, then another short), and orange in colour; these are formed by the dorsal tubercular warts being bright yellow, as also is the area of the subsegment between them (the yellow extending across the back as far, or rather farther, down each side than the supraspiracular tubercles); on the subdorsal area, the margin surrounding these yellow transverse stripes is blotched with velvety-black, especially well marked on meso-, metathoracic and 1st abdominal segments; abdominal segments 1—8 each have an oblong blotch or stripe on either side, bordered above by a rather longer black stripe; on the 1st and 8th these are horizontal, but on the 2nd to 7th they are set obliquely, and, as the larva gets well-grown in 1st stadium, they lengthen and form a series of faint oblique stripes in some respects like those on larvæ of *Cosmotriche potatoria* and *Dimorpha versicolora*, and sloping in the same direction; the bases of prothoracic ear-tubercles orange; the other large lateral tubercles (iii, iv + v) are whitish at base; the long dorsal hairs are black, the lateral hairs and the short dorsal hairs are white (November 1st, 1896). *Second instar* (One moulted into this skin on November 8th): Head: dull dead blue, with scattered white and a few black hairs, and same face-markings as in 1st instar. Body: prothoracic scutellum still fairly smooth; lateral tubercles on thoracic segments still large and prominent; all other tubercles of 1st instar almost or quite obsolete; the 8th abdominal segment slightly humped in region of anterior trapezoidals; hairs more numerous and scattered; whilst in 1st instar only a few secondary hairs were present, and these arose from small secondary tubercles, there is now a tendency for the tubercles to flatten out and hairs to arise from all parts of the skin-surface; the bright yellow and orange of the transverse dorsal spots has deepened into orange-red, the spots forming a series of irregular, diamond-shaped patches; a group of white hairs (hardly a tuft) present on the dorsum of meso- and metathorax; on abdominal segments 1—7 a wedge-shaped spot forms the apex of the diamond previously mentioned; the ends of the middle transverse bars on meso- and metathorax (now forming the right and left points of diamond-shaped marking) much paler than on other segments (and suggest the origin of the white or yellowish spots that occur in a similar position on the larvæ of *Cosmotriche potatoria*); lateral hairs white, long dorsal hairs black, the short dorsal ones red; a faint, interrupted, blue subdorsal line present, formed by a dot on each segment (suggesting the much more strongly marked blue stripes of the larvæ of *Pachygastria trifolii* and *Malacosoma castrensis* (November 15th). *Third instar* (One larva in 3rd instar, November 22nd, nearly all in this skin by December 6th, 1896). Length from 16mm.—25mm. Head as in second instar, thickly covered with fine white hairs. Body: much deeper in colour; dorsal area velvety-black; lateral and ventral areas deep blue, mottled and spotted with black; remnants of oblique stripes and lateral lines, clearly marked, deep orange-red in colour; the lateral line broken and crossed by the oblique lines, and faintly edged with white or cream (especially marked on 1st abdominal); a short white dash on each abdominal from 2 to 7, just above lateral line (these dashes sometimes with a bluish tint); on the meso- and metathorax the ends of the middle and yellow transverse dorsal band now left as disconnected spots (often whitish at top), due either to loss of the remainder of band, or to its obliteration by the dense dorsal fur (spots of similar form and position are present on the larva of *Cosmotriche potatoria*); the mediodorsal line of white wedge-shaped spots is fairly traceable; spiracles white; tubercles quite as smooth as in 2nd instar, colour deep orange-red; the 8th abdominal segment still slightly humped; prothorax wider than other segments; lateral and ventral hairs white, dorsal hairs short, thick, forming a golden-brown fur with a few long black hairs twice as long as the thickness of the body; an isolated patch of white hairs still present on dorsum of meso- and metathorax, and a few scattered ones on the dorsum of each abdominal segment; the short, thick dorsal fur stops abruptly at the junction of the segments, exhibiting, when larva is stretched, the velvety-black of ground colour (December 6th, 1896). *Fourth instar* (Three larvæ moulted into this instar, December 20th): Head: rich golden-brown, mottled and spotted with black, white markings on face still present; a short downy coat of golden hairs, a few scattered, long, white ones, and a few black ones, of medium length on head. Body: spiracles white, now very prominent (previously only those on the prothorax and 8th abdominal segment were conspicuous); hairs forming thick, short dorsal fur, golden-brown in tint; in addition to bare velvety-black intersegmental bands, there are, on each segment, four subdorsal black spots, caused by a tuft of the short fur being turned down at a sharp angle over lateral area (this character very slightly marked in 3rd instar); all long body hairs now pure white, with only a few black of medium length; an interrupted narrow white subdorsal line present, also remnants of the yellow oblique lines; lateral area dull blue, slightly tinged with green and mottled with black; the lateral tubercles still clearly developed, especially on thoracic segments; the subdorsal spots on meso- and metathorax now very plainly marked, consisting of a golden-brown double convex spot with a sharply contrasted white tip (one suspects these to be remnants of a double ocellar marking that suggests a possible protective mark of warning or startling significance in the past history of *L. quercûs* and *C. potatoria*, as do similar markings now for the larvæ of *Eumorpha elpenor* and *Aglia tau*). Altogether the larva of *viburni* when it has just entered the fourth stadium is not unlike that of *Pachygastria trifolii*, though one misses the blue bands of the latter species (December 20th, 1896). As the larvæ get larger in the fourth stadium they appear to grow darker, passing from a golden-brown to a deep red-brown, due, it appears, to a change in the tint of the short dorsal fur, the long hairs and ground colour remain the same; larva 50mm. in length at end of 4th instar (January 3rd, 1897). *Fifth instar* (One larva moulted into this skin January 17th): No great changes occur at this moult. The dorsal fur is distinctly lighter after the moult, so that the hairs possibly do deepen in tint as the larva gets older; the red and white "ocellar" markings on thoracic segments weaker; the white of the interrupted subdorsal line stronger, and spread out at junction of metathorax and 1st abdominal segment. Some details in the observations made on the fullgrown larvæ have led me to suppose that some at least may reach a 6th instar, but I suspect this is not really so, and that the great difference in size and the laggard habit of the larger larvæ really mean that the female larvæ undergo each ecdysis later than the male larvæ, becoming much larger (and taking more time to become larger) before they are ready for pupation (January 17th, 1897). These larvæ were finally fullfed by January 30th and the few days following (Bacot). COCOON: ♂, 28mm. long, 14mm. wide; ♀, 34·5mm. long, 14·5mm. wide, forming a compact cylinder of closely-felted, pale, ochreous-brown silk. PUPA: More squat, shorter and comparatively broader than that of var. *meridionalis*; some difference in the curve of the antennæ, resulting from the difference in shape (Bacot). FOODPLANTS: *Rubus*, *Viburnus tenus* (Guénée), *Erica arborea*, *Scoparium*, *Arbutus*, *Cytisus hirsutus*, &c. (Millière). DISTRIBUTION: France: Auvergne (Sand), Cannes, Hyères (Berce), Haute-Garonne—Pibrac, Luchon (Caradja), Var (Cantener), Provence (Guénée). Italy: (Curò), [Sicily (Minà-Palumbo)]. Spain: Pyrenees (Agassiz).

This form, in spite of its southern habitat, appears on the wing late in the year (see Constant, *Ent. Record*, xiii., p. 257). Millière says "July, August, and sometimes in September, the var. *viburni* much more frequent than the type (var. *meridionalis*) in the Alpes-Maritimes, &c., most characteristic and constant, and probably specifically distinct." Bruand notes its capture as late as October in Provence in 1866. Guénée says (*Ann. Soc. Ent. France*, 1858, p. 441) that "*viburni* differs from *quercûs* in that the forewings of the males are squarer, *i.e.*, the terminal edge is straighter. The ground colour is dark violet-brown to the transverse angulated bar, which is narrow, almost straight, sharply-edged on both sides; on the hindwings it is still more contracted, and nearer the outer margin than in *quercûs* and *callunae*; it is also regularly arched, but not sinuate; more often all the terminal space is yellow.* The ♀ is very near *quercûs* var. B, but the elbowed line is, as in the ♂, regularly arched and very much nearer the outer margin. [He adds: "It is found in Sicily where Dahl † has taken it abundantly, but we also get it in southern France. The larva differs notably from that of *L. quercûs*, the

* Certainly here Guénée refers either to var. *sicula* or ab. *guillemotii*.

† There is no evidence whatever, we believe, that Dahl took either var. *viburni* or ab. *spartii* in Sicily; he brought (*teste* Treitschke) var. *sicula* from Sicily and died almost directly after he returned to Germany (see, *posteà*).

colour being darker, the front segments more ferruginous, the black segmental incisions narrower, and also in the absence of the white subdorsal line, and of the "dessin du boutonnières"; the area surrounding the stigmata is bluish-brown. The larva lives on *Rubus* *, and like that of *quercûs* hybernates in the winter, spins up in May, the imago emerging in August and September."] Herrich-Schäffer diagnoses † it (*Sys. Bearb.*, ii., p. 106) as: "Striga pallida angustior limbo propior," and Staudinger (*Cat.*, p. 69) sinks it as a synonym of ab. *spartii* which he describes as: "Obscurior, alis omnibus anguste flavo-fasciatis." When describing *L.* var. *viburni* (*Ann. Soc. Ent. France*, 1868, pp. 403 *et seq.*), Guénée compared it with the south of France *quercûs* (var. *meridionalis*, Tutt) and criticised the ignorance of authors concerning the geographical variation of *L. quercûs*. He, however, as we have just stated, fell into considerable error himself, stating that the typical *spartii* of Dahl and Hübner is only to be found in Italy. This is true of Dahl's *spartii* which is referable to var. *sicula*, but Hübner writes of his *spartii* (*Eur. Schmett.*, text p. 144): "Heim.: Deutschland; einzeln noch, in mehreren Gegenden," and both are entirely different from the south of France races, one of which Guénée named *viburni*, whilst the other, which he called Provençal *quercûs*, we have since named var. *meridionalis*. Guénée insists that var. *viburni* does not replace var. *meridionalis* in Provence, but that both exist there, flying side by side, without mixing, and that one, therefore, cannot assume *viburni* to be merely a climatic variety or one that has been induced by a difference of latitude. The distinction is essentially based on the perfectly distinct larvæ. The differences exhibited, he says, are not matters of chance nor is it a simple larval dimorphism set up among the individuals of any or every brood, but a racial difference shown by the two forms producing, in confinement, each its own specialised form of larva. He reared some 600 larvæ, obtained from two well-authenticated pairings—one of *viburni*, the other of *quercûs* (=var. *meridionalis*)—about 300 of each, and all the larvæ of the two pairs, without a single exception, presented in all their stadia the differential characters distinguishing them from each other. He adds that, in spite of the distinct larval differences, the imaginal differences are very slight indeed, and further observes that the larva of *quercûs* from Provence (var. *meridionalis*) differs slightly from the larva of *L. quercûs* from Paris, but he has, he states, met with intermediates, and he notes that the greater number of larvæ of Provençal *quercûs* (var. *meridionalis*) have particularly white hair and a distinct facies, observable at once. The imagines from Provence (var. *meridionalis*), he adds, are naturally of a warmer tone and larger than the Parisian, but this, he says, is evidently due to climatic conditions, and does not affect the question as between *viburni* and *meridionalis*, both of Provence. He questions, too, whether the peculiarity sometimes exhibited by the Spanish race (apparently *catalaunica*,

* *Rubus* was the food-plant on which Dahl found larvæ of var. *sicula*. Probably Guénée was getting his information secondhand from Treitschke (*Die Schmett.*, x., pt. 1, p. 191).

† Herrich-Schäffer's diagnosis might fit the real ab. *spartii* but he gives Sicily as its home, so that he, too, either had var. *viburni* from Sicily, or was working on the same erroneous data as was Guénée.

Staud.), in which the yellow transverse band often entirely disappears in the ground colour, be not due to climatic causes. He enters into a detailed comparison of the larvæ of var. *viburni* and var. *meridionalis* (*loc. cit.*, p. 407), noting:

1. Larvæ of both hatch simultaneously at commencement of October, and are very similar in first stadium. 2. The yellow dorsal marking, in the 2nd stadium, is entire or simply divided by two very fine black lines in var. *viburni*, the marking being distinctly broken up into four parts in the form of "accents" or "accolades" in var. *meridionalis*. 3. In the 3rd stadium (end of November) the dorsal fur of var. *viburni* becomes beautiful golden-yellow in colour, whilst that of var. *meridionalis* is dirty grey; the lateral hairs sparkling white in var. *viburni* and of a dirty hue in var. *meridionalis*, &c. 4. In the 4th stadium (February) the differences are accentuated, the fur of var. *viburni* becomes golden red, with the lateral hairs and long dorsal hairs (not the dorsal fur) white, whilst *meridionalis* has the fur pale grey, the longest lateral hairs white, with ferruginous bases, the hairs on prothorax and the dorsal hairs ferruginous, &c. 5. In the 5th stadium (end of February), var. *viburni* is covered with long white arched hairs; var. *meridionalis* has similar hairs but yellowish-white, the two extreme segments strongly conspicuous from their rusty colour. 6. The last (5th) represents the adult coloration although the larva of *viburni* gets in the 6th stadium some carmelite, red-brown hairs (almost like those of the larvæ of *Macrothylacia rubi*), and that of var. *meridionalis* becomes whitish-blond; besides this, *viburni* still has the subdorsal line less white and narrower than in all the forms of *quercûs* (including var. *meridionalis*) from all localities and always interrupted at the incisions by spots or dots of bright ferruginous; lastly all the hairs (dorsal and lateral) are mixed with other white hairs (not fur) bent in many directions of different lengths, but always thick and a little woolly, whilst the larvæ of the Parisian *quercûs* have all the hairs concolorous, pale ashy, silky and straight.

Guénée asserts that these differences were to be noted in all the larvæ of var. *meridionalis* and var. *viburni* which he reared. From his observations he formulated the following conclusions:

1. That the larva of *viburni* by the red-brown or carmelite colour of its fur, and the long white hairs mixed therewith, possesses a facies that, once seen, cannot be mistaken.

2. That the larva of the *quercûs* of Provence (=var. *meridionalis*) differs, much less essentially without doubt, from the larva of *L. quercûs* from Paris; in the early stadia, by the "éparpillement" or breaking-up of the fleur-de-lys design; and, in the later stadia, by the whiter dorsal fur and more abundant hairs.

3. That the difference between the larvæ of *viburni* and *callunae* (compared with those of var. *meridionalis* or Parisian *quercûs*) becomes marked at first as the larvæ grow, is most marked after the first moult, and becomes less marked as the larvæ get older.

As to the time of appearance of var. *viburni*, Guénée notes that when he first bred the Provençal form he expected the imagines would emerge early, and carried the pupæ with him on a long journey into Switzerland, but they did not emerge until after he had returned to Châteaudun, in September and October, although *L. quercûs* was flying everywhere, even in the Swiss mountains, in the middle of July. The food-plants utilised varied, but *Viburnus tenus*, our common garden laurestinus, was preferred. Guénée found no difference between the cocoons and pupæ of var. *viburni* and those of var. *meridionalis*. He further observes that the imagines are very close, the most constant point of difference being in the tint of the yellow bands, that of the forewings being paler than that of the hindwings in *viburni*, whilst they are of the same shade in *meridionalis*. Millière notes, as we have already stated, that in the Alpes-Maritimes the species emerges in July and August, sometimes in September, the male flying during the day at great speed, the variety (*viburni*) being much more frequent than the type (*meridionalis*). He adds that *viburni* is a most marked and constant variety, and very probably a distinct species.

η. ab. *roboris*, F. J. A. D.,* "Bork. Rhein. Mag.," i., p. 362 (with reference to Esp., "Schmett. Eur.," pl. xiii., figs. 2-3) (1793); Schrank, "Faun. Boica," ii., 1, pp. 275-276 (1801); Germ., "Bomb. Spec.," p. 47 (1812); Sordelli, "La Farfalle," p. 121 (1885); Kirby, "Cat.," p. 828 (1892); Auriv., "Iris," vii., p. 150 (1894); Tutt, "Ent. Rec.," xiii., p. 113 (1901). *Quercûs*, Esp., "Schmett. Eur.," iii., pl. xiii., figs. 2-3, p. 84 (1783.—*Phalaena Bombyx quercûs*. Alis reversis ferrugineis: fascia flavo punctoque albo. Linn., no. 25; Esp., tab. xiii., figs. 2-6; tab. xiv., figs. 1-2; Rösel, tab. xxxv*a*, fig. 1 larva, tab. xxxv*c*, figs. 4, 5, 6 imago. Common everywhere in Oberhessen. Of *quercûs* there are two different races, which I am almost inclined to consider two different species, for I have, on investigation, found that they breed true as Herr Esper has already remarked, but in the larvæ I found no difference in all the various stages of their growth. Linné, it is clear from his description, knew only Esper's second race (tab. xiv., figs. 1-2); should there, therefore, be two different species, this one must retain the name of *Bombyx quercûs* and might best be defined: *Bombyx* alis reversis, maris saturate brunneis, fœminis ferrugineis: fascia flava punctoque albo. The second species, or Esper's first race (tab. xiii., figs. 2-3), which is the commoner in our district and throughout Hessen, may, on account of its relationship, be called *Bombyx roboris* and might be defined as: *Bombyx* alis reversis, maris brunneis, fœminis luteis: fascia flava postice diluta, punctoque albo. However, I leave the decision of the question to more experienced entomologists † (F. J. A. D.).

Westwood and Staudinger, and, following them, most recent authors, have referred this varietal name to Schrank, and attached to it a diagnosis that does not apply to Esper's figures (pl. xiii., figs. 2, 3), on which the original describer of the form largely, if not entirely, based his diagnosis. Schrank himself also appears to have studied Esper's figures, and makes the same references and uses the same name as the original describer in Borkhausen's *Rhein. Mag.*, p. 362. Schrank's description reads as follows: "Sommer-eichen Spinner, no. 1461. ♂. The wings on both sides reddish-chestnut-brown; a white spot on the forewings—on the upperside with a spot at the base‡, and a band, yellow; the underside with the whole outer half yellow. ♀. The wings brownish-ochreous-yellow, a white spot on the forewings, an obscure, anteriorly dark-margined, almost straight, transverse line on all, whitish; the rest of the wing beyond the line paler. *Bombyx roboris (Bombyx quercûs*, Linn., 'Faun. Suec.,' no. 1106; Esp., vol. iii., pl. xiii., figs. 2—6). Hab.: on oak, whitethorn, dwarf birch. Flight-time: June. Very similar to the preceding species *(quercûs)*, and the ♂s hardly distinguishable at all. It is somewhat smaller than *quercûs*, and the ♀ also somewhat more brownish-yellow. In the ♂ the yellow band on the upper wings is, indeed, somewhat

* Hagen attributes this article to Dr. A. F. A. Diel, we do not know on what authority. Not only do the initials disagree, but the contemporary account of Diel's writings (in Hamberger's *Gel. Teutschl.*, edn. 5, Bd. ii., 1796) makes no allusion to it (Prout).

† Borkhausen, on p. 363, adds an editorial note: "I do not believe the two races are different species. Only last summer I fed up a great number of larvæ which I found on alder bushes, and bred among them several females which were very different in their ground-colour. Some were quite dark yellow, others as dark as the females of the second race, whilst others might be regarded as intergrades between the two. They, therefore, do not probably breed true. If one is to regard merely the change of colour as of specific value, then one might also make a separate species of the light ochre-yellow ♂ which Herr Gerning possesses."

‡ No mention is made of a spot at the base in the original description *(suprà)*.

removed from the outer margin, but on the under surface* it is quite at the outer margin. The part of the underside of the forewings which projects beyond the hindwings is somewhat duller than the prevailing wing colour; this colour also shows itself somewhat on the underside of the hindwings just before the fringes." Schrank's reference to Linné's *Fauna Suecica*, no. 1106, which is described as "Pallide ferrugineus, aliis obscure ferrugineus; alæ omnes utrinque fascia arcuata flava; punctum album in medio alæ; litura flava ad basin alarum superiorum," is due to Linné's mention of the yellow epaulette. Esper (on whose figures the name *roboris* largely depends) writes (*Schmett. Eur.*, iii., p. 84): "There are two very different races of this moth, which I have figured on the two accompanying plates. I have observed no difference in the larvæ; perhaps the food and habitat have produced the difference. The larva that produced the moth figured on pl. xiii., figs. 2—3, fed on willow, but that from which the moth on pl. xiv., figs. 1—2, came, fed on broom. Yet this difference is not an essential one. In the two kinds the colour shows considerable divergence. The male of pl. xiii., fig. 2, is 'weichselbraun' towards the outer side. A very broad, light ochre-yellow, somewhat curved band, runs through the middle of both wings, but is lost towards the outer margin in the brown-yellow colour. The ♀ is of an almost unicolorous pale ochre-yellow colour, and only darker tinted towards the body. The brown-margined white spots in the middle of the forewing are alike in both. The form figured in pl. xiv., figs. 1—2, is different. Here the ♂ has a deep, dark, 'weichselbraun' ground colour, and a narrow, bright, yellow-coloured band runs sharply defined through the ground colour without losing itself therein. The ♀ is reddish-yellow; the wings darker towards the body and also at the border of the bands; I have compared examples from other districts which, in colour, almost agree with the ♂. They breed true, yet they are not different enough to form distinct species. Rösel has figured both sexes of the latter kind at pl. xxxv., figs. 4—6." One must largely depend on Esper's description for a clear idea of what the two forms, to which he refers, really are, for his pl. xiii., fig. 2, represents a ♂ *quercûs* (highly coloured) with the transverse band extending considerably towards the outer margin without reaching it, whilst, on the hindwings, the band is almost typical, just a little broad, and shading off gradually into the slightly darkened marginal colour. It is clear that ab. *roboris* is, therefore, really but a slight aberration of the type, having wider transverse bands, and must not be confused with ab. *guillemotii*, Trim., or ab. *marginata*, n. ab.

θ. ab. *guillemotii*, Trim., "Actes Soc. Linn. Bord.," xxii., pp. 31—32 (1859); Berce, "Faun. Fr.," ii., p. 191 (1868); Warburg, "Ent. Rec.," xiii., p. 238 (1901). *Roboris*, Staud., "Cat.," 2nd ed., pp. 69, 423 (errata) (1871); 3rd ed., p. 121 (1901); Hofm., "Gross-Schmett.," p. 53 (1887); Tutt, "Ent. Rec.," viii., p. 303 (1896); Seebold, "Ann. Soc. Esp.," xxvii., p. 124 (1898).—This very remarkable form (♂ and ♀) almost entirely replaces the type in the Gironde district, and differs from the latter in that

* There appears to be some confusion in the various translations of the original between "under wings" and "under surface." The diagnosis (*suprà*) makes it quite clear that it is "on the underside that the whole outer half of the wings" is yellow, and not the "outer half of the hindwings," as Staudinger notes in his diagnosis.

the male has the transverse band on the hindwings entirely yellow and extending to the margin without the reddish border, whilst in the female the ground colour is reddish, not yellow. The ♀ is not larger than the ♂ (Trimoulet).—DISTRIBUTION. Austro-Hungary: Tyrol (Staudinger). France: Dept. Gironde (Trimoulet), Nice (Agassiz), Rennes (Oberthür), Rouen, Saintes (Dupont), Haute-Garonne—La Croix, Falgarde, with the type (Caradja), Aude (Mabille), Auvergne (Sand), nr. Autun (Constant). Germany: south (Staudinger). Italy: [Sicily (Minà - Palumbo); requires confirmation, possibly var. *sicula*], Roman Campagna, Boscolungo (Calberla), northern Italy (Curò). Portugal: north (Staudinger). Spain: Bilbao (Seebold). Switzerland: Martigny, Fully, &c. (Favre).

Berce describes this aberration as: "♂, having the band of the hindwings completely yellow, without the red border; ♀ of the size of the ♂, with the ground colour tending to that of the male, reddish not yellow." Staudinger erroneously refers it to *roboris*, diagnosing it as: "♂. Al. ant. fascia lata flava, al. post. margine late flavo." Hofmann says: "Male with broader yellow band, hindwings with yellow margin." Chapman observes that this form stands under the name of *roboris* in Constant's collection. The aberration must not be confounded with the russet-brown Sicilian race, var. *sicula*, which also has the outer margin of the hindwing yellow. The form has undoubtedly a wide range, occurring as a rare aberration in many districts with the type.

ι. var. *burdigalensis*, Gerhard, "Berl. Ent. Zeits.," xxvi., p. 127 (1882); Kirby, "Cat.," p. 828 (1892); Auriv., "Iris," vii., p. 150 (1894).—Very similar to var. *sicula*, only in the latter the margin of the hindwing is entirely yellow, whilst var. *burdigalensis* has a bright brown dusting before the yellow fringes. Bordeaux (Gerhard).

One suspects this to be very nearly identical with Trimoulet's *guillemotii*, especially as it comes from the same district. It differs from it, however, in not having the yellow border extending quite to the hind margin. The French and German lepidopterists frequently do not seem to understand that, though var. *sicula* has the marginal band of the hindwings widened similarly to that of ab. *guillemotii*, the band of var. *sicula* is of a bright orange-yellow colour, whilst the ground colour is distinctly russet-brown, and neither of the deep chestnut-brown nor of the ferruginous tint that is usual in the various forms of *L. quercûs*. The whole facies of var. *sicula* is very distinctive. Staudinger makes *burdigalensis* synonymous with ab. *guillemotii*, and quite erroneously with ab. *roboris*.

κ. ab. *marginata*, n. ab. *Quercûs*, Hb., "Eur. Schmett.," fig. 270 (? 1800); Humph. and Westd., "Brit. Moths," i., pl. xi., fig. 13 (1843). *Roboris*, Humph. and Westd., "Brit. Moths," i., pl. xi., fig. 9 (1843); Guénée, "Ann. Soc. Ent. Fr.," (3), vi., p. 440 (1858). — Of the normal coloration, but with the yellow band of both fore- and hindwings extended to the outer margin. Hübner figures (fig. 270) an excellent example of this aberration; the marginal areas are wholly concolorous, and the fringes are of the same yellow colour. It is, of course, an extreme development of the characters exhibited by ab. *guillemotii*, in which the yellow is extended to the outer margin only in the hindwings. [Humphreys and Westwood copy Hübner's figure and call it *quercûs*; they also figure a somewhat similar one, which they call *roboris*.]

λ. var. *sicula*, Staud., "Cat. Lep. Eur.," ed. 1, p 30 (1861); ed. 2, p. 69 (1871); ed 3, p. 121 (1901); Sord., "La Farfalle," p. 121 (1885); Minà-Pal., "Nat. Sic.," vii., p. 331 (1888); Kirby, "Cat.," p. 828 (1892); Auriv., "Iris," vii., p. 150 (1894); Hofm., "Gross-Schmett. Eur.," p. 53 (1887); Tutt, "Ent. Rec.," viii., p. 303 (1896); vol. xiii., p. 113 (1901); Bacot, "Ent. Rec.," xiii., pp. 114 *et seq.* (1901); Warburg, "Ent. Rec.," xiii., pp 257 *et seq.* (1901). *Spartii*, Frr., "Neu. Beit.," pp. 48, 177, pl. xxvi (October, 1831); Bdv., "Icones," p. 157, pl. lxvi., figs. 1—2 (1834); Treit., "Die Schmett.," x., pt. i., 191 (exc. cit. Ochs. et Hb.) (1834); Dup., "Hist. Nat.," supp. iii., p. 92., pl. viii., figs. *a—b* (1836); H.-Sch., "Sys. Bearb.," ii., p. 106 (1847); ? Bell., "Ann. Soc. Ent. Fr.," (3), viii., p. 688 (1860).—Alis ant. anguste flavo-fasciatis, al. post. margine late flavo, sæpius brunnescente (Staudinger, *Cat.*, 3rd ed., p. 121). LARVA: *First stadium:* To the naked eye the larva appears to be of a dark chocolate colour,* slightly hairy, with a broad white mediodorsal band. The structure and development of tubercles are as in the larvæ of the other forms and races of *L. quercûs.* The lateral area is seen with the aid of a lens to be dull blue with traces of the oblique stripes, the dorsal and subdorsal tubercles being yellow or orange as in the other varieties, but the extent to which the yellow spreads from the bases of the tubercles is greatly curtailed by the white dorsal band (this is the chief cause of the difference in appearance from the English forms), and the black margin or border on the subdorsal side of the yellow triangles is very greatly developed, and still further curtails the yellow area which is the predominant feature of the larvæ of the French forms var. *viburni* and var. *meridionalis.* The general effect on the larva of var. *sicula,* of the restriction of the yellow by black and white areas, aided by the black or dark brown hairs, is to produce the dark chocolate ground colour of the larva; although, if a lens be used, or the larva be placed in bright sunlight, the different colours which go to make up this general effect can be clearly distinguished. The head of the larva of var. *sicula* is shiny black with a trifoliate white marking on the face, being, possibly, a further † development of the marking seen on the face of the larvæ of var. *viburni* and var. *meridionalis* (October 24th, 1899). *Second stadium* (well-grown): The larvæ do not seem to differ greatly from those of var. *viburni* and var. *meridionalis.* Still there is a superficial difference, due to the size of the markings, although the latter appear to be fundamentally the same§. The lateral hairs are white and curve downwards; the dorsal hairs brown or black, and mostly short on thoracic segments; these short dorsal thoracic || hairs are very numerous, and form the commencement of the coat which, in later stages, covers the dorsal area of all the segments ‡ (Bacot, November 7th, 1897). *Almost fullgrown* (? Penultimate instar).—50mm. long when at rest, 58mm. when stretched, 7mm. wide at the 3rd abdominal segment; the head comparatively small, partially retractile within prothorax, the width pretty uniform, but the meso- and metathorax rather less than the prothorax and abdominal segments, of which the 3rd—6th are rather

* The larvæ of var. *meridionalis* and var. *viburni*, in 1st stadium, are light red- or orange-yellow, with white mediodorsal band; but those of English *L. quercûs* and of var. *callunae* appear as dark blue-black larvæ with orange triangles on each segment, and the width and flatness of the triangles almost suggest yellow transverse bands. The French races appear to be rather more hairy; the colour pattern is really the same, but the British races do not develop the white mediodorsal band until about the 3rd stadium, and then only as a chain of spots. The great difference in the appearance of the larvæ, to the naked eye (other than that caused by the absence or presence of the white band), is brought about by the greater or less development of the yellow and black areas (Bacot).

† I am of opinion that the larva of var. *sicula* is the most specialised form presented by the larvæ of *L. quercûs* and its numerous varieties with which I am acquainted (Bacot).

§ More distinctly marked in the larva of var. *sicula* than in the larvæ of the other varieties is the resemblance that the markings, formed by the junction of the lateral band with the transverse central dorsal stripe, bear to those of *Trichiura crataegi* and *Lachneis lanestris*, in which the interrupted lateral (or subdorsal) band and its junction with the divided transverse dorsal band form the most noticeable feature of the larval markings (Bacot).

|| The thoracic segments of the larger Lachneid larvæ are of special importance when the larvæ are young, compared with the abdominal. These segments are usually larger in size, and bear specially bright-coloured markings, hairs, or hair-tufts. Adult characters, too, are first developed on the thoracic segments, *e.g.*, *Eutricha quercifolia*, *Cosmotriche potatoria*, *Odonestis pruni*, *Dendrolimus pini* and *Macrothylacia rubi* (Bacot).

‡ This suggests that the thoracic segments of the ancestral form had some special development, from which have been evolved, on the one hand, the dorsal fur of the larva of *L. quercûs*, and, on the other hand, the hair-tufts of the larva of *Cosmotriche potatoria*, as well as the special startling colours and scale-like hairs of *Dendrolimus pini* and *Eutricha quercifolia* (Bacot).

the widest. *Head:* uniformly brown; clypeus triangular, similarly coloured, smooth; the two lobes covered with pale brown and longer grey hairs. *Body:* coloration sharply divided on either side by a white supraspiracular line; the dorsal area (thoracic and abdominal segments) bright golden-brown with wide velvety-black segmental incisions, and much less defined subsegmental incisions (6 subsegments to abdominal segments, arranged as—black, red-haired, red-haired, red-haired, red-haired, black—the first and last subsegments of two successive segments make the velvety-black segmental incisions); a series of grey hairs down mediodorsal line, longer than brown hairs, and forming a somewhat marked series of loose tufts, one on each segment; sides below supraspiracular line, blackish-grey, covered with grey hairs pointing downwards and backwards; the incisions less distinctly marked; the spiracles (including the prothoracic) conspicuous, white; the prothorax swollen laterally, fairly well developed traces of "ear-tubercles;" meso- and metathorax each divided into 4 subsegments; between subsegments 3 and 4 of the meso- and metathorax, and in the segmental incision between abdominal segments 8—9, is a pale, flesh-coloured supraspiracular boss represented in incisions of other segments by a small boss bearing red-brown hairs only noticeable when the larva is crawling, and almost of the same tint as the dorsal clothing; when at rest the terminal segments are drawn under the 8th abdominal in such a manner as to give the latter a slightly humped appearance; the venter velvety-black, hardly so intense as the dorsal incisions, but sharply cut off from the lateral areas; the true legs are brown in colour, as also are the prolegs; on the 1st and 2nd abdominals are brown warts representing marginal tubercles (vii), and well developed at base of prolegs; the anal flap edged with bright red. This larva does not roll in a ring when disturbed, as does the larva of var. *meridionalis* from Cannes [Tutt. Received, March 11th, 1899, from Mr. Brabant, the latter having obtained it with others from Sicily when small, and reared them through the winter on fullgrown (old) leaves of ivy]. PUPA: ♀. Coloured like that of *L.* var. *viburni*, but hardly so cylindrical in shape, the hollowed or indented wing-cases somewhat of the form of those observed in the pupa of *Pachygastria trifolii*, but in a much less marked degree; the wing-cases also appear to project more at the base. COCOONS: Vary much in size, one is 1·3 inches long and ·7 inches thick (Bacot). Darker than those of *L. quercûs* (Bellier). [HABITS OF LARVA: Lives singly or in groups of two or three; it hides during the heat of the day (Bellier). PARASITES: *Ophion undulatus*, Grav., *Metopius dentatus*, Grav. (Bellier). FOODPLANTS: *Rhamnus alaternus* (Bellier), bramble (Dahl), &c. TIME OF APPEARANCE: September, October and November; possibly pupæ that go over the winter emerge in July (Bellier).] LOCALITIES: Sicily (Dahl). Spain: Andalusia (Staudinger).

The var. *sicula* is the most specialised of all the races of *L. quercûs*. It is exceedingly constant in its "russet" ground colour, the narrow transverse band of the forewing, and the orange-yellow marginal area of the hindwing. The larval characters, too, appear to be pretty constant. It has, as we have already shown, been probably much confused by collectors and authors with var. *viburni* (under the name of var. *spartii*), but is a very distinct and separate race. Staudinger did not diagnose this form when he named it (*Cat.*, 1st ed., p. 30), but simply cited the references: "Frr., 26, i., p. 177 (October, 1831); Tr., x., i., 191 (excl. cit. Hb.); Bdv., Ic., 66, 1—2." This leaves the descriptions and figures of these three authors as detailing the characters of the variety. In his *Catalogue*, 2nd ed., p. 69, Staudinger describes *sicula* as: "Al. ant. fasciis angustis flavis, al. post. margine lato flavo." Freyer writes (*N. Btr.*, i., p. 48): "*Gastropacha spartii*, Tab. 26. The insect figured by Hübner as *B. spartii* (fig. 173) appears to be merely an aberration of our common *quercûs;* yet I am much inclined to refer Hübner's fig. 224* here, since

* This is a ♀, somewhat more brownish-ochreous than in *L. quercûs*, the area within the transverse line, *i.e.*, to the base, darker than the outer marginal areas in all the wings, and with a distinct reddish tinge over the darker areas, the inner edge of the pale band on forewings being more distinctly reddish. One suspects it, however, as a German example, *vide* Hübner's text, p. 143.

his figure agrees tolerably well with mine; Esper's, pl. xiii., fig. 2*, might also be rather referred here than to the ordinary *quercûs*, more particularly on account of its broad yellow margin, which is the chief distinction separating *spartii* (=*sicula*) from *quercûs*. That *B. spartii* (=*sicula*) is really distinct from *quercûs* is certain from their being bred from distinct larvæ. The larva of *B. spartii* (=*sicula*) that I figure on the accompanying plate is, indeed, extraordinarily similar to that of *L. quercûs*, but lacks the white, hook-formed lateral stripes which the larva of *L. quercûs* possesses, and this is the strongest proof of its specific distinctness; the larva is also darker than that of *L. quercûs*, and its black-brown sides are thickly clothed with fine grey hairs (my figure is made from a very well blown example received from Herr Büringer). *B. spartii* (=*sicula*) has the colour, size, and form of our *quercûs*; the yellow line which runs through the forewings is very narrow, straighter and not so arched, and is sharply separated from the ground colour on both sides. The other principal difference is that in the ♂ the white spot of the forewings is farther removed from the yellow line in *spartii* (*sicula*) than in *quercûs;* further, the hindwings in *spartii (sicula)* have a broad, orange-yellow border. The ♀ is smaller than that of *L. quercûs*, and the band on the forewings much narrower. The whole ground colour is somewhat darker than in ♀ *quercûs*. On the underside the two species are pretty much alike, yet the white spot of the forewing of the ♂ *sicula* shows through more distinctly than does that of *quercûs*. This species was brought by Dahl from Sicily, and the original of my figure is from the collection of Herr Büringer of Gunzenhausen." Freyer further quotes *(loc. cit.*, p. 177) a letter from Treitschke, in which the latter says: "The larva is not quite like the figure, the blown skin may have been damaged; it is much more fox-red than the figure, &c." Freyer's only comment is that "the larval skin from which the figure was made was in a very good state of preservation." Treitschke's diagnosis (*Die Schmett.*, x., pt. i., p. 191) reads as follows: "*Gastropacha*. Mas. Alis brunneis; anticis puncto medio albo, fascia subrecta flava, posticis limbo flavo. Fœmina: Alis dilutioribus, fascia media limboque posticarum obsolete flavidis. Ochs., iii., p. 266, and iv., p. 58, *G. quercûs* var. †; Hb., 173 and text p. 143, no. 2. *spartii* ‡; Hb., 224

* This is a highly-coloured ♂, with the transverse band extending considerably towards the outer margin without reaching it, whilst in the hindwings the band is almost typical, only just a little broad. It is, of course, the figure on which the ab. *roboris* is partly founded (see *anteà*, p. 65). It is remarkable that Freyer makes a point of the broad yellow margin. One is almost inclined to wonder whether some copies of Esper were differently coloured, although Esper's own description of the insect represented by pl. xiii., fig. 2, forbids the association of it with var. *sicula*.

† Ochsenheimer's variety is based on Hübner's figs. 173 and 224, the narrow-banded ab. *spartii*, and Esper's pl. xiii., figs. 2—3, the wide-banded ab. *roboris*, reference also being made to the original description of the latter form in "*Bork. Rhein. Mag.*," p. 362, and to Schrank's description of *roboris*, "*Faun. Boica*," ii., 1 Abth., p. 275. An incongruous mixture, having no connection with *sicula* !!

‡ Hübner's fig. 173, ♂, is his type of ab. *spartii*, a common aberration of *L. quercûs* from Germany. The text at p. 143 describes this common German form. Neither figure nor letterpress gives any suggestion whatever of var. *sicula*.

(fœm.)*, 270 (mas)†, *quercûs* var.; Freyer, n. Btr., i., Heft v., p. 48, and Zusatz, p. 177; tab. xxvi., *B. spartii*." He then says: "Hübner long ago called attention to *spartii* as a species distinct from *quercûs*, but his figures were positively declared by Ochsenheimer and others to be aberrations of the latter, so much the more as all examples sent out by dealers as *spartii* were really nothing more than rather common aberrations of ♂ *quercûs* with narrower band, and the darker redder ♀ also belonging thereto. The true *spartii* I found among a small collection brought here from Sicily, but only males, which, however, were again stated to be varieties, and of which probably one passed into Hübner's hands, and which he reproduced as fig. 270§. Dahl's residence in Palermo first cleared up the matter; he found the larvæ commonly on bramble and bred them. The day before he left he further met with a worn ♀, which laid him nearly 200 eggs. They almost all hatched, and the larvæ accepted bramble as food. This was in October, the winter at hand, and he had, therefore, to think of another foodplant. He chose the garden rose, covered a number of stocks with gauze, and placed the larvæ on them, the latter, in a warm room, reaching a size of 1½ inches after about 3 moults. They then rested immovably on the stems for about 6 weeks, eating nothing, and shrivelled up, and he thought he should lose them; yet, in February, they were again active, grew rapidly, moulted about six times more, and on reaching the ordinary size of *quercûs* larvæ, spun up in the month of May among leaves or on the earth among moss. In August and September the moths emerged, and were like those reared in Sicily the preceding year; several pairs copulated at once, and fertile eggs again resulted. Unfortunately Dahl's severe sickness and death brought the whole colony to grief, and from the few at my house, I obtained only males. The six-weeks' rest of the larvæ seems to correspond to the rainy season in their native land. We took care often to sprinkle the rose-stocks with fresh water, and saw that they greedily drank the single drops, as is also done by most of the related species. The egg resembles that of *quercûs*, is oblong, and pale brown, although greenish at first. The larva differs from that of *quercûs* in its higher fox-red colour, especially on the anterior segments, in its more slender form, and especially in the lack of hook-formed white lateral stripes. The protuberance in which the spiracles stand as single white dots is bluish-brown. The segmental incisions are velvety-black. The cocoon and pupa are as in *quercûs*. The imago is as large as those of that species, the ♂s in particular are sometimes still larger. Few, but constant, characters, distinguish the newer species. In the ♂ the ground colour is a brighter purple-brown. The yellow line of the forewings very narrow, almost straight, only at the costa a little curved. It is sharply cut off exteriorly, while in *quercûs* the colour gradually passes into the ground colour. The white spot is more widely removed from the yellow line. The margin of the hindwings is bright yellow, while

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* Hübner's fig. 224, represents a rather dark ♀, most probably of German origin (see, *anteà*, p. 69, footnote).

† Hübner's fig. 270, ♂ = the type of our ab. *marginata*, n. ab. (*anteà*, p. 67). It certainly is not var. *sicula*, which has a very narrow band to forewings, and there is no evidence whatever in support of Treitschke's view that it may have come from Sicily.

in the ♀ there is only a line of that colour. To be sure we obtained also some aberrations where the yellow was more or less dusted with brown, but the yellow ground colour always shone through distinctly, and on the underside it was likewise present in the form of a band. The ♀ has almost the colour of *Pachygastria medicaginis.* On the forewings the paler lines and the white spot stand as in the ♂; on the hindwings the inner area is ruddle-red; the outer, before the line, red-yellow. The underside of both sexes corresponds with the upper- in the differences mentioned." Bellier de la Chavignerie appears to maintain *sicula* (under the name of *spartii)* as a species on account of the ♂ having the antennal shaft brown, whilst, he says, it is washed with yellow at the extremity of that of *L. quercûs* and its different varieties. Minà-Palumbo and Failla-Tedaldi state (*Nat. Sic.*, vii., p. 331) that they are unable to recognise the difference in specimens in their possession, and that they think it an insufficient character on which to found a species.

μ. var. *subalpina*, Agassiz, "Mitt. Schw. Gesell.," x., p. 248 (1900).—Agassiz simply notes, "Swiss Jura," without description.

ν. var. *alpina*, Frey, "Lep. der Schweiz," p. 97 (1880); Hoffmn., "Stett. Ent. Zeit.," xlix., p. 153 (1888); liv., p. 125 (1893); Kirby, "Cat.," p. 828 (1892); Auriv., "Iris," vii., p. 150 (1894); Reutti, "Lep. Bad.," p. 58 (1898); Favre, "Lep. Val.," p. 111 (1899); Staud., "Cat.," 3rd ed., p. 120 (1901).—In the higher mountains at Zermatt, Gadmen, and in the Upper Engadine, from 6000 to 7000 feet, occurs a very interesting variety, dark in both sexes, which, in these high altitudes, emerges from pupæ that go over the winter. In this alpine form the ♂ is deeper brown, the broad transverse band paler, the fringes of the hindwings pale; the ♀ comes nearest to var. *callunae*. It is found on the Stelvio, at Zermatt, in the Upper Engadine, on the high Alps around Gadmenthal, and Sardasca in the Grisons (Frey); Brenner dist—Navis, July 17th, 1899 (Galvagni); Upper Hartz (Hoffmann); nr. Herrenwics (Spuler); Valais—Glacier de Trient, Loèche-les-Bains, Riffelalp, Simplon, &c. (Favre); Finland—Kuusamo (Hoftman).

Hoffmann says (*S. E. Z.*, xlix., p. 153): "The var. *alpina*, Frey, flies in the Upper Hartz at the end of May and throughout June; the larva emerges from the egg at the beginning of July, but does not grow much the same year, hybernating small, and, in June of the next year, one may still find them gregariously on *Vaccinium* and *Calluna*, although later they separate. By the end of July they are fullgrown, and at the beginning of August pupation takes place; these pupæ hybernate, the moth appearing in the spring of the next year, so that one finds together quite small larvæ and fullgrown ones from the moths of the previous year. The same peculiarities are observed in the high Alps of Switzerland, and it forms a transition between the lowland form and var. *callunae*." He also states (*loc. cit.*, liv., p. 125) that he collected at Kuusamo, in North Finland in 1892, fullgrown larvæ in the middle of August, on *Vaccinium* and *Calluna*, which, in the spring of 1893, produced the mountain form, var. *alpina*, Frey. Favre notes (*Lep. Val.*, p. 111) the male as "dark brown, with the band wider, paler, and the fringes of the hindwings lighter than in the type; the ♀ very near *callunae*. Hybernates in the pupal stage under rocks and stones; very rare in the alpine region of the Valais." Caradja observes of the Roumanian *quercûs*, that the males form a transition from var. *alpina*, Frr. to var. *roboris*, Schrk., having deep, dark chocolate-brown (not red-brown) ground colour, and extraordinarily broad, orange-yellow bands; Hormuzaki obtained a similar male in the mountains of Bucovina.

ξ. var. *callunae*, Palmer, "Zool.," v., p. 1656 (1847); Weaver, "Zool.," xi., p. 4066 (1853); xv., p. 5403 (1857); Harding, "Zool.," xvi., p. 5925 (1858); Gn., "Ann. Soc. Ent. Fr." (3), vi., p. 442, pl. x., fig. 3 (1858); (4), viii., p. 410 (1868); Edl., "Ent. W. Int.," vii., p. 93 (1859), "Zool.," xviii., p. 6815 (1860); Shipston, "Ent. W. Int.," ix., p. 68 (1860); "Zool.," xix., p. 7359 (1861); Parke, "Zool.," xxi., p. 8647 (1863); Newm., "Ent.," ii., p. 137 (1865); iii., p. 27 (1866); Snell., "De Vlind.," p. 186 (1867); Staud., "Cat.," 2nd ed., p. 69 (1871); 3rd ed., p. 120 (1901); Lampa, "Ent. Tids.," vi., p. 41 (1885); Ellis, "Nat.," 1886, p. 108 (1886); Hinchliff, "Ent.," xix., p. 272 (1886); Batt., "Ent.," xx., p. 109 (1887); Hofm., "Gross-Schmett.," p. 53 (1887); Buckl., "Larvæ," &c., iii., p. 58 (1889); Tutt, "Brit. Moths," p. 56 (1896); "Ent. Rec.," viii., pp. 298—302 (1896); xiii., p. 113 (1901); Thomps., "Ent. Rec.," viii., pp. 125 *et seq.*, 158 *et seq.*, 315 *et seq.* (1896); Barr., "Lep. Brit.," p. 27 (1896); Hewett, "Ent. Rec.," viii., pp. 209—210 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 58 (1898). *Quercûs*, Linn., "Faun. Suec.," 2nd ed., no. 1106 (1761); "Sys. Nat.," xiith ed., pp. 814—5 (in part) (1767); [? Esper, "Schmett. Eur.," pl. xiv., figs. 1—2 (1793)]; Stephs., "Ill.," ii., p. 30 (1828); Zett., "Ins. Lapp.," p. 925 (1840); Sta., "Zool.," iii., p. 1091 (1845); iv., p. 1230 (1846); Harding, "Zool.," v., p. 1731 (1847).—From repeated conversations which I have had with my friend the well-known naturalist, Mr. Weaver, and from careful investigation of all the facts and circumstances stated by him, little doubt exists in my mind that, under the common designation of *L. quercûs*, two perfectly distinct species of British "Eggers" have been confounded by entomologists. I have minutely examined through a powerful microscope the antennæ of the common species (*quercûs*), and those of that which Mr. Weaver is seeking to establish as new, and can consequently vouch for the correctness of his observations respecting the peculiarities of structure of that important organ, which tend so powerfully to corroborate his views. . . . . The following is Mr. Weaver's statement: "Entomologising on Rannoch moors, in June, 1845, I had the good fortune to capture ten specimens of this noble moth—eight males and two females—flying at mid-day. Their flight is so high and so rapid that it is very difficult to capture them. I took also, at the same date, in the dusk of the evening, a very fine specimen of the female. In June, 1844, on Rannoch moors, I found a caterpillar of which I had not before seen the like, and, therefore, it was the more interesting to me. By diligently searching on a misty day over the moors, I found others feeding on heath, which, in September, formed their cocoons. In June, 1845, I found more on the heath, and these also changed to the chrysalis state in September. Again, in June and July, 1846, I took a few more of the caterpillars on the heath, which changed in September, and these I now have in the chrysalis state. I have given my best attention to all the changes of this interesting species for the last three years, and the result is that I find all the circumstances precisely the same in each year. The larva, whilst young, feeds on birch, willow and heath (*Calluna vulgaris*). It comes out from the egg in July, and is adorned with a row of small grey spots on the back, which increase in size as the caterpillar grows, till the spots appear as large as common peas. These spots are not in the skin, but consist of light grey-coloured hairs, the rest of the hairs being of a dark chestnut colour, and so contrasting with the light grey before mentioned; but at the end of 12 months the caterpillar changes into its last skin, and the spots at the same time entirely disappear. It might then be mistaken for the caterpillar of another species, if its size and the season of the year were not regarded, and also the long period of 15 months which it had passed in the caterpillar state. Forming its cocoon in September, it lies through the winter in the pupal state; therefore it requires two full years to complete its metamorphoses." . . . Comparing it with *quercûs*, we have: (1) *Lasiocampa quercûs*, according to Donovan (*British Insects*, iii., pp. 83—85), appears in the winged state in June, and according to Westwood in August. The ♀ deposits her ova in June and July, the caterpillar is hatched in autumn, and remains during the winter in this state. It feeds on *Quercus robur*, *Prunus spinosa*, *Crataegus oxyacantha* and divers herbaceous plants. All the successive skins assumed by the animal in this state exhibit, from first to last, the same general colours and markings. In the middle of May it spins a cocoon of a dull, dirty straw-colour, and the perfect insect comes out in June or July, so that one year only is occupied in its progress from the ovum to the imago. The antenna of the male is very strongly and distinctly pectinated, and consists of 64 minute articulated pieces, the joints of which are nearly hidden by fine hairs, and measures, on an average, three-eighths of an inch in length. The size of the insect is generally smaller, and the colouring of the body, wings and antennæ less deep and rich than those of the species following. (2) *Lasiocampa callunae*. The perfect insect appears in June. The precise period of deposition of the ova is unknown. The caterpillar hatches in July, and passes through the first winter in this condition. *Calluna vulgaris* constitutes its principal food. In every succeeding skin except the last, the hairs investing it are so coloured as to represent a series of circular ash-grey spots arranged along the dorsal region of the caterpillar, and increasing in size as the caterpillar grows. From the last skin these spots wholly disappear, and it then resembles, in colour and markings, the caterpillar of the common species, and may be readily confounded with it by those who have had no opportunity of observing the caterpillar in the successive stages of its development. It passes into the chrysalis stage invariably in September, and goes through the ensuing winter and spring in that state, the cocoon being of a deep muddy-brown colour, so that two entire years are consumed in the process of evolution. The antenna of the male is more closely and delicately pectinated than in the preceding species; it consists of 84 pieces not concealed by fine hairs, and measures fully half-an-inch in length. The antenna of the ♀ is also stronger and longer than in the ♀ of *L. quercûs*. The size of the insect is larger and the prevailing colours deeper than in the first species, and a rich, glossy piece not seen in that insect is exhibited on the wings of both sexes. It may, perhaps, be objected that *L. quercûs* sometimes passes a second winter in chrysalis; this, however, constitutes the exception, not the rule. The same phenomenon has occasionally been observed in our new species, and two, and even three, winters have elapsed ere the insect has emerged from its cocoon. Size and colour, it may be argued, are very uncertain characters for the discrimination of species. Taken by themselves they are certainly fallacious, but acquire considerable value when invariably connected, as in the present instance, with other more solid and important differences of structure and habit, and, I may affirm that many species universally acknowledged as distinct are founded upon characters much less strongly marked and invariable than those distinguishing *L. quercûs* from the new species that Mr. Weaver has had the honour first clearly to identify, and which he has kindly deputed me the pleasant task of thus imperfectly introducing to the scientific world. It is gratifying to add that the opinions of Mr. Weaver and myself on this interesting subject derive powerful confirmation from the testimony of your able correspondent, Mr. Stainton, to whose remarks (Zool., iii., p. 1091) I beg leave to refer the curious reader (Palmer). The first description of the imago was made by Guénée (*Ann. Soc. Ent. France*, (3), vi., p. 447) and a later comparative one (*loc. cit.*, (4), viii., p. 410), which reads: "*Callunae.* ♂. D'un brun chocolat un peu transparent. Grand. Ailes oblongues: les inférieures ovales. Ces bandes concolores aux quatre ailes; celle des supérieures large, régulièrement sinuée en S du côté interne, très-rétrécie au bord interne, fréquemment dentée, touchant du côté extérieur à un large espace plus clair et transparent, marqué de nervules foncées; celle des inférieures peu arquée, mais offrant un sinus à l'angle anal; l'espace terminal largement d'un brun pur sur lequel tranche la frange d'un jaune clair. Une tache humérale formée par des poils jaunes. Antennes plus longues, à tige d'un gris brun avec une tache plus foncée précédant l'extrémité, qui est blanche. ♀. Grande et oblongue; d'un jaune qui a à la fois quelque chose de violâtre et de verdâtre; ailes un peu transparentes par places, à bandes très-distinctes, souvent un peu dentées; les supérieures ayant cette bande précédée d'une ligne dentée d'un brun violet, les inférieures à bord terminal d'un brun roux comme la base; frange brunâtre aux premières, jaune aux secondes; nervures concolores mais se dessinant sur la transparence du fond; poils de la base très touffus et reproduisant parfois la tache humérale." OVUM: Somewhat cylindrical in shape, with rounded ends. The length: breadth: height :: 3: 2: 2. There is a somewhat irregularly oval depression centrally on the upper surface. The egg appears creamy-brown in colour to the naked eye, with rather darker brown markings; the micropyle is placed at one end of the egg, and appears as a small brown-black dot to the naked eye. Under a two-thirds lens the opalescent character of the markings of the egg is well-marked. It is now seen to be creamy-white in colour, with darker creamy and creamy-brown markings irregularly distributed over the surface, and giving a distinctly opalescent appearance to the egg. The surface is covered with minute polygonal cells, more especially distinct on the paler parts of the egg. The cells are much more distinct at the end surrounding the micropylar area. These cells are surrounded by a fine but distinct reticulation, with minute black knobs at the angular points of the polygons forming the reticulation. The micropyle is situated in the base of a small hollow at one end of the egg, and is composed of an open net-work of brown-black cells somewhat quadrangular in shape, which become smaller centrally. The micropyle proper is situated in the centre of the area, and forms a minute star of radiating cells. [Eggs laid June 28th, received from Mr. G. B. Routledge, description made July 8th under a two-thirds lens.] The number of eggs laid by 5 females in 1895 were 121, 204, 226, 227 and 122 respectively; those laid on June 17th hatched July 13th—14th; those laid June 20th hatched July 15th—16th (Hewett); eggs of *callunae* obtained in 1894 hatched a fortnight before those of *L. quercûs* (Pitman); eggs laid July 6th hatched July 30th, in Argyll (Chapman); eggs laid July 24th, 1859, at Bowdon, hatched August 10th; whilst a ♀ was found laying eggs in nature on Carrington Moss, as late as August 7th, 1859 (Edleston); the eggs are laid in June and hatch about the middle of July (July 14th, 1898) in Hoy (Cheesman). Larva.—*First instar*: *Head*—large, rounded, black, glossy; only faint traces of the white face-markings conspicuously present in larva of *L. quercûs*; numerous scattered black hairs. *Body*—structurally agrees with that of larva of *L.* var. *viburni*, already described; tubercles many-haired warts, i and ii large and flat, iii supraspiracular, iv + v subspiracular; a large accessory prespiracular; few secondary hairs present; trapezoidals yellow and suggest the yellow bands seen in larvæ of *L. quercûs* and var. *viburni*, but much less developed than in these larvæ; yellow bars divided in centre by a broad gap of ground-colour; on each segment traces of a dark mediodorsal line; no lateral markings yet present but on subdorsal area of each segment is a large irregularly-shaped black velvety patch; from the mesothorax to the 8th abdominal, this patch partly surrounds the yellow transverse bars—*i e.*, at front, back, and lower edge—below the posterior trapezoidals; it is, however, only narrow behind, and below the bar, and forms a large patch in front; it is much larger behind the bar on metathorax and joins the forward patch on 1st abdominal. Prolegs spread widely and have a slight tendency to a ⊥-shaped foot. Hairs black, brown and white on the dorsal area, mostly white laterally, the black hairs the longest, the white ones the shortest (July 11th, 1897). The *second instar* is similar to the first in many respects, although it foreshadows the third instar in others. *Third instar*: *Head*—dull blue in colour, surface dull; covered with fine hairs, no white face-markings. *Body*—of even thickness, cylindrical, segments fairly distinct; dorsal area velvety-black, with a diamond-shaped, bright, yellow mark on each segment, the apex of the diamond being pale, whitish rather than yellow; a small yellow spot on either side of front part of diamond; on thoracic segments (2 and 3), the mark is larger than on abdominal segments and triangular rather than diamond-shaped; lateral area dull blue with faint traces of double oblique stripes. *Hairs*: long ones black, short ones brown. *Fourth and Fifth instars* (October 24th, 1897): Now vary from 1½in. to 2¼in. in length (the smaller in the fourth, larger in the fifth, instar). The short fur dull brown, the long hairs dark brown or black; still retain the interrupted, whitish, mediodorsal band (composed of tufts of white hairs) broken up into discontinuous spots, one on each segment; the subdorsal white band (or line) fairly clearly marked; traces of the oblique stripes present (these can be traced on some of the hybrid *viburni* × *quercûs* larvæ but are not present as a rule in the larvæ of Cannes var. *meridionalis*); traces of bright blue shading still to be seen on velvety-black of the intersegmental areas, (apparently the remnant of a blue subdorsal band). *? Sixth instar* (November 7th): One larva now in adult plumage; the urticating fur uniform bright-brown in colour (very much darker than in *L. quercûs*); the long hairs of the same colour (not paler or white as in var. *viburni*); the colour, spots, &c., of thorax as in English *L. quercûs*. Head—dark indigo blue with just a trace of red on cheeks (Bacot). Three forms of the young larvæ of *L.* var. *callunae* are figured by Buckler (*Larvæ* &c., pl. xlvii., figs. 3, 3*a* and 3*b*). He also figures (3*c*) the larva just previous to the last moult, and the fullgrown one (3*d*). Cocoon: Dark, brown-black; male cocoons somewhat paler than those of females; oval in shape, twice as long as broad, both ends almost equally rounded; of a close, thin, papery texture, readily splits at that end towards which the head of the pupa lies; the inside smooth; the cast larval skin lies loosely at anal end. Reid says: "It is found among moss at the roots of heather, being most frequent round the edge of large stones or by the sides of footpaths or overhanging brooks." Gordon notes: "Often spun among heather and consists of a loose superstructure enclosing the hard, darkbrown, oval-shaped cocoon proper." Horne says there is always some loose spinning about the cocoon of *callunae*. The larvæ, he states, usually spin up among the moss, around the roots of the heather, sometimes, however, they spin higher up like *Saturnia pavonia*, but such cocoons rarely maintain their position through the winter, getting shaken down among the roots by the wind; Arkle found cocoons on the rocks at Tan-y-Bwlch; Cheesman in Hoy finds cocoons amongst heather and moss, almost on the ground, well concealed, the colour harmonising well with that of the environment; Chapman notes the cocoons as being found on heather in Argyllshire generally close to the ground. Tyrer states that he has often obtained winter cocoons by raking grassy banks, and Tunaley obtains them at Derby in winter at the bottom of hawthorn hedges (*vide*, *posteà*). Hewett avers that in Yorkshire the cocoon of *callunae* is lighter than that of *L. quercûs*; this was decidedly the case with one that we obtained from a larva found on Mont de la Saxe, near Courmayeur, and which was quite bright yellow ochreous in tint. PUPA: The pupa active, moves about much within the confined area of its cocoon. The skin delicately wrinkled transversely; the legs and antennæ very finely and distinctly segmented; the thoracic segments, wings, and ventral limbs purplish-brown in female, red-brown in male, these portions of body being covered with a delicate bloom; the head ventral, an upper projecting dorsal head-piece with narrow semilunar glazed eye on either side; labrum above, and ? mandibles on either side of, labial palpi, well-developed; labial palpi, maxillæ, and two (1st and 2nd) pairs of legs enclosed in the area bounded by the antennæ; the latter reaching about two-thirds along costa of wing; beyond tips of antennæ the third pair of legs extend to the apices of wings, separating the costæ of the two wings; in male the antennæ extend farther and the second pair of legs are more conspicuous; the prothorax placed quite frontally; the prothoracic spiracle in the pro-mesothoracic incision; the mesothorax large, swollen dorsally, expanding laterally without a break into forewings; the metathorax contracted, wrinkled, much reduced centrally; the hindwings rising from it traceable narrowly along inner margin of forewings; forewings well-developed, the nervures distinct, and slightly ridged; wing dark-coloured yet transparent and the internal structures to be seen beneath it; the abdominal segments ventrally and dorsally paler red-brown than other parts of the body, but the contrast much less strongly marked in ♂ than in ♀; the first abdominal segment much contracted, the 2nd, 3rd and 4th increasing in size, the pupa attaining its greatest width at 4th segment, the movable incisions in both sexes between 4-5, 5-6, 6-7, abdominal segments; the skin of movable incisions very smooth; spiracles on abdominal segments 2-7 conspicuous, that on 8th aborted; spiracles narrow, almost linear, with well-marked, shining, black rim; the anal segment blunt, thickly studded with short, red-brown hairs. The peculiar head-structure, the legs, and the character of the striations of the ventral surface remind one of the similar structures in the pupa of *Dimorpha versicolora* [Description made January 27th, 1897, from pupæ sent by Mr. Horne of Aberdeen]. LARVAL HABITS: Larvæ feed from June until August of the following year, the pupal stage lasting thence until June, so that the insect takes two years to reach maturity and there must be distinct races appearing in alternate years (Reid); great differences exist in the size of larvæ in spring, *e.g.*, on May 18th, 1898, at Corsemalzie, several halfgrown ones were found, also two small ones, with two large ones on the same heather bush, although they usually feed singly; contrary to what might have been expected the largest did not spin up till the end of July and the imagines appeared in June, 1899 (Gordon); the larvæ are fullfed in mid-August in the valleys of the Upper Engadine (Mengelbir), the larvæ also fullfed in August, the insect hybernating in the pupal stage in the mountains of Silesia (Prittwitz); fullfed larvæ are to be found in August on heather on all the moors of the Scotch Highlands including Skye; the imagines from these emerge the following year at the beginning of June; one also finds young larvæ at the same time as the fullfed ones; occasionally one must feed up more rapidly and emerge without hybernating as a pupa, as an imago was taken on August 15th, 1895, on the moors of Argyllshire (Christy); larvæ are to be found by day among the dead sallow-leaves, and at night on the sallow stems (Gregson); the ♀ lays eggs round the stems of heather* in May and June; the larvæ emerge in from 14-21 days, feed during summer and autumn, undergoing three moults during this period, then descend to roots of heath, and spin a slight web on which they remain during the winter months; they reappear in following spring, feed during summer, undergo three or four more changes of skin and pupate in August and September, the imagines emerging in May and June the next year (Shipston); in Hoy the ova are deposited about the middle of June, hatch early in July, the larvæ feed slowly and hybernate in second (or third) stadium from the end of August until early May, feed on slowly again till the end of August or beginning of September (August 27th to September 13th, 1898) and then pupate, imagines appearing the following June (Cheesman); at Rannoch, in Arran, and on all the Scotch moorlands, one sees many large larvæ late in autumn, whilst one finds, not only here, but in the Orkneys, &c., in April, young larvæ, larvæ fully half-grown, and pupæ on the same day; the larvæ remaining

* This we consider is an error of observation. The eggs noted were probably those of *Macrothylacia rubi* or *Saturnia pavonia*. See also Parke (*Zool.*, p. 8647), who considered them to be the ova of *Saturnia pavonia*.

abundant throughout the summer and autumn, yet the young ones are rarely seen during this part of the year; the larvæ appear in great profusion in Hoy in some years, but have not yet been found in the Shetlands (McArthur); as observed in Argyllshire the insect takes two years to mature, commencing its existence about July 1st in the oval state; the larvæ emerge from the egg in 24 days, and by the end of autumn are fully an inch long, and then pass their first winter in the larval state resting on heath; they become fullgrown larvæ in August of the next year, spin their egg-like cocoons and pass the second winter as pupæ; imagines appearing the following year from middle of June to middle of July (Chapman); eggs at end of June, on Cannock moors, hatch in 10 or 18 days according to temperature; larvæ hybernate during winter about 1½ inches long; fullfed next year in July and August, and spin up, a few of the early ones emerging in August if weather be favourable, but most going over till the third week in June of the following year (Freer); ♀ captured at dusk ovipositing whilst flying along a grassy bank between two fields at Pwllheli, July 17th, 1895; no heathy ground or moorland near (although the ♀ is of the *callunae* form); eggs were laid and hatched, and the larvæ fed on willow, bramble, hawthorn, privet, ivy; they fed right on, pupated before Christmas, 1895, and the imagines began to emerge April 4th, 1896 (Nicholson); larvæ abundant at Crosby, May 21st, 1881, over-wintered as pupæ, and emerged next year (Walker); from the moors about Harrogate young larvæ were obtained, these hybernated all the winter, fed up next spring and summer, and pupated in September, went over the winter as pupæ, and the imagines emerged following summer (Ridley). Routledge notes that on October 12th, 1894, an imago emerged from a pupa of the year, all the other pupæ obtained going over, at Carlisle. Larvæ on Rhombald's Moor, May 17th, 1896, about half-grown; the larvæ at this time closely resemble the twigs of heather on which they rest, and are very difficult to detect; about 7 p.m. the larvæ move up the twigs to feed (Hewett). Sometimes pupæ go over two years, making the life cycle occupy three years altogether, *e.g.*, a larva spun up in 1898, went over two winters as pupa, imago emerged June, 1900, at Keswick (Beadle); larvæ, June 17th, 1883, at Duntroon, 11 females and males emerged June 6th—18th, 1884, the remainder did not emerge till June, 1885 (T. Briggs); larvæ of 1879, pupated autumn of 1879, did not produce imagines till June, 1881 (Lowrey); pupæ from Ilkley Moor, December, 1898, imagines emerged June 6th—16th, 1899; a pair of these copulated June 12th, larvæ appeared July 2nd, 13 had spun up by October 12th, 1899, others were then of varying size from one-half inch to fullfed, the small ones hybernated, the larger ones died, whilst of those that pupated 7 emerged June 17th—July 19th, 1900, the other cocoons contain pupæ that are going over a second winter (1900-1901) in the pupal stage; the hybernating larvæ spun up in September and October, 1900, and are going over the winter 1900-1 with the others (Butler). FOODPLANTS.—Practically polyphagous (Chapman), almost all low-growing plants, heather, &c., on moors (Reid); broom, birch, plum (Pearson); blaeberry, bog-myrtle (Gordon); *Calluna*, sallow (Dalglish); aspen (Newman); oak (White); poplar and hawthorn (Elliot); bramble (Clarke); *Hippophaes rhamnoides* (Tutt); mountain-ash (Cheesman); ivy (Hutchinson); privet (Nicholson); gorse flowers (Robinson). HABITS AND HABITAT.—The male flies by day, especially in the afternoon, the ♀ immediately after impregnation (Reid); males fly strongly in sunshine (Gordon), not only in the sunshine, but also at sunset, whilst the ♀s fly very late, several caught on the wing after 10 p.m. (Dalglish); males on wing during the hottest part of day, the ♀s only at dusk, when oviposition takes place, then, however, their flight is rapid (Day); males fly freely over the moorlands at Galashiels in June, assembling freely to the ♀s in the evening (Haggart); the males fly in the sunshine over the bogs and moors in Ireland, average dates, June 23rd—27th (Kane); newly-emerged females frequently picked up in Glen Mallon, July, 1897, at rest on heather (Dalglish); bred a ♀ *callunae* on July 2nd, 1897, to which males of typical *L. quercûs* assembled freely at Boxworth (Thornhill); the males fly by day and the females in June and July at dusk in Cumberland (Routledge). Elliott states that the imago emerges from 8 p.m—12 p.m., but Hewett says that the majority emerged at York between 1–2.30 p.m., although one male and one female emerged between 7.30 and 9 p.m., and another between 10 p.m. and 6 a.m. The males, he adds, assemble most freely between 11.30 and 2 p.m. Edleston observes that the females come out in the early forenoon, and the males fly directly after mid-day. The habitats of this form are not very varied, being almost always moorlands of some form or other, maybe they are bleakly exposed, sometimes on mountain sides, at others more or less sheltered by scrubby wood, still *callunae* is essentially a moorland form. Thus we have—open moors and hills to about 2,000 feet all over central and northern Scotland (Reid); on moors and in woods in Moray (Gordon); on the moors throughout the Rannoch district (G. O. Day);

on the moorlands at Galashiels (Haggart); abundant on all the moors of Aberdeenshire; scarce at Muchalls, on the Kincardine coast (Horne); on all the moors round Corsemalzie (Gordon), at Hoy prefers the heathery mosses from the seashore to the base of the hills, rarely going far up the hills (Cheesman); swarming at Hoy on the heather on the north part of the island, July, 1895 (Horne); abundant on the moors of Arran and Rannoch, but rare on the moors of Lewis (McArthur); generally distributed over (and possibly the only form in) Ireland, prefers the bogs and moors (Kane); abundant on the sides of the Tyrone mountains that are covered with heath and fern (Greer); on railway embankments and on boggy land at Galway; on the bogs and mountains about Enniskillen (Allen); on the heaths at Perth, where Wylie asserts that *quercûs* is as common as var. *callunae*, a very doubtful assertion; on the moors at Whitby (Lockyer); moors about Harrogate (Ridley); on the broom, birch and heather on the mountain sides of Crafnaut and Capel Curig (Pearson); on the heaths of the Wye Valley (Vaughan); on the mosses around Carlisle (Day); abundant on the mosses, heaths and sandhills of Lancashire and Cheshire (Ellis); on the heaths at Ringwood (Fowler); on the heaths in the western part of Durham on ling (Gardner); on the Northumbrian moors (Nicholson). TIMES OF APPEARANCE.—Middle of May to middle of July in Scotland (Reid), occasionally emerging in August in English localities (see *posteà*); larva, August, 1832, pupated in autumn, imagines May 29th, 1833, at Lycksele, in Lapland (Zetterstedt); larvæ from Halifax, June 9th, 1860, pupated in autumn, imagines emerged from June 21st, 1861; also bred several from Aberdeen pupæ from June 9th—16th, 1890 (Fenn); larvæ on Rannoch moors, August 9th, 1860, and at Spaen Bridge, August 12th, 1860 (Keays); May 7th, 1861, bred from Scotch pupæ (Huckett); larvæ on Whitby moors, August, 1866 (Lockyer); imagines, June 19th, 1867, at Rannoch, June 8th, 1870, at Kirriemuir (White); imagines, June 13th, 1870, at Braemar (Traill); larvæ in hundreds on Rhombald's Moor, Bradford, on June 1st, 1881 (Carter); imagines common at Rannoch in May, 1898 (G. O. Day); larvæ, July 5th, 1883, on Faraway Moss (Shuttleworth); imagines, July 15th, 1886, at Tarbert; May 25th—28th, 1893, June 5th—8th, 1895, at Loch Riddon; and 2 ♀s, just emerged, taken, July 11th, 1897, in Glen Mallon (Dalglish); imagines, August 8th, 1886, June 25th, 1890, June 19th, 1894, June 28th, 1896; larvæ, June 26th, 1897, June 7th, 1898, June 14th—15th, 1899, at Carlisle (Wilkinson); imagines, June 14th, 1889, June 2nd, 1895, at Hayton Moss; June 12th and July 1st, 1897, a female captured on each of last-named dates about 10 p.m. (Routledge); bred June 18th—22nd, 1890, from Aberdeen pupæ (Daws); larvæ, June 27th, 1890, at Rixton Moss (Collins); at Galway, larva, June 5th, 1892, pupated same year, imago emerged June 18th, 1893 (Allen); bred June 6th, 1893 (♂), at Penrith; larvæ, April 16th—May 5th, 1894, at Penrith; others, May 31st—June 19th, at Aberdeen; emerged July 6th, 1894 (♀), May 30th (♂), May 31st (♀), June 1st (4 ♀s), June 2nd (♀, 2 ♂s), June 5th (♂), June 6th (♀), June 7th (2 ♂s), June 10th (♀), 1895; captured at Penrith, July 7th, 1894 (2 ♂s); at Aberdeen, June 5th (♀), June 8th (2 ♂s, 1 ♀), 1895; at Penrith, June 26th (♀), 1896 (Varty); fullfed larvæ, July 29th, 1894, at Haverthwaite; imagines, July 24th, 1894, at Heysham Moss; July 25th, 1894, at Witherslack (Arkle); larvæ, fullfed, June, 1894, on ling at Keswick (Beadle); larvæ, abundant, September 10th, 1894, in southern Argyll (Christy); imagines, end of June, on Skiddaw (Beadle); imagines during July, 1895, at Pwllheli (Nicholson); bred from Aberdeen pupæ, June 2nd—12th, 1895 (Prout); through June, 1895, in Glen Lochay; June 17th — 21st, 1898, at Rannoch, both imagines and larvæ (Morton); bred June 5th—29th, 1895, several males and females; many males assembled to virgin ♀s on Rhombald's Moor on June 9th and 17th; others bred May 31st—June 2nd, 1896; half-grown larvæ, June 26th, and others nearly full-grown, July 9th, 1896; many ♂s and ♀s bred from Rhombald's Moor, June 22nd—July 4th, 1897; many males assembled, June 27th and July 4th, almost fullfed larvæ also taken on the moor on latter date; fullfed larvæ from the moor, July 22nd, 1898; imagines, bred July 4th, 1899 (Hewett); June 9th, 1897, at Winster; July 1st, 1897, at Rowdsey Moss (Cotton); May 16th—19th, 1895, larvæ 2 inches long on Quhillart moor, began to spin July 14th, emerged 1896; abundant at Corsemalzie from June 27th—July 11th, 1898; one male bred on September 4th from cocoon formed during the preceding July; first seen on wing in 1899 on July 12th, and continued throughout the month (Gordon); ♀ taken on heather, and larvæ about 1 inch long collected, May 25th, 1896, at Great Ayton; moths from these emerged July 6th—25th, 1897, one or two ♀s being very dark; one laid ova that hatched August 12th, 1897, the larvæ went through winter small, but two or three fed up rapidly in spring and pupated about midsummer, 1898; the rest spun up later; many larvæ three-parts grown found July 11th, 1898, at Ribsdale (Lofthouse); imagines, bred May 29th, 1895, others captured June 24th—27th and July 10th, 1897, on heaths at Carlisle, ♂s flying by day, ♀s at dusk to oviposit (F. H. Day); three nearly fullfed larvæ, on July 7th, 1897, on Sleight's Moor, and at same time a worn ♀ sitting on heather on open moor (Ash); larvæ nearly fullfed, on heather, May 18th, at Altadiawan (Kane); larvæ, May 1st, 1897, at Heswall, hybernated as pupæ, imagines emerged in 1898; other imagines captured, same locality, August 5th, 1895 (Freeman); ♀ emerged June 8th, 1897, from cocoon spun by larva taken at Capel Curig (Tetley); bred ♀ on July 3rd, 1897, at Boxworth, to which ordinary local males assembled freely (Thornhill); larvæ, August, 16th, 1897, at Whitby (James); larvæ and imagines, May 21st—31st, 1898, at Galashiels (Haggart); larvæ on August 25th, 1898, on mts. of Dungannon (Greer); bred between June 30th—July 12th, 1898, from Aberdeen pupæ of 1897 (Adkin); larvæ, 2—2½ inches long, abundantly at Capel Curig, June 2nd—3rd, 1898, feeding on heather on mountain slopes, fed on plum, on return to Notts, till fullfed in August, when they spun up (Pearson); imagines and larvæ abundant June 8th—22nd, 1898, at Rannoch (Porritt); imagines, June, 1898, at Rannoch; also larvæ, three-quarters grown, one of which reached an enormous size, and emerged in June, 1899, at Bournemouth (Cowl); June 1st is a good average for favourable seasons at Hoy, imagines found June 2nd—28th, 1898 (Cheesman). Localities. – In Ireland, there is no county known that has been worked by an entomologist where *callunae* does not occur (Kane); certainly the prevalent form throughout Scotland, the northern counties of England, and the highlands of Wales; overlapping the typical form in the midlands, western, and south-western counties. Aberdeen: All moors near Aberdeen (Horne), Pitcaple (Reid), Pitfour (Mutch), Castleton, Braemar (Traill). Anglesea (Blagg). Argyll: Common along all the west coast of Scotland (Chapman), Tarbert, Lochgoilhead, Loch Fyne (Dalglish), Carradale (Ord), Kilmartin (Vaughan), Loch Riddon (Christy), Kilberry (Cottingham), Duntroon (Briggs), Dunoon (Stainton). Ayr: Ayr (Fergusson), Beith (J. Smith), Shewalton (Rose), Straiton (Dalglish). Brecon: Wye Valley (Vaughan), Black mts. (Kane). Bute: I. of Arran, Brodick (Stainton), I. of Bute, common, Cumbraes, common (Dalglish), Lamlash (Mackay). Carnarvon: Tan-y-Bwlch (Arkle), Pwllheli (Nicholson), Llanwrst (Cotton). Cheshire: mosses, heaths and sandhills throughout the county (Ellis), Bowdon, Carrington Moss (Edleston), Heswall (Freeman). Cork: Queenstown (Bond). Cumberland: mosses around Carlisle, Durdar, Todhills, Bolton Fell, Bowness (F. H. Day), Orton Moss (Stephens), Penrith (Varty), Hayton Moss, Gelt Wood (Routledge), Keswick, Skiddaw (Beadle). Derby: Breadsall Moor (Sheldon), Little Eaton, Derby (Hill). Devon: Exmoor* (Bacot), Buckerell (Riding). Donegal: Donegal (Campbell). Dorset: Portland (Forsyth). Dumbarton: Glen Mallon, Luss, Arrochar, Glenfalloch, Isles of Loch Lomond (Dalglish). Dumfries: Dumfries (Lennon). Durham: moors in west of county (Gardner), Bishop Auckland (Greenwell), Chopwell, Marsden (Hedworth), Shull (Backhouse), Highforce (Howse), Hartlepool (Lees), Darlington (Milburn). Fermanagh: Enniskillen (Allen). Flint: Overton (Perkins). Galway: Galway (Allen), Ardrahan (Kane), Gloucester: Bristol dist. (Clarke). Hants: Lyndhurst (Prout), Ringwood (Fowler). Hunts: Fens (Harding). Inverness: Inverness (Barclay), Outer Hebrides, Lewis (McArthur), Skye (Christy). Isle of Man: mountains and heaths (Clarke). Kerry: Killarney (Birchall). Kincardine: Muchalls and coast districts (Horne). Kirkcudbright: Douglas (Robinson). Lanark: Lamington, Carluke (Dalglish), Steps (Ord), Douglas (Mackonochie). Lancashire: mosses, heaths and sandhills throughout county (Ellis), Rixton Moss (Collins), ? St. Anne's-on-Sea (Baxter), Crosby (Walker), Chat Moss (Gregson), Formby (Moss), Clougha Pike, Heysham Moss, Haverthwaite (Arkle), Faraway Moss (Shuttleworth). Limerick: Castle Cornell (Marsden). Lincoln: Hartsholme (Carr). Londonderry: Londonderry (Campbell). Merioneth: Barmouth (Imms). Capel Curig, Crafnaut (Pearson). Moray: Forres (Norman). Nairn: Ardclach dist. (Thomson). Northumberland: nr. Hexham, Gilsland (Nicholson), Twizell (Robson) Ridewater dist. (Howse), Morpeth dist. (Finlay). Orkneys and Shetlands: abundant—Hoy,

* McArthur notes that he has found *L. quercûs* fairly common on Exmoor, feeding on heath, the young larvæ appearing early in the spring, feeding up, pupating, and emerging in about the same time as the larvæ do on the south coast; the imagines, however, are slightly darker than south coast specimens; in confinement the larvæ readily ate sallow, whitethorn, &c,

Pomona (Cheesman), absent in Shetlands (McArthur). PERTH: throughout the county on the moors—Kirriemuir, Glenfalloch dist. (White), Perth (Wylie), Glen Lochay, Rannoch (Morton), Methven Moss (Bush), Callander, Aberfoyle (Evans), Camachgouran (Longstaff). RENFREW: Port Glasgow (Cross), Kilmalcolm (Dunsmore), Mearns Moors (Dalglish). ROSS: Contin (White), Outer Hebrides (McArthur). ROXBURGH: Hawick (Guthrie), Galashiels (Haggart) Jedburgh (Elliot). STAFFS: Cannock dist. (Bostock), Rugeley (Freer), Burnt Wood, Market Drayton dist. (Woodforde). STIRLING: Drymen (Ord), Fintry (Eggleton), Stirling (Sim *teste* Studd). SUTHERLAND: Lochinver (Beveridge), Strathmore, Milness, &c. (Mackay). TYRONE: Tyrone, Dungannon (Greer), Altadiawan (Kane). WESTMORLAND: Witherslack (Porritt), Winster, Rowdsey Moss (Cotton), Windermere, Kendal (Moss). WIGTON: Monreith (Morton), Corsemalzie dist., Whauphill, Quhillart Moor, &c. (Gordon). YORKS: very common on moorlands of West Riding (Butterfield), Crosland Moor, Huddersfield, Linthwaite (Porritt), Whitby, Sleight's Moor, (Ash), Harrogate (Ridley), Exton Hills, nr. Battersby, Lennington, Great Ayton, Ribsdale (Lofthouse), Birstwith (Walker), Halifax (Fenn), Greetland Moor (Shipston), Rhombald's Moor, Leeds (Hudson), Cloughton Moor (Head), Newlandale (Hall), Bradford (Carter), Coltherstone (Hewett), Danby, Ribblehead (Pearson), Ilkley Moor (Beauland). DISTRIBUTION.—AUSTRO-HUNGARY: Bucovina (Hormuzaki), Carpathian mountains (Caradja), the Riesen and Marienbad (Nickerl). BELGIUM: Once nr. Taviers, 15 miles from Namur (Lambillion). DENMARK: heath districts (Bang-Haas). GERMANY: mountains of Silesia (Prittwitz), nr. Ueberlingen, Eckberg, nr. Säckingen (Reutti), Thuringian mountains (Krieghoff), Saxon Upper Lusatia (Schutze), Dresden (Steinert), mts. of Würtemburg (Hofmann), Oberursel (Schmid), Rheingau (Fuchs), Cassel (Jordan), Wolmar (Lutzau). ITALY: Piedmontese mountains, Courmayeur (Tutt). NETHERLANDS: heath districts (Snellen), Upper Hartz (Heinemann). RUSSIA: Baltic provinces, Treiden, &c. (Nolcken). SCANDINAVIA: Sweden, East Gothland (Lampa); southern Lapland, rare—Lycksele, &c. (Zetterstedt). SWITZERLAND: Upper Engadine* (Mengelbir).

Possibly as much has been written of this local race of *L. quercûs* as of any other insect inhabiting Britain. It was introduced as a distinct species in 1847, by Weaver, and many discussions took place as to whether it should or should not be so considered, these discussions being largely based on differences in the appearance of the larva and the imago, and physiological differences in the economy of the insect as compared with the normal habits of *quercûs* in our southern counties. Weaver insists (*Zool.*, 1856, p. 5403) on its specific distinctness, gives *callunae*, the larvæ of which he first found in 1844 on the Rannoch moors, the name of the "Scotch Eggar," says that it is of a darker colour, the antennæ one-third longer with 84 antennal joints (*quercûs* 64); the larva, more or less bluish in parts, the underside brownish with a row of large black spots, the cocoon larger, rough, dark brown in colour, the insect requiring two years to undergo its transformations. Doubleday, who was very keen on the differences between *quercûs* and *callunae*, and inclined to give the latter specific rank, notes *quercûs* as having "larvæ found on whitethorn hedges, fullfed early in June, when they spin up, remaining six or eight weeks in the pupal stage, the moths appearing about the end of July or beginning of August." It differs, he says, from *callunae* in the form of the band on both upper and lower wings, on the upper wings of *quercûs*, the band always turns inwards on the lower margin, in *callunae* it turns outwards, whilst on the lower wings of *callunae* the yellow band turns down to the anal angle, while in *quercûs* it is nearly a semi-

* Mengelbir notes that Pfaffenzeller gives "*spartii*" as occurring in the Engadine, but adds that he suspects that Pfaffenzeller was referring to the dark-coloured form of *L. quercûs*, the var. *spartii* being a southern form. Pfaffenzeller was evidently right; at any rate Mengelbir is entirely wrong in calling *spartii* a southern form.

circle. He states that he believes that in all the northern examples the white spot on the upper wings of the male is seen on the under as well as on the upper surface, but he never saw the least trace of it on the underside of the wings of *quercûs*, and really thinks *callunae* is a species distinct from *quercûs*, the general appearance of the two being so different (*teste*, Robson, *Young Nat.*, iv., p. 157). We are now aware that none of the differences on which reliance has been placed for the specific separation of the forms holds absolutely, although the racial peculiarities are, on the whole, abundantly evident. The Cheshire, Lancashire, and Yorkshire coast districts seem to be the most northerly limits of pure *quercûs*, all specimens exhibiting the *quercûs* characteristics of habit, physiological peculiarities, &c., coming from the north of this area being either off-shoots towards the *quercûs* form from the ancestral *callunae* race, or, on the other hand, they may be considered as exhibiting atavic traces of the ancestral *quercûs* form, if, indeed, *quercûs*, and not *callunae*, be the older form. Although *callunae* may be considered, in general, as the moorland race of these islands, it is, nevertheless, true that special racial peculiarities are developed in the specimens of different localities, which are less or more particularly marked as they approach to, or are very different from, the normal habitats of typical *quercûs*; in some of these localities, too, there is a much less perfect segregation of the moorland form, than occurs, for example, in the high moorlands of Scotland, or in the outlying islands of the outer Hebrides, the Orkneys, &c. Apart from these differences, there are also large numbers of individual aberrations of *callunae* recorded, and it is probable that ab. *olivaceo-fasciata* belongs almost entirely to the *callunae* race. Edleston notes of the *callunae* taken (and bred) at Carrington Moss: "The specimens are most variable, especially the males, some are very small, others very large, some deep chocolate, others reddish-brown. I possess a male and female olive-brown. The basal tawny patch is developed in an extraordinary manner through all gradations to none at all, and the tawny bands assume all sorts of forms being sometimes very broad at others dwindling down to a narrow streak, while yet others occur, but rarely, without any band at all. The female is not so liable to these extraordinary changes, and it is chiefly in the tone of colour that variation occurs, some examples being very dark and others very light, the largest and darkest females coming from the moors. Newnham notes an aberration in which the right and left hindwings have two teeth, the dentations making them appear similar to those of *Eutricha quercifolia*. Studd has a male bred by Sim, May 31st, 1891, from a larva found in Stirlingshire, all the wings of which are of a dark claret-colour, the forewings with a narrow yellow band, the hindwings unicolorous with no band; Adkin has a female, the outer half of each wing scaleless yet with the fringes developed, and Varley used to breed transparent-winged forms from Huddersfield larvæ; Hewett has a ♀ without the pale band on hindwings, and a male with the bands suffused with olive, whilst Porritt notes a female, chocolate-coloured, with the usual band replaced by one of dark olive-green; Walker bred a ♀ from a Crosby larva with the basal half of the upper- and underwings of a dark chocolate-brown, bounded by a median line of a darker shade, whilst beyond the outer margin of this line lies a broad band of dark olive-green which gradually merges into the ground colour; the spot in upperwings pure white. Horne states that a long series bred from Hoy are distinctly darker than Aberdeenshire specimens, and Gordon notes that the females from Corsemalzie are much darker than New Forest specimens, whilst Kane records an Irish female with hindwings very dark brown like the male; Marsh notes the breeding of a male, in 1887, minus the left hindwing, otherwise perfect; a male exactly the colour of a female was captured in Lancs. (Sumner). That our own moorland form is well distributed on the continent under identical conditions, and also exhibiting exactly the same peculiarities in its economy, as in Britain, is shown by the following: Krieghoff notes that, in Thuringia, *L. quercûs* hybernates as larva, but on the higher mountains as pupa; Schütze observes that in Saxon Upper Lusatia the pupa sometimes hybernates; Steinert notes that at Dresden some examples go over the winter in the pupal stage; Hormuzaki says that it is certain that, in the Carpathians, at 1500m.-1800m. elevation, *L. quercûs* requires two complete years for its development, and, in the second winter, at least generally, hybernates as a pupa; Hoffmann and Keller state that, in the higher mountains of Würtemburg, the moth (quite like the Scotch var. *callunae*) flies in the latter half of May and in June, the hybernation being double, first as larva, second as pupa; Schmid says that at Ratisbon some examples stay, not infrequently, two years in pupa; Bang-Haas notes that in the heath-districts of Denmark fully grown larvæ as well as young ones are found in August, the former hybernating as pupæ the imagines emerging at the ordinary time (July and beginning of August); Snellen says that, in the Netherlands, the dark chocolate-brown ♂ s with a yellow spot at base of forewings and brown-dusted antennal shaft are bred chiefly from heath larvæ; Nickerl says that *L. quercûs* occurs everywhere in Bohemia but has two races —in Prague the imagines fly at the end of July and in August, the progeny hybernating as larvæ, whilst in the Riesen and at Marienbad the imagines appear in June and the progeny pupate the same year (?), hybernating in that stage; Lutzau notes that, at Wolmar, transitions to ab. *callunae* occur, and he gives the latter half of May and beginning of June as the time of their appearance; Heinemann records finding a fullgrown larva on heath in the Upper Hartz, at 3000ft., at the end of July, which pupated and hybernated in the pupal stage; Nolcken notes that, in the Baltic provinces, Teich found fullfed larvæ in August, 1865, which overwintered as pupæ, and Bienert found a larva at Treiden which pupated at the end of July and did not produce an imago till the June of the following year. It is generally supposed that var. *callunae* alone is found in Ireland, bnt there are certainly some districts in which the usual habits of this race are not at all so completely segregated as in Scotland and certain parts of northern England. Allen gives (*in litt.*) an interesting note on this phase of the subject. He says: Near Galway, a larva found June 5th, 1892, on railway embankment, fed on oak, pupated same year, an imago emerged June 18th, 1893; another larva June 3rd, 1894, in the same district, on ling, pupated June 9th, and imago emerged July 30th, of the same year; near Enniskillen large larvæ were found on boggy land, September 17th, 1895, also almost fullfed larva on May 30th, 1896, on ground covered with ling, a half-grown larva at same place June 10th, 1896, another nearly fullfed one July 5th, 1897, and a very large number later in the autumn, whilst at the top of a mountain near Enniskillen a larva was found spinning its cocoon, March 31st, 1899, all of which, perhaps, go to suggest *callunae* as the usual form occurring in Galway and Enniskillen, except that the specimen bred in 1894 had definite *quercûs* habits. Much information is available on this point of overlapping areas, where part of a brood, or an occasional specimen of a brood, of *callunae* will give up the normal habit (of hybernating as a larva one winter, as a pupa the second winter, emerging at the end of the second year), and will complete its metamorphoses *quercûs*-like in one year. Thus we have: Larvæ at Dumfries, on heather, May 10th, 1860, pupated from July 14th, emerged from August 12th, 1860 (Lennon); the larvæ of *callunae* were very abundant about Forres in 1868, only one out of more than 20 pupæ, however, gave the imago the same year, *viz.*, on July 29th, all the rest went over the winter in the pupal stage, the summer being a late one (Norman); larvæ, Aberfoyle, April and May, 1896, one larva spinning up May 24th, the moth emerging July 5th, 1896 (Evans); on August 19th, 1891, a male emerged from a pupa, one of a brood the rest of which went over the winter of 1891-1892 and emerged in 1892 (Arkle); at Carlisle one imago out of a large number of larvæ of var. *callunae* reared, came out in October, all the rest emerging the following year (Routledge); of the fullfed larvæ that spin up and pupate in June or July, on the moors at Morpeth, a few imagines occasionally emerge at the end of August, but the usual time of emergence is about the end of the third week in June of the following year (Finlay); Nicholson's account already quoted (*antea*, p. 77) of a Pwllheli brood that completed its metamorphoses under favourable artificial conditions between July 17th, 1895 (eggs), and April 4th, 1896 (imagines), probably bears less on this point, and simply shows that some specially favourable circumstances in the oval stage were the main factors in the result, *e.g.*, such circumstances as those mentioned by Standfuss (*antea*, p. 49). Similarly, in the case of eggs from a Perth ♀, obtained August 15th, 1889, larvæ kept in living-room, full-grown by Christmas, spun up in due course, the first imago emerging July 1st, 1890, the others following directly after (Forrester). An almost parallel case is that in which Mera obtained eggs of *callunae* in June, 1899, three larvæ of which spun up in the autumn of the same year without hybernating, one of the cocoons producing a ♀ on June 11th, 1900. One of the most valuable series of field observations on this species was published by Edleston (*Zool.*, xvii., pp. 6815—6816); these observations were made on Carrington Moss, near Bowdon, and result as follows: Larvæ vary much in size in early spring, some grow in their later stages with amazing rapidity, and pupate and emerge in about a month, thus keeping the *quercûs* habit; others feed slowly till August and September, and then go into cocoon and pass the winter as pupæ. These latter give imagines near the end of June, but the later imagines (from cocoons of the year) keep on emerging until August. Edleston notes the largest and darkest specimens as coming from the moors, the lightest from the lanes; one might have been inclined here to suspect a mixing of larvæ, those from the lanes being true *quercûs*, and, therefore, those that emerged from cocoons of the year, those from the moors being *callunae*, and hybernating as pupæ, but this is not so, for of six moorland larvæ obtained at Carrington Moss on May 12th, 1858, four pupated prior to July 23rd, a ♀ emerging from one of the cocoons on July 24th, when two of the larvæ were still feeding; by August 2nd one of these larvæ had spun up, whilst another ♀ emerged, 20 fine selected males that assembled to her on the moss being taken the same day; on August 6th another ♀ emerged, and on the 7th, on the moss, males visited her also in great numbers; as a result, by the end of August, these six larvæ had given three imagines, two pupæ were going over, and one larva was still feeding. On May 9th, 1859, on Carrington Moss, Edleston took eight and Sidebotham some larvæ; two of Sidebotham's pupated in June, 2 ♀s emerged July 7th, at this time all the other larvæ were feeding; on July 19th one larva spun up, the others continued to feed till late autumn, so that, in this district, whilst some of the spring larvæ pupate in June and emerge in July and August of the same year, most of the others do not spin until August and September, and emerge the next year. Here there can be no doubt then, that, even on the moors, mixed *quercûs-callunae* habits prevail, and, as bearing on this point, Edleston adds that not only did the females bred from moorland larvæ attract wild moorland males in abundance, but they also attracted ordinary males from the lanes around Bowdon when placed in his garden for this purpose. Some of the dates of emergence, too, at Carrington, are unusually late for the moorland forms; thus, in 1858, the ♀s had evidently been out some time on Carrington Moss on July 14th, yet, on July 24th, August 2nd and August 7th, large numbers of very perfect males "assembled" on the moss to newly-emerged ♀s; also, in 1859, *callunae* was seen on the wing at the foot of Skiddaw, in Cumberland, on June 21st; and large numbers of ♂s were attracted at Carrington Moss on June 27th, and, again, on July 8th, yet they were still flying abundantly on the moss on the 18th, and probably much later. These details suggest that the more southern moorland (*callunae*) forms (*e.g.*, of our midland, western, and southern counties) emerge later (late June, July, and early August) than in Scotland (end of May and throughout June), and one suspects that Prout's record of a ♀ taken on an elevated heath in the New Forest at end of July, 1894 (one just emerged July 28th, and resting on a twig of *Erica* with unexpanded wings), may well have been this form, which Prout says it approached, although hardly agreeing with the best marked specimens of the *callunae* variety. On the experimental side, Young tells us that on August 15th, 1899, a ♀ *callunae* laid a large batch of ova. These were divided into four portions: (1) Kept in living-room, fed on crab and bramble, began to spin up Christmas, the first imago, a ♀, appearing on July 1st, 1900, and the rest continued rapidly to emerge on the following days. [This result is very similar to that obtained by Nicholson (*suprà*).] (2) Fed on bramble and crab, but kept in a cellar, began to pupate May 27th, 1900, and no imago had emerged up to July, 1900. (3) Similarly treated as the last, but all died off. (4) Kept in a shed out of doors, fed on crab till September, then placed (still out of doors) on a growing plant of bramble, partially hybernated, appeared to eat very little, and got rather smaller; about the middle of March placed back in shed, hawthorn and crab given as soon as leaves could be obtained, some began to spin up June 1st, others still feeding, in July. That the New Forest heaths are common ground for those forms of the species with the combined *callunae* and *quercûs* habits is clear from Fowler's note that "larvæ occur on the heaths and in the lanes, about an inch long in April, are fullfed in June, producing, in some cases, imagines in late July and August, whilst in other cases the pupæ go over the winter and the imagines emerge the following June." On several occasions, he adds, fullfed larvæ have been found in late August, which have pupated in due course, and produced imagines during the following June.

In concluding our notes on this form, we may mention that Newman describes (*Ent.*, ii., pp. 137—139) fully the superficial differences between the larvæ of *L. quercûs* and *L.* var *callunae*, the differences in their habits, &c., and then gives (*loc. cit.*, pp. 140—141) the following table, many of the characters mentioned in which, our own account shows to have no real specific value.

L. quercûs.	*L.* var. *callunae.*
Imago appears in July.	Imago appears in May.
Takes one year to come to maturity.	Takes two years to come to maturity.
Larva feeds on whitethorn, blackthorn and broom.	Larva feeds only on ling.
The young larva has a dorsal series of lozenge-shaped markings, white and orange.	The young larva has a dorsal series of triangles only.
Cocoon smaller and yellower.	Cocoon larger and browner.
The wing nervures in passing through the pale band of the wings assume its colour.	The wing nervures are darker than the pale band.
The lower extremity of the transverse bands of fore- and hindwings has a direction towards the abdomen, more especially marked in hindwings.	The direction of the lower extremity of the band is towards the anal angle of both wings.
Males of a ferruginous-brown colour.	Males umber-brown in colour.
Imagines smaller than var. *callunae.*	Imagines larger than *L. quercûs.*

Mrs. Battersby quotes (*Ent.*, xx., pp. 109—110) Doubleday as giving the following differences between the two forms:

L. quercûs.	*L.* var. *callunae.*
The white spot on the upper wings (presumably) of the ♂ to be seen only on the upper surface.	The white spot on the upper wings of the ♂ to be seen on the under as well as on the upper surface.
The transverse band on the upper wings turns inwards and on the under wings forms nearly a semicircle.	The transverse band on the lower margin of the upper wings turns outward, and on the under wings turns downward to the anal angle.

We suspect Mrs. Battersby is referring here to the quotation already noted (*anteà*, pp. 80—81). Doubleday also mentioned that he considered the form figured by Newman (*British Moths*, p. 43) to be the typical form of *callunae*. Many entomologists have disposed of the assumed differences tabulated above, and it is now well known that few of them, indeed, are always quite constant even in the same brood. There is sufficient general difference in appearance and habit to give us, in Britain, two good local races, but there can be no doubt that differentiation has not yet reached that point at which we consider the variant forms to be species.

ξ. var. *lapponica*, Fuchs, "Stett. Ent. Zeit.," xli., p. 123 (1880). ? *Quercûs*, Zett., "Ins. Lapp.," p. 925 (1840). ? *Spartii*, Lampa, "Ent. Tids.," vi., p. 41 (1885).—As var. *lapponica*, I received, in the autumn of 1879, from Herr Kricheldorff, a ♀, which, although of the same size as local specimens (38mm.), differs in the shape of the forewings, which are more pointed, and the outer margin, instead of being curved, forms a straight oblique line, and is, in fact, bent slightly inwards medially. I am unaware whether this is an individual peculiarity or whether it is always present in var. *lapponica* ♀. That the wing-form of *quercûs* varies in different localities is shown by my ♀s of var. *sicula*, the forewings of which are narrower and not so round as those of typical *quercûs*; var. *lapponica* has them just as broad but not so round as those of the typical form. Otherwise, var. *lapponica* ♀, like that of var. *tenuata*, is one of the dark forms. Its colour is darker yellow-brown than the darkest of my Oberursel females. The broad transverse band is brighter yellow, which makes it more prominent on all four wings. The fringes of the forewings are lighter than in *L. quercûs*, those of the hindwings are pure yellow (Fuchs).

o. var. *olivaceo-fasciata*, Cockll., "Entom.," xxii., p. 3 [with reference to "Ent.," xi., p. 103 (1889)]. *Quercûs*, Frohawk, "Ent.," xxxiii., pl. iii., fig. 8 (1900).—*Lasiocampa quercûs olivaceo-fasciata*, *Entom*, xi., p. 103, due to development of green pigment; probably the change in the *Lasiocampa* represents the excessive metabolism which normally only attains the brown and black stages (Cockerell). The reference (*Entom.*, xi., p. 103) simply reads: "Messrs. Porritt and Varley showed . . . . an olive-banded variety of *Lasiocampa quercûs* from Huddersfield."

This aberration was first figured by Engramelle (fig. 225*g*) from Gerning's collection, and is described as having "the bandelette greenish." Borkhausen speaks of this (*Sys. Besch.*, iii., p. 464), and Guénée also refers to it (*Ann. Soc. Ent. France*, 1858, p. 441). Edleston observes (*Zool.*, xviii., p. 6815) that he has two olive-brown examples (♂ and ♀) from Carrington Moss. Gregson notes (*Ent.*, iv., p. 13) a female, of a dark olive-green-brown, without any markings whatever upon it except a faint indication of the central light spot. Porritt writes (*i.l.*) that he bred, on July 1st, 1873, from a single larva picked up on Crosland Moor, nr. Huddersfield, in 1871 (or 1870), the pupal stage lasting two (or three) years, a ♂ of rich chocolate-brown colour, with the bands on all the wings and the margin of the hindwings clear olive-green, though the olive-green extends over a wider area than the yellow in ordinary specimens. By 1883, Porritt noted (*List. Yorks. Lep.*, p. 29) that two or three others had been bred. Walker notes that, from a Crosby larva taken in 1880 which wintered as a pupa, a ♀ was bred with the basal half of the upper- and underwings of a dark chocolate-brown banded by a median line of a darker shade. Beyond the outer margin of this line lies a broad band of dark olive-green, which gradually merges into the ground colour. The spot in upperwing pure white. Pearce records (*Entom.*, xv., p. 254) that, on July 28th, 1882, a ♂ emerged at Portsmouth of a deep chocolate colour, with the usual white spot in the centre of the forewings; the stripe across both pairs of which is narrow and of a deep green colour, and the fringe of the underwings is of the same colour as the stripe. The larva was black, with the usual white markings; the cocoon was also black. Porritt again notes (*i.l.*) another ♂ and ♀ from Rhombald's Moor in 1893, the ♀ bred, and the male obtained by assembling; another ♀ is recorded by Porritt as bred in June, 1894, from a Huddersfield larva, with a deep chocolate band very fairly tinted with dark olive. Tunstall records breeding in June, 1898, from a larva obtained on Royd's Edge Moor, nr. Huddersfield, a dark chocolate ♀ with the band very faintly traced in dark olive; and Porritt states that yet another ♀ is recorded from Norland Moor, some five miles from Huddersfield in another direction. Hewett has three ♂ specimens all from Rhombald's Moor in his collection, taken by "assembling," and says that the olive-green colour of the band is so apparent that it can be detected when the insect is on the wing. The example figured in *Entom.*, xxxiii., pl. iii., fig. 8, is stated to have been bred by Purbrook of Brighton, its locality not being mentioned. It is described as having the pale median band of a light greenish-olive, which gradually blends into the marone or purplish-brown margin, the underside being similarly coloured to the upper, but somewhat paler.

π. ab. *olivacea*, n. ab.—The whole of the wings suffused with greenish, and not merely the transverse bands so tinted as is the case with ab. *olivaceo-fasciata*. This form is even rarer than the last-named.

ρ. ab. *fenestratus*, Gerhard, "Berl. Ent. Zeits.," xxvi., p. 128 (1882); Kirby, "Cat.," p. 828 (1892). *Fenestrata*, Auriv., "Iris," vii., p. 150 (1894).—An interesting form, frequently bred from hybernated pupæ. The yellow band beyond the middle is, on both fore- and hindwings, as also in both sexes, rubbed-looking, and the whole surface appears transparent (Gerhard). "? Leipzig."

These more or less scaleless specimens, which are often distinctly transparent, are frequently bred, and are probably the result of bad nutrition in the larval stage. Porritt notes that Varley used to breed a form having transparent wings from larvæ found in the Huddersfield district, and many such bred examples are on record in our various magazines, generally occurring unexpectedly and usually with a number of quite normal examples. Some of these have already been noted (*antea*, pp. 53—54 and p. 81). Staudinger diagnoses ab. *fenestratus* as: "Ab. al. extus subdiaphanis."

Egg-laying.—The eggs are laid loosely, our note (*antea*, vol. ii., p. 436) of eggs being attached, evidently referred to eggs of *Macrothylacia rubi*, so also, we suspect, does the record of Shipston, noted *antea*, p. 76. The female deposits her eggs with great rapidity, over 100 were extruded in an hour, but the stimulus of flight appears to be necessary for a female to lay all her eggs (Clifford). A captured ♀ will often lay them freely whilst one holds her in the hand (Tutt). Speaking of var. *callunae*, Parke notes (*Zool.*, xxi., p. 8647): "From one to two hours after copulation (which extends to about three hours), the ♀ takes wing, and flies swiftly in circles over the foodplant (*Calluna vulgaris*), reminding one of the peculiar oscillating movement of the *Hepialidae*, and dropping her eggs as she flies. The time thus occupied seldom exceeds from 20—40 minutes. The ♀ then settles down and rarely lives out the day." The eggs of all the forms hatch in late summer and autumn. In Belgium the egg hatches in August, the larva remains small all winter, and lives solitarily (Lambillion); eggs from Newton Abbot hatched August 4th, 1898 (Holdaway); eggs laid by a ♀ at Polegate on August 12th, hatched September 2nd, 1898 (Carr); the eggs are laid quite loosely; when extruded the eggs are of a pale drab colour, but a few days before hatching they become wholly brown; after the larva leaves the egg the shell largely regains its original colouring; eggs laid August 6th, 1886, in S. Devon, hatched August 30th, 1886 (Prideaux); a batch laid August 25th, 1875, gave larvæ September 12th, 1875 (Buckler); a ♀ at Bulmer deposited 111 ova on August 10th, 1899, and 3 others next morning; these hatched August 30th, 31st, September 1st and 2nd, some on each day (Ransom). Van Segvelt notes (*Feuill. Nat.*, xii., p. 11) the hatching of eggs in the body of a ♀, a very remarkable phenomenon, and one that suggests some error of observation.

EGG-PARASITE.—*Teleas* ? sp. (Bartlett).

OVUM.—*L. quercûs* (English): Cylindrical in outline with rounded ends; length: breadth: height::4: 3: 3; colour to the naked eye blackish-grey, with the micropyle showing as a black point at one end; no depression on the upper surface, but a very smooth area occupies the usual position of this depression; under a two-thirds lens the opalescent character of the egg is most marked; the ground colour is white, marbled with dark greenish-fuscous, and it is these dark fuscous markings that give so a remarkable an opalescent appearance to the egg; the surface is covered with minute shiny points, which are traceable as the angular terminations of a polygonal reticulation which covers the surface, each being placed at an angle of one of the polygons forming the reticulation; the points are very irregularly placed, hence the reticulation is irregular; the central part of the egg is somewhat smoother than the ends; the micropylar area forms a distinct depression, black in colour, the cells small, but with a minute central stellate structure; the black micropylar area is sharply cut off from the surrounding area, which is white. [Eggs laid on July 3rd, description made July 8th, under a two-thirds lens.] *L.* var. *meridionalis* (French): Oval in outline, but appearing scarcely so round as those of var. *viburni*, examined at the same time *(anteà*, p. 60); distinctly brown or reddish in colour to the naked eye, mottled finely with darker; the micropyle reddish, and the depression on the upper surface not dark as in var. *viburni;* there is no noticeable dark part at the nadir of the micropyle. Under a two-thirds lens the colour of the egg is seen to be white, marbled thickly over with bright reddish, or brownish, opalescent patches, the depression being marbled in the same manner as the rest of the egg; the shell is rather less distinctly reticulated than is that of var. *viburni*, but the reticulation shows as fine shiny threads in a good light, forming a network of irregular polygonal structure, the minute black points being distinctly marked; the micropyle proper is placed at one pole of the egg in a not very distinctly marked depression; the micropylar area is composed of a number of very minute red-brown cells with a very tiny central depression, the true micropyle; the micropylar area is surrounded by an irregular ring of pale, washed-out, red-brown colour, and the irregular markings beyond are of two shades, some being pale brown, others inclining to reddish-brown; the 12 eggs examined are very similar in markings and coloration; the shell reminds one of a piece of opalescent tree-sparrow's egg.

COMPARISON OF OVA OF LASIOCAMPA VAR. MERIDIONALIS AND L. VAR. VIBURNI.—The egg of *L.* var. *meridionalis* is distinctly red, whilst that of *L.* var. *viburni* is distinctly ochreous in general tint; that of the former has no distinct dark patch in the depression on the long side, a character which is well marked in the egg of *L.* var. *viburni;* the micropylar area of *L.* var. *viburni* forms a distinct depression, that of *L.* var. *meridionalis* is very much less defined.

COMPARISON OF OVA OF LASIOCAMPA QUERCUS (ENGLISH) AND L. VAR. CALLUNÆ. — The two eggs are similar in their opalescent appearance. We cannot think of a better simile to describe the difference between the egg-shells of these two races, in colour and markings, than to say that the egg of *L. quercûs* reminds one of an opalescent piece of the shell of a thickly-mottled house-sparrow's egg, whilst that of *L.* var. *callunae* (*antea*, p. 74) suggests an opalescent piece of the shell of a robin's egg. They are also similar in the raised points which are found at the angles of the reticulation with which the eggs are covered. The reticulation, in both eggs, is more distinct over the ends of the eggs than over the central parts. The eggs of both are laid loosely. The eggs suggest a wider separation than we had previously considered possible between the more isolated forms of the two races. The main differences noted were as follows:

1. *L. quercûs*—Blackish-grey, the black micropylar area cut oft sharply from the surrounding white area; plumper and rounder, especially on upper surface, where there is no depression, only a smooth shining portion marking the position of the usually sunken area; micropylar area black, formed of closely-set cells, the black area cut off sharply from ground colour.

2. *L. callunae*—Pale creamy-brown, the black micropylar area surrounded by a ring of large, pale brown polygonal cells, which, in turn, are surrounded by the creamy ground colour; the egg flattened at top and bottom (long sides), and with a distinct depression on upper surface; the micropylar area composed of distinctly open (clearly defined) cells, and not cut off sharply from ground colour.

Comparison of ova of Lasiocampa quercus (English) and L. var. meridionalis (French).—In critically comparing an English egg of *L. quercûs* with a French one, we are much astonished at their close resemblance, as they at first appeared very different owing to the fact that, whereas the ground colour of the egg of the French insect is tinted with reddish and the markings tend to a more ochreous-brown colour, that of the English *quercûs* has the ground colour clearer white and the markings of a more fuscous hue. Still the difference appears a very superficial one when closely compared, and the modification, marked as it appears when the eggs are examined separately, is a very slight one. Even the micropylar areas are identical in structure, although different in colour, the same minute depressed micropylar point, and the same want of defined coloration around the area. The depression on the long side, too, is very much less marked in both than in the eggs examined of either var. *callunae* or var. *viburni*. [We have already described eggs of British *L. quercûs* as being without a depression; this is true of some, but a depression has since been observed in others.]

Habits of larva.—The larva hybernates at least one winter in all its various forms, but, as var. *callunae*, usually in a later stadium than does the southern *quercûs*. In spite of this, the latter commences to feed up more rapidly in spring, overtakes and passes the *callunae* larva, and, pupating in June and early July, the imago appears the same year, whilst the larvæ of the latter, feeding on until July and August, pupate then, but do not disclose their imagines (except very occasionally) until the succeeding May and June. In southern Europe, the metamorphoses take place within a year, but, in the high mountains of central Europe, and in high latitudes, the *callunae* habit of two years is normal. On the south coast of England, *e.g.*, at Plymouth, the larvæ cannot be said to hybernate at all; they may be found throughout the winter on sunny days feeding in hedges, but they are still very small, and do not increase much in size until the spring is far advanced, and, never, in this district, have been known to pupate in the autumn of the year in which they hatch (Reading). We have also already noted (*antea*, pp. 77, 83) that occasional instances of exceptionally rapid feeding-up, pupation, and emergence have been recorded. Andrews states (*E.M.M.*, xxxvii., pp. 125 *et seq.*) that a ♀, taken in the New Forest, August, 1900, laid some 100 eggs, which hatched in 12 days; the larvæ fed slowly on oak until September 20th, then broad-leaved sallow was given them until October 10th, and willow until November 10th, when bramble was substituted. Until this date, each of the larval moults had occupied six days, but a moult that occurred now extended over 12 days, and the larvæ were then put on ivy; feeding up rapidly, the first larva pupated on December 15th and the last during the first week of February, except one larva which remained unchanged in its cocoon from early January until the middle of February (6 weeks). This was then removed to a warm room, where it pupated in three days. The first imago appeared on February 23rd, 1901, and between this and March 22nd, 6 ♂s and 7 ♀s emerged. A pairing was obtained about the middle of March, and 150 eggs resulted; these eggs hatched at the end of April, and the larvæ were fed during the first stadium on oak, and afterwards on willow; they fed up rapidly, the first larva spinning up on July 15th, and the first emergence taking place about August 24th. Another pairing was obtained in due course, and fertile eggs from this coition are now (October 1st, 1901) undergoing development. It is further interesting to observe that, at the present time, one pupa of the brood that spun up between December 15th, 1900, and the first week of February, 1901, is still in that state, and, in spite of its being kept in the same place and under exactly the same conditions as the rest, shows no sign of emergence, and evidently intends passing the winter, 1901-2 as a pupa. Ransom observes that the larvæ feed by night, preferably on whitethorn in the Sudbury district, and often hide in the grass below the hedges by day; Clifford states that the young larvæ will continue to feed on even into December, if the weather be mild, on oak, hawthorn, and hazel leaves, not even rejecting them when withered; they prefer to place themselves on the twigs to winter, although some will extend themselves upon the ground, usually singly, and once they begin to hybernate they continue stretched out on the twigs, and, from time to time, move their position slightly, recommencing to feed in February and March, when they will indulge in a slight repast upon the young vegetation springing up from the ground, although they may yet more often be found stretched at length on hawthorn twigs. Rea says that, at Worcester, larvæ feed up all the winter without hybernating. In the spring, when nearly fullfed, the larvæ may be found during the day in the Strood district, stretched at full length on the stems of various bushes, preferably on maple, where they are rather difficult to detect except by a well-trained eye, so well do the lateral hairs meet the twigs, and break the shadows that would otherwise be formed. The larvæ, about an inch long, are to be found in the Weymouth district in late autumn and spring principally on bushes in dry situations, feeding on bramble, whitethorn and blackthorn, but, in the autumn of 1895, at Portland, although the bramble stems on which they are then usually sunning themselves were carefully searched, none was found, when, by chance, one was seen upon a scrubby piece of dogwood, and further search resulted in 40 being found in half-an-hour (Forsyth). Corbin says that the larvæ must come early from their winter-quarters, as he found several when beating leafless hawthorn hedges for females of *Hybernia rupicapraria*. The larvæ are found in the Reading district by searching whitethorn hedges in the daytime; but at St. Helen's, in the Isle of Wight, in 1895, they were found feeding on willow and broom by the river Yar, few to be seen by day, but up and feeding in great plenty after dusk (Holland). The larvæ sun themselves on the bramble in Folkestone Warren in early June (Pickett). The peculiar way in which the larvæ jerk themselves from side to side if one suddenly shouts or whistles near them is perhaps worthy of note, and Andrews states that the larvæ he reared during the autumn and winter of 1900—1901, were supplied with a piece of wadding sopped with water, in which they would fasten their jaws and draw in the liquid after the manner of cows (*E. M. M.*, xxxvii., p. 125). Ransom observes that the young larva can suspend itself by a thread as soon as hatched, and undergoes the first moult when 12 days old. We have already noted that it is the larval habit of true *L. quercûs* to hybernate as a small larva, to feed up in spring, to pupate in June and early July, the imagines emerging in July and August; whilst the *callunae* larval habit is to feed from June, to hybernate as a rather large larva, then to feed on until the following July and August, to hybernate a second winter as a pupa, and, finally, for the imagines to emerge in May and June of the following year. The normal *quercûs* larval habit, however, is sometimes modified in undoubted larvæ of *L. quercûs*, so as to assume the *callunae* larval habit, *i.e.*, occasional larvæ of true *quercûs* feed on until August and pupate late, hybernating a second winter as pupæ, and producing imagines the following year. Such instances appear often to be in direct response to unsatisfactory weather conditions, *e.g.*, the inclement summer and autumn of 1891 resulted in the larvæ of *L. quercûs*, in its most southern British localities, going on feeding until September and October, when they pupated, and produced imagines in July, 1892, a year later than their normal time, but others are not to be so explained, *e.g.*, the single example noted by Andrews in his forced brood (*suprà*). Occasionally only a single individual of a whole brood will develop this habit. The following records are interesting as illustrating this particular phenomenon: At Ashbourne, eggs laid August 13th, 1855, hatched September 5th, fed slightly through the winter, pupated from June 23rd, 1856, first imago emerged August 1st, 1856, whilst others went over the winter 1856—1857 in the pupal stage, emerging in the summer of the latter year (Lighton); larva found in May in Suffolk, then 2½ inches long, with rusty hairs and lilac rings, spun up in August, emerged the following June (Greene); larva from Bisterne pupated July 28th, went over the winter, emerging the next year, although another obtained at the same time and place pupated June 12th, and emerged July 28th of same year (*Substitute*, p. 29); larvæ and pupæ common in hedgerows at Skipwith, but some of the pupæ go over one winter to emerge the next year (Ash); in the southern counties, *e.g.*, Hants, Berks and Oxon, the number of *L. quercûs* larvæ that feed slowly, pupate in autumn, and go over the winter as pupæ to emerge next year is small; in the New Forest, on the contrary, the number is greater, and increases as one goes north (Holland); eggs hatched August 18th, 1864, at Northleach, pupation of larvæ took place during August, 1865, an imago emerged June 28th, 1866 (Todd); a larva pupated in 1865 at Worcester, produced an imago, July, 1866 (Edmunds); a cocoon was picked up at Witney in early May, 1861, having gone through the preceding winter as pupa, and emerged in due course in the summer (Stone); a ♀ emerged May, 1861, from a pupa found at Stoke, in south Devon, and that had evidently gone over the winter in that stage (Harvie); on February 14th, 1865, took 29 cocoons of *L. quercûs* from the bottom of a hawthorn hedge near Derby; they were large, brown, and oval-shaped, and produced ordinary typical-looking imagines (Tunaley); larva, in summer of 1870, at Driffield, went over winter 1870—1871 and emerged in the summer of 1871 (Dawson); larva, found at Harrow, spun up June, 1872, emerged July 2nd, 1873, yet another, taken at the same place, which spun up July 2nd, 1873, emerged on August 2nd, 1873 (Bull); larva at Christchurch, Hants, in August, 1890, and another at Yarmouth, Isle of Wight, a day or so later, produced imagines which both emerged within two or three days of each other in 1891, the earlier, a ♀, on July 14th (Bristowe); fullfed larvæ, taken August 29th, 1891, at Folkestone, spun up within a few days, went over the winter as pupæ, and produced imagines in 1892 (Mackmurdo); larvæ, August, 1891, at Folkestone, hybernated as pupæ, and emerged June, 1892, as typical *L. quercûs* (Bacot); on sandhills at Stockport, larvæ collected in 1895, most of which produced imagines the same season, but 11 went over as pupæ and emerged in June, 1896 (Johnson); Wicken larvæ, obtained June, 1891, gave several imagines July 12th, &c., of the same year, but some of the pupæ did not disclose imagines till the summer of 1892 (James); of two larvæ at Chester, June, 1891, one produced an imago August 9th, 1891, the other went over the winter as pupa and emerged in 1892 (Arkle); larvæ at Overton usually spin up and produce the imagines the same summer, but one emerged July 3rd, 1893, from an 1892 pupa (Perkins); August 25th, 1894, small larva on ash at Eltham, fed up slowly through 1895, passed winter of 1895—1896 as pupa, emerging June 29th, 1896 (Bower); a single pupa of a whole brood taken at Mansfield, went over the winter in this stage, and produced a typical *L. quercûs* the next summer (Daws); larvæ half-grown, at Wrotham, June 6th, 1897, produced imago August 14th, 1898 (Carr); larva, at Benfleet, 1897 (or earlier), produced imago July 18th, 1898 (Whittle). Tero observes that, on December 17th, 1882, he reared a specimen of *L. quercûs* that had been in the pupal stage since 1879. Occasionally an example spins up normally, goes over its usual time for emergence, giving one the idea that the winter will be passed in the pupal stage, and then emerges late in autumn. Such an one is noted by Prout, who bred one from a Sandown larva on September 26th, 1900, after it had been three months in the pupal condition. The peculiarity of the larval habits of typical *L. quercûs*, when compared with those of its varieties, makes all scraps of information from other than British districts more or less important. Not only do we find some larvæ in many British localities following the habit of typical *L. quercûs* and others, in the same district, under apparently identical conditions following that of *L.* var. *callunae*, but this plurality of habit has been noticed elsewhere, and will possibly prove of interest to future workers. Nolcken notes that Teich found, in the Baltic Provinces, in 1865, some full-grown larvæ in August that hybernated as pupæ, and states that, from four larvæ found in the spring of 1866, he obtained three females in June of the same year, the other larva not being fullfed at the end of July; whilst Bienert, from a larva found at Treiden, and which pupated in July, did not get an imago till the June of the following year—suggesting that here (Baltic Provinces), as with us, the habit is inconstant. The following dates on which larvæ have been taken have accumulated: May 17th—18th, 1899, at Lyntham (Marsden); larvæ, May 7th, 1871, at Southstoke, common every year at Oxton in April and May, *e.g.*, April 5th, 1895, April 22nd—29th, 1896 (Studd); April 28th, 1871, at Wanstead; April 11th, 1887, June 27th, 1888, July 2nd, 1890, October 5th, 1897, at Brentwood (Burrows); larvæ plentiful April 15th, 1872, at Wallasey (Porritt); April 30th, 1871, at Lee; May 20th, 1872, at Darenth; May 25th, 1873, at Lee; April 12th, 1877, at Loughton; April 14th, 1877, at Eltham; May 21st, 1877, at Darenth; May 24th, 1889, at Eltham; May 3rd, 1892, at Bexley; August 25th, 1894, very small, at Eltham; June 1st, 1896, fullfed, at Chattenden, August 2nd, 1898, very small, on an elm at Mottingham (Bower); larvæ, June 12th, 1880, at Rugby (Rowland-Brown); June 20th, 1885, at Abbot's Wood (Hanes); May 9th, 1887, at Brentwood; May 7th, 1892, at Panton; August 21st, 1896, at Woodhall Spa; June 15th, 1898, at Woodham Ferris (Raynor); May 28th, 1887, at Fermain Bay, Guernsey (Walker); halfgrown at Ferrol, in northern Spain, April 4th, 1889 (J. J. Walker); June 27th, 1889, in north Cornwall (Sheldon); April 17th, 1890, at Whitwell; April 16th—21st, 1896, at Crosby; April 17th—May 4th, 1896, April 17th, 1897, May 5th—11th, 1897, at Formby; April 9th—May 6th, 1896, at Wallasey (Freeman); June 14th—16th, 1890, at Tancarville (Leech); June, 1891, at Lyme Regis; June 3rd, 1892, in Folkestone Warren (Helps); June 13th, 1891, at Ipswich; April 6th, 1896, at Southend (Williams); June 18th—26th, 1892, at Folkestone (James); April 24th, 1894, at Chilwell (Pearson); April 18th, 1894, at Felixstowe (Morley); eggs laid at end of July, 1894, produced larvæ which, on November 2nd, were two inches long, pupated December, and emerged April, 1895 (Nicholson); larvæ, May 28th, 1894, September 26th, 1897, at Newnham (Lifton); April 30th, 1894, at Salcombe (Turner); half-fed, June 10th, 1896, although fullfed larvæ had been found May 30th, 1896; others found half-fed in autumn and fullfed in early summer, at Enniskillen, suggest an overlapping of *L. quercûs* and *L.* var. *callunae*, so far as larval habits are concerned (Allen); larvæ, April 15th—29th, 1897, at Angmering; May 11th, 1897, at Leigh (Dollman); larvæ, May, 1897, at Chester, some spun up by July 22nd, 1897, others went on feeding till late autumn (Arkle); June 5th, 1897, fullfed at Freshwater, Isle of Wight (Kaye); April 17th—May 11th, 1897, April 24th, 1898, at Formby (Patton); April 2nd, 1900, at Deal, only about one inch long, whilst, on May 1st, at Margate, eight larvæ were found about three inches long (Colthrup); September, 1900, on sallow, at Fleet, June 15th, 1901, on blackthorn, at

Addington (Russell); April 23rd—May 7th, 1901, on bramble, at Epping. June 1st, 1901, at Rye, June 5th, 1901, at Marhamchurch (Image). Larvæ are much more abundant in some years than others in many districts, *e.g.*, the Chatham and Strood district (Tutt), the King's Lynn district, especially so in 1898 (Atmore), &c., whilst Galliers observes (*Ent. W. Int.*, vi., p. 107) that he and friends alone took away more than 250 larvæ from the Wallasey sandhills in the spring of 1859.

Larva.—Structurally all the forms of the larvæ of *L. quercûs* are identical with that already given of *L.* var. *viburni* (*anteà*, pp. 60—62) and *L.* var. *callunae* (*anteà*, p. 75); there is, therefore, no need to reproduce the structural peculiarities. [In the first two instars, the colour of the larvæ of the two French forms is almost identical, although considerable differences occur in this particular in the later stadia. The following notes, therefore, relating to the larvæ of *L.* var. *meridionalis*, must be read in conjunction with the description of the larva of *L.* var. *viburni* already given, and if it be observed that they refer more particularly to differences of plumage, it is because the structural characters are identical. These notes, which are comparative, were made on the same dates and side by side with the larvæ already described (*anteà*, pp. 60—62). 1. *Larva from Southern France* (L.* var. *meridionalis*): *First instar:* No certain difference observable between the larva in this stage and that of *L.* var. *viburni*. The oblique stripes are, perhaps, rather stronger, but the difference is not sufficient to certainly distinguish them, the character being more or less emphasised in different larvæ (November 1st, 1896). *Second instar:* No differences noticeable from larvæ of *L.* var. *viburni;* they appear to be identical even to the colour of the hairs (November 15th). *Third instar:* Exactly similar still except in one respect, *i.e.*, the colour of the hairs on the central dorsal area, in the line of the wedge-shaped spots; the colour of these hairs is much lighter in var. *meridionalis* than in var. *viburni* (December 6th). *Fourth instar:* There is now a very marked difference between this and var. *viburni*. The short downy hair or fur which covers the dorsal area, with the exception of the intersegmental areas, is pure white†, as also are the lateral and the long dorsal hairs; there are a few scattered black hairs of medium length present as in var. *viburni;* the only golden-brown hairs on var. *meridionalis* larva now are a few on the head, thoracic segments, and 9th abdominal, and, in some larvæ, a few scattered patches on lateral area; in all other respects the larvæ appear to be identical (December 27th, 1896). *Fifth instar:*

* This account of the larva of *L.* var. *meridionalis* would have been better added to our description of the imago (*anteà*, p. 59), but, having been omitted there, has found a place here.

† This difference in the colour of the dorsal fur is really an important one, for the fur is, perhaps, the most characteristic feature of the larva. The larva of *L.* var. *viburni* gives one the impression of a golden-red or -brown larva with black bands. Larvæ of *L.* var. *meridionalis* from southern France suggest a white larva with similar bands. It would be interesting to know if the habits and habitats of these two forms of the larva are exactly similar in nature, and, if not, what the difference is that produces so striking a change in colour. There must be some important environmental factor at work in this direction. The larvæ of *L. quercûs* from Dorsetshire differ from both the continental forms in the characters by which they have just been distinguished; they approach, however, nearest to the larvæ of French *meridionalis* in the third instar, but are somewhat larger (Bacot).

In this instar the differences already noted are still more clearly marked; traces of the oblique stripes are still present (January 3rd, 1897). *Sixth instar:* No real change from previous instar, although the difference between the larva of var. *meridionalis* and the larva of var. *viburni* is still more strongly accentuated; traces of oblique stripes are present in both forms of the larva (Bacot, January 17th, 1897).] 2. *Larva from Dorsetshire L. quercûs: ? Third instar:* Very different in appearance from the two French forms of the larvæ (*meridionalis* and *viburni*); the white markings on face, conspicuous in the French larvæ*, being usually absent (occasionally faintly discernible); the body hairs scanty, and almost exactly resemble those of French larvæ (of both forms) that are still in second instar, although twice as bulky; no trace of the white lateral hairs that occur in larvæ of var. *viburni* and var. *meridionalis* (December 6th, 1896). *? Fourth instar:* Larger than var. *meridionalis* in third, not so large as var. *viburni* in fourth, instar; the larva is longer, thinner, and less thickly haired than either form of the French larvæ, and there is quite a bright blue, but narrow, band in the centre of the velvety-black intersegmental areas (the blue much more marked in some larvæ than others); the oblique stripes more conspicuous, the spiracles also very distinct; usually no trace of white markings on face (although they can be faintly traced in a few larvæ, but in no case are they so well marked as in the French larvæ). The differences between the English and French larvæ are now so clearly marked that they can be distinguished at a glance (December 20th). *? Fifth instar:* Head: Still deep blue, face-markings very faint or absent; if face-markings be present they differ from those of the French larvæ by being divided by a Λ-shaped mark of the ground colour. Body: The dorsal fur much more scanty; the fur varies in colour from red-brown on the thoracic, to dull whitish on the abdominal, segments; the whitish dorsal fur on the abdominal segments encroaches, along the mediodorsal line, upon the red-brown hair of the thoracic segments; the white subdorsal line, although interrupted, as in the French larvæ, is much stronger, and the oblique lines show up more markedly; traces of blue shading are often present on the black intersegmental bands; in some larvæ this feature is specially well marked†; the skin surface can still be clearly seen laterally, blue mottled with black. In this stage the English larva is more striking and rather prettier than the French. In the adult English larva the dorsal fur has a dusky, silky appearance, very different from the pure white and bright red-brown of var. *meridionalis* and var. *viburni* larvæ; also the long hairs of the English larvæ are brown, whilst in the larvæ of both the French races they are white (Bacot, Jan-

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* Some larvæ of mixed broods of French *meridionalis* received later show rather more similarity to the English larvæ, in these particulars, than those of the first brood examined. In one or two examples of the mixed lot, the face-markings are absent or very faint, and the white wedge-shaped patches on the dorsum show up clearly, whilst in several others there were rather more red and orange on the sides than was usual in the larvæ of the first batch (Bacot).

† In an earlier stage some English larvæ have the blue shading so strongly developed that it almost replaces the black of the intersegmental areas just above the subdorsal line (Bacot). Some larvæ are much darker and bluer when young than when fullfed, the blue marks between the segments becoming later of a rust-red colour (Whittaker).

uary 17th, 1897). Fenn describes the *adult larva* as follows: Head rounded; lobes of the head dull purple dusted with grey; face ochreous marked with brown. Body hairy, except at the segmental incisions, cylindrical, rather elongate; intersegmental incisions velvety-black, the remainder of the dorsum covered with soft, fulvous hair of moderate and unequal length; an interrupted white lateral stripe, below which the sides are dark purplish-brown marbled with orange, with tawny hairs; spiracles white; an oval white (red- or brown-centred) spot immediately above the lateral stripe on the meso- and metathorax; front edge of prothorax dull orange, and when half-fed, with a short, whitish, diagonal dash meeting the lateral stripe; venter black, marked with ochreous and tawny at the side, and with a series of shiny black spots on the posterior segments; prolegs tawny, with black dashes; legs shining brown spotted with black; anal segment tinged with ferruginous (May 15th, 1875). Buckler figures (*Larvae*, &c., pl. xlvii., fig. 2*a*) a dark brown aberration of the larva, with long brown hairs, a purplish (bluish) supraspiracular line, bluish spiracles, and a small lateral oval mark (Bacot's "ocellar" marking) on the meso- and metathorax. This larva was found feeding on sloe. Buckler also figures (*loc. cit.*, fig. 2), excellently, the typical form of the larva just previous to the last moult. Linné describes the larva as: "Larva lævis, pilosa, grisea, nigro annulata, alboque maculata" (*Sys. Nat.*, 12th ed., p. 815). Ramdohr, in 1811, described and figured (*Verdauungswerkzeuge der Insecten*, pp. 163—166, pl. xviii., figs. 5—6) the intestinal canal of the larva of *L. quercûs*, and this species was one of those that were dealt with, in 1815, by Gaede in his *Beyträge zur Anatomie der Insekten*.

General comparison of the different forms of the larva of L. quercus.—The differences between the various forms of the larva of this species that have been examined—English *quercûs*, *callunae*, *meridionalis*, *viburni*, and *sicula*—consist chiefly in the colour and markings of the head and the colour of the hairs (see *anteà*, p. 37). The latter may, for convenience, be considered under two heads: 1. The long hairs, more or less evenly distributed all over the body. 2. The fine, short, closely-massed hairs of the dorsal and subdorsal areas, which form a thick fur. This fur, as we have already shown (*anteà*, p 36), is most probably of protective value, as the hairs forming it are readily detached, and produce irritating urticating results if they enter the skin. The following are the chief colour peculiarities presented (compare, *anteà*, p. 37):

1. *Callunae.*—Both the long hairs and short fur are dark brown (approaching the hairs of *Macrothylacia rubi* in colour). [This appears to be the most specialised form in an opposite direction to the line of development exhibited by the larva of *L.* var. *meridionalis.*]

2. *Quercûs* (English).—The long hairs brown; the short fur dirty white or pale dusky brown.

3. *Viburni.*—The long hairs white; the short fur bright reddish-brown.

4. *Sicula.*—Both the long hairs and short fur as in the larva of *viburni*, but possibly a little paler.

5. *Meridionalis.*—Both the long hairs and short fur pure white (sometimes slightly dusky directly after a moult). [This appears to be the most specialised form in an opposite direction to the line of development exhibited by the larva of *L.* var *callunae.*]

No doubt a perfect series of transitional forms, between the larvæ of *callunae* on the one hand and *meridionalis* on the other, could be obtained, yet the larvæ of the races inhabiting the extremes of latitude are distinct. In their early stages, the larvæ of the two south of France races, *viburni* and *meridionalis*, are alike, but very different from the larvæ of the two English races, *quercûs* and *callunae*, in the same stadia; the latter races, also, being very similar to each other in their early stages. The larva of *sicula* follows the south of France races, rather than the English forms, but it differs from them in tint and in several details of pattern.

COMPARISON OF LARVÆ OF L. QUERCUS (ENGLISH) AND L. VAR. CALLUNÆ.—Comparison of Buckler's figures of a full-grown larva of English *L. quercûs* (*Larvae*, &c., pp. 57—58, pl. xlvii., fig. 2 *b*), and of *L.* var. *callunae* (*loc. cit.*, fig. 3 *d*) would suggest considerable difference in the plumage of the fullgrown larvæ; the former having distinct white spiracles, a white supraspiracular line (broken by the intersegmental incisions), and red subspiracular line; the latter with yellowish spiracles, yellowish supraspiracular line (much less well-developed) and no red subspiracular line. This larva of *callunae* is, however, scarcely typical of the fullgrown form. Buckler's comparison reads as follows:

1. *Quercûs*: The general colour of the hairs above the subdorsal stripe of a rather light brown, but below and on the ventral surface darker brown; along the subdorsal region a large triangular mark or streak of white with black centre; besides the much-interrupted white subdorsal streak on the mesothoracic and metathoracic segments, there is, just above it on the black rings, a whitish oval or shuttle-shaped mark, with a black spot within it near its anterior margin; the white subdorsal stripe appears to be *continuous* on all the black velvety parts of the body that were not hidden with hairs, for these interrupted it from view about the middle of each segment; from the subdorsal stripe oblique white streaks flow backwards near the beginning of each segment, those beyond the thoracic spotted or mottled with dull red below; *above the legs are two whitish and red dull stripes, with indications of an interrupted middle line between them;* the oval spiracles white.

2. *Callunae*: The general colour of the hairs above the subdorsal region bright golden-brown, darker or lighter in individuals, but very bright and glossy; below, on the sides, the hairs deep blackish-brown, the ventral surface still darker brown and nearly black; the triangular subdorsal mark on the prothorax just edged above with white, but chiefly bright red, and the same with the ear-like subdorsal marks, of which one is about the middle of the mesothorax and one on the metathorax; *there is no subdorsal stripe*, but only a row of subdorsal spots one behind each segmental division; these spots have much the character of a triangular oblique streak of red, having, in some individuals, the anterior apex white, but in others wholly bright red; there is *only one stripe above the legs;* this is red and only obscurely visible; the oval spiracles white, with a fine hair-like black line down the centre, marking the aperture.

NOTE ON LARVA OF L. HYBR. BACOTI.—We have already referred (*anteà*, p. 34, footnote, and p. 38) to the fact that the larvæ resulting from the pairing of *meridionalis* ♂ with *viburni* ♀, ultimately divided into two moieties that followed closely the respective parents, at least so far as the colour of the urticating fur was concerned. Of one special batch, however, that Bacot had under observation during the autumn and winter of 1896—1897, he noted that, in the 3rd instar, many of the larvæ exhibited a tendency to be more like the British forms; the white wedge-shaped dorsal spots being well marked in some larvæ, and the head, in two cases, resembled that of the British races in being without the white mark on the face. In the 4th instar, the larvæ showed extremes of variation, extending from the pure white dorsal fur of the typical larva of *meridionalis* to the red-brown fur of that of *viburni*, yet one or two curiously showed a tendency to the dusky-coloured fur characteristic of the larva of English *quercûs*. There were, however, no truly doubtful forms, as those most approaching the English larval type were, in reality, but little divergent from the larva of *meridionalis*, and were very much nearer the latter than the former (January 17th, 1897). Of ten larvæ of this batch that had reached maturity by February 20th, 1897, six were of the *viburni*, and four of the *meridionalis*, larval form, except that the latter presented a distinct dusky tinge to what should otherwise have been a pure white dorsal fur. [It is doubtful whether dirt had not something to do with this latter peculiarity] (Bacot).

PUPATION.—The fullfed larva usually spins its cocoon in a fork of two or more small branches, or suspends it among the twigs of its foodplant, or encloses it between two or more leaves. Harrison notes it as spun among small branches of the foodplant in a breeding-cage, or placed in a corner either on the floor or roof of the cage. Larvæ were observed spinning up in the crevices of Castle Rock, Lynton, June 22nd, 1899 (Bartlett). Lambillion says that, in Belgium, the cocoons are found in hedges, cracks of walls, and under moss; and de Selys-Longchamps observes that they are fixed between the branches of trees. Many of those of var. *callunae* are hidden low down among the roots of heather on the moors that this particular form loves so well. The cocoons of many of those that go over the winter in the midlands as pupæ may be found among the dead leaves at the bottom of hedges, usually spun up in leaves that have fallen in the autumn, whilst others still remain attached to a dead leaf or two that have been fastened to the twigs by a loose spinning of silk. Tunaley notes (*Ent. Rec.*, viii., pp. 167—168) that, near Derby, he obtained many cocoons by sifting, through the fingers, the dead leaves accumulated in the forked branches at the bottom of a hawthorn hedge, during the winter. Pickett discovered six cocoons in August, 1900, attached to dry bramble leaves, on the Dover cliffs, where the bramble was growing very flat and straggling; the cocoons looked very like the dry leaves. Once the place is selected, the spinning of the cocoon is a short but exceedingly interesting occupation, splendidly described by Réaumur (*Mémoires*, i., pp. 516—517). After remarking on the disproportion between the large size of the larva and the cocoon it spins, he enters into details of the making of the cocoon, which he describes as an elongated ellipsoid in shape, almost cylindrical, with the ends rounded. To spin a cocoon of this shape, the larva holds its body bent in different ways at different times, but always "raccourci, au point d'avoir précisement, dans le sens où il est le plus long, une longueur égale à celle du plus grand diametre interieur de la coque, et contourné de maniere que les deux parties qui sont aux bouts de la plus grande longueur, ont toûjours une courbure semblable à celle que doivent prendre les deux bouts de la coque. Assés souvent la chenille est pliée en S. Sa tête et son derriere sont quelquefois presque vis-à-vis l'un de l'autre, et vis-à-vis le milieu du corps, mais placés de differents côtés; quelquefois la tête est placée plus près du milieu du corps que ne l'est la queuë. Les deux portions du corps, qui representent celles où l'S s'arrondit, où elle a exterieurement deux convexités, sont les moules des bouts de la coque.

Dans d'autres temps la chenille est pliée en deux, de maniere qu'elle forme un anneau applati et allongé. Alors sa tête et son derriere sont du côté du ventre; et c'est tantôt l'un et tantôt l'autre qui sont plus proches du milieu du corps. Elle varie de mille manieres differentes, soit les figures d'S, soit celles d'anneau applati qu'elle fait prendre à son corps; mais malgré ces varietés, il y a toûjours deux bouts diametralement opposés, qui ont la courbure de ceux de la coque. C'est par degrés insensibles qu'elle échange chacune de ces attitudes, et qu'elle passe d'une attitude à une autre. C'est aussi peu à peu, lorsque sa tête a appliqué assés de fils vers un des bouts de la coque, qu'elle la conduit vers l'autre bout, pour y ajoûter des fils. Elle fait glisser tout doucement son corps, contourné en anneau, le long des parois interieures de la coque commencée, elle le fait tourner, comme on feroit tourner un écheveau de fil sur un devidoir, en le tirant avec la main, dans le sens où on veut le faire tourner. D'ailleurs sa maniere de travailler n'a rien de particulier; la tête applique des tours de fil tantôt à un des bouts, tantôt à l'autre, tantôt sur quelqu'autre partie de la circonference interieure; mais quand le tissu de la coque est devenu une espece de reseau à mailles assés serrées, et qui a de la consistance, c'est alors qu'on peut observer une petite manœuvre qui lui est propre, et à quelques chenilles du même genre. On voit tout-à-coup une partie de la coque devenir herissée de poils, qui s'élevent beaucoup au-dessus de sa surface exterieure. Ce sont ceux d'une partie du dos qu'elle a fait passer au travers des mailles de la coque. Elle se donne alors de petits mouvemens, comme pour frotter cette partie de son dos successivement en des sens contraires, contre la surface interieure de la coque. Quand l'œil ne pourroit pas suivre les petits mouvemens de la chenille, les poils qui sont à l'exterieur les apprendroient. On leur voit faire des vibrations, s'incliner successivement, et assés vîte, vers des côtés opposés. Les frottements d'une portion du dos contre la coque, tendent à arracher les poils dont cette portion est couverte, et qui étant passés dans les mailles, y sont retenus en quelque sorte comme dans un étau. Les poils sont aussi bientôt détachés par cette manœuvre. Dès qu'ils le sont, la chenille se retourne bout par bout, elle conduit sa tête à l'endroit où les poils sont resté engagés en partie dans le tissu de la coque; quoiqu'ils s'élevent là au-dessus de sa surface superieure, il y a encore une longue portion de chacun en dedans de la coque; ils l'y herissent comme par dehors, ce qui n'accomoderoit pas la chenille; elles veulent toutes que lorsqu'elles seront en crisalide, leur corps soit touché par des surfaces lisses. La tête travaille donc à coucher sur les parois interieures, les bouts interieurs des poils, et à les retenir couchés par des fils qu'elle tire dessus. Les portions exterieures des mêmes poils se couchent alors necessairement, au moins en partie, sur la circonference de la coque, qui cesse de paroître herissée. Son tissu se fortifie et devient plus opaque. Enfin, quand la chenille s'est entierement épilée, que tous ses poils ont été bien arrangés et bien attachés, on ne peut plus l'appercevoir au travers de la coque. L'ouvrage est conduit à ce point en trois heures, mais il n'est entierement fini qu'en neuf à dix heures; et alors l'interieur de la coque est tapissé d'une couche de soye bien lustrée." Réaumur then says that "when the larva wishes to rid itself of its hairs it pushes them through the interstices of the cocoon. This does not offer any special difficulty. Imagine the larva twisted up in its cocoon, its hairs flat on its body and all pointing in one direction—*i.e.*, towards the rear. If it advance, roll round, or twist about, head forward, its hairs will always lie flat; but if it endeavour to go backwards its skin sticks up and its hairs will be pushed against the walls of the cocoon, and all those that happen to be opposite interstices will be pushed outside; by repetitions of these movements it will ultimately get rid of all of them." He further notes that, in the neighbourhood of Paris, the pupal stage lasts at least a month, the imagines emerging through the whole of August. This is, of course, for the type. The pupal stage, however, even of the type is often extended to 13 months, that of the var. *callunae* is normally 9-10 months, but frequently extends to 21-22 months. Still longer pupal periods are on record, and one finds several noticed also in a continental magazine (*Ent. Nachr.*, v., pp. 218, 257—258, 285), *e.g.*, a ♂ bred July 2nd, 1879, from a pupa of the summer of 1876 (Stein), &c.

Cocoon.—The cocoon is cylindrical, rounded at both ends, composed of dense silk, intermixed with the short dorsal fur of the larva, masses of the urticating hairs that form the dorsal fur, often lying loose in the outer web by which the cocoon is attached to the twigs, &c., among which it is spun; they also stand out directly from the cocoon proper, and hence careless handling of the cocoon is almost sure to result in breaking off some of the fine points in the skin. 1. *L.* var. *viburni*: A cocoon examined (containing ♂ pupa) is 28mm. long and 14mm. wide, forms a compact cylinder with rounded ends, rather brittle, pale yellow-brown in colour, composed of closely felted silk with a paper-like texture, some hairs on surface mixed with silk, some fine flossy silk on outer surface of cocoon which forms means of attachment to twigs, leaves, &c., among which larva spins up. The cocoon, on being opened, is seen to consist of double walls, the inner of fine whitish material, wafer-like in appearance, but thin and papery in texture, easily separated from outer coat, coming off in thin flakes. A ♀ cocoon of the same batch is 34·5mm. long, 15·5mm. wide, and about 12·5mm. in thickness; the inner lining thinner and more papery in texture than in ♂ cocoon. The cocoons of *L.* var. *meridionalis* from southern France are like those of *L.* var. *viburni*. 2. The cocoon of *L. quercûs* (English) [compared with that of *L.* var. *viburni*]: Much darker, softer, more silky as regards outer casing; 25mm. long, 12·5mm. wide; tougher, thinner, less brittle; the inner wall not peeling so easily from outer wall, also very thin, silky, less wafer-like. 3. *L.* var. *callunae* (Scotch): Very large, 30-36mm. long, 15-16mm. wide; similar to those of English *L. quercûs* as regards quantity and general appearance of inner lining, but of closer texture, and harder externally. [Possibly the paler colour of the cocoons of the southern (French) forms is due to a drier atmosphere, for some cocoons of *L.* hybr. *bacoti*, allowed to pupate in glass jar instead of the ordinary cardboard box, are quite as dark as the cocoons of *L.* var. *callunae*.] (Bacot). 4. Réaumur describes the cocoon of Parisian *quercûs* as: "Brown, its exterior apparently smooth, but bristling with stiff hairs to the touch; an elongated ellipsoid in shape, almost cylindrical, with the ends rounded." 5. Andrews notes (*E. M. M.*, xxxvii., p. 125) that the first covering of the cocoon consists of web; the second consists of a glutinous secretion—probably the web itself in a liquid state—which the larva smears over the first; and the final coat is web again; the hairs of the larva are also mixed with the outer covering, and, in consequence, handling the cocoons causes a certain amount of irritation. 6. Nicholson observes that the cocoons made by larvæ of *L. quercûs* and *L.* var. *callunae*, that had been bred side by side, were not really different in appearance; some in each set varied from dark brownish-black to greyish. Crallan notes that he obtained both light and dark cocoons from larvæ collected on Hayward's Heath (and that never fed on ling), but that there was no difference in the imagines bred therefrom. Ross notes (*Zool.*, 1846, p. 1346) that the empty cocoon, when burnt in candle flame, turns first to white ash, then becomes equal in intensity to the "Bude light"—a brilliant phosphorescent white of dazzling brightness.

PUPA. — 1. *L.* var. *meridionalis:* ♂. 24mm. in length, 11mm. in width (from end of wing-cases to shoulders), about 9·5mm. in thickness just at tips of antenna-cases which are much raised. *Ventrally:* The wing-cases reach to end of 4th abdominal segment, giving a very wide and heavy appearance to pupa; segments 5, 6, and 7 taper rapidly to anus, forming a relatively short cone attached to the more oblong portion formed by thorax and wing-cases; the head blunt, almost square in outline. *Dorsally:* The pupa tapers gradually from the 1st or 2nd abdominal segment to anus; the thoracic plate is markedly convex, and appears stout and strong; colour, red-brown, pale on ventral surface of abdominal segments, dark on dorsal area, almost black on thorax and head; wing-cases dark brown. *General notes:* The antenna- and leg-cases very marked, the former much raised; the head small, but stands out clearly from thorax; the eye-cases prominent; spiracles black raised bosses, with a deep, slit-like pit in centre, those on 7th abdominal specially prominent; anal end evenly rounded; cremaster consists of a thick mass of short, stout, pointed bristles, most conspicuous dorsally; a few fine, short bristles round the spiracles on 5th, 6th, 7th and 8th abdominal segments; the fine sharp pitting on surface suggests that the pupa was ancestrally covered with fine hairs (like that of *Macrothylacia rubi*). ♀. 32mm. in length, 14mm. in width, and 11·5mm. in thickness; greatest girth at 4th abdominal segment, at end of wing-cases; tapers considerably towards head; wing-cases not projecting from sides (so much as in ♂ pupa); the antenna- and leg-cases not so prominent; otherwise the ♀ pupa is structurally very similar to that of ♂. 2. *L.* var. *viburni* (from southern France): Pupæ of two males examined; only difference from above is that the pupa of *L.* var. *viburni* is more squat, shorter, and comparatively broader than that of *L.* var. *meridionalis.* 3. *L. quercûs* (English): ♂. 22mm. long, 11mm. wide, about 9mm. in thickness. No difference to be detected between the pupæ of English *L. quercûs*, and French *L.* var. *meridionalis.* The difference in the curve of antennæ is very different in both English *quercûs* and French *meridionalis* from that of the pupa of *L.* var. *viburni*, probably due to greater width of the latter. There is no development in the ♂ pupa suggestive of the strongly pectinated antennæ of the ♂ imago, although the pupal antennæ are rather more prominent and raised in the male than in the female (Bacot). Fenn notes the pupa as: "Very stout, segmental incisions and appendages strongly indicated, spiracles prominent, anal extremity blunt and bristly; colour purplish-brown."

COMPARISON OF PUPÆ OF LASIOCAMPA QUERCUS AND COSMOTRICHE POTATORIA.—The pupa of *L. quercûs*, compared with that of *C. potatoria*, is shorter, stouter, bright red-brown in colour, and not dark (almost black) mahogany-brown, the shell semitransparent and more fragile than is that of *C. potatoria*. The antenna-cases of the pupa of *C. potatoria* have more in common with those of the pupa of *L. quercûs* than with those of *Eutricha quercifolia;* those of *L. quercûs* are raised, and curved in transverse section, rather than broad and flat; they taper gradually and are not sharply elbowed; those of the ♂ are rather longer than those of the ♀, rather broader, and much more raised above the general surface, and, in both sexes, they project beyond the second pair of legs and form the apex of the angle between the wing-cases. The pupal antenna-cases of ♂ *C. potatoria* and ♀ *L. quercûs* have decidedly more in common than have those of the opposite sexes (*i.e.*, ♂ *L. quercûs* and ♀ *C. potatoria*), and as regards prominence (though not width), those of ♂ *C. potatoria* agree better with those of ♀ *L. quercûs* than with those of ♂ *L. quercûs*. The anal portion of the pupa of *L. quercûs* is less smoothly rounded, and covered with a growth of stout, recurved, chitinous bristles. The face-parts appear to be identical, although their relative proportions may differ slightly, but the pupal head of *L. quercûs* projects slightly ventrally, which is certainly not the case with that of *C. potatoria*. The pupæ of *L. quercûs* and *C. potatoria* agree in being comparatively smooth and shiny, whilst that of *E. quercifolia* is so dusted with white powder that the skin shows a marked bloom (Bacot).

DEHISCENCE.—The dehiscence of the pupa of *L. quercûs* takes place along the mediodorsal line from meta- to prothorax, the latter being entirely detached from the rest of the case, and, in all the pupæ examined, has dropped out. The fracture extends along the front of the antennæ about as far as the base of the second pair of legs, and between the antenna- and wing-cases, for a little less than half the length of the former. There is also a fracture between the wings and the mesothorax for about half the length of the latter, whilst posteriorly the break extends between the meso- and metathorax, and between the fore- and hindwings as far back as the spiracles on the 3rd abdominal segment (Bacot).

FOODPLANTS.— *Quercus*, *Betula*, *Prunus spinosa*, *Erica*, *Salix* (Linné), bramble (Brown), blackthorn, whitethorn, maple (Tutt), *Rosa canina*, *Betula alba* (Lambillion), *Cornus sanguinea* (Allchin), sallow (Freeman), plum, pear, raspberry (Edelsten), hazel, fruit-trees (Rühl), *Sarothamnus*, *Salix* sp. preferred, *Calluna* (Hering), *Rubus saxatilis* (*S. E. Z.*, xxxix., p. 438), Portugal laurel (Wilson), dwarf sallow (Porritt), laurel, ivy (Pitman), meadowsweet (Arkle), sand-rose (Gardner), broom (Holland) ash, elm (Bower), *Hippophaes rhamnoides* (Raynor), leaves of many trees and some low plants, apple, &c. (Caradja), *Vaccinium myrtillus*, &c. (Meurer), *V. uliginosum*, *Arbutus* and fruit-trees (Cuní y Martorell), *Pinus* (Garbowski), *Cytisus* (Nesbitt), aspen (Nolcken), gorse (Turner), rose (Charles), *Erica arborea*, *Scoparia*, *Viburnum*, *Arbutus*, *Cytisus hirsutus* (Millière), black poplar (St. John); *Sorbus*, *Prunus padus*, *Populus alnus*, *Rubus* (Favre), strawberry (Butler).

PARASITES.—*Cryptus obscurus*, Gr. (Rogenhofer), *C. migrator**, Fab. (Fitch), 10 ♂ s and 1 ♀ bred, February 2nd, from one cocoon, and 3 ♂ s, May 9th, from another cocoon (Bignell); *C. titillator*, Gr. (Tugwell); *Ophion ventricosum*, Gr. (Marshall); *Ophion undulata*, Gr. (Perris); *Bassus nigritarsus*, Gr. (Bignell); *Limneria rufa*, Bridgn., bred from half grown larvæ, the ichneumon larvæ emerging from the living caterpillars, April 5th and 21st, and making oval black cocoons (Bignell); *Metopius dentatus*, Fab. (Farn); *M. micratorius*, Fab. (Norgate); *Gravenhorstia picta*, Wiegm. (Giraud); *Thryptocera bicolor*, Meig. (Bignell). [Patten observes that in the Wye valley, in the wet summer of 1889, the larvæ were attacked by a species of slug. Tempel of Chemnitz notes that in 1897 he found in larva of this species two tapeworms, about 25cm. long and 2mm. in diameter, which were determined as belonging to the genus *Mermis*. Fom a larva of the same species Werner also obtained three white *Filariae*, 7—7¼ ins. long (*S. E. Z.*, 1842, p. 158).]

HABITS AND HABITAT.—The males fly swiftly by day, especially in the afternoon sun, and are attracted by a newly-emerged female in a very marked manner (*vide*, *antea*, p. 41). One of the most interesting of the many accounts of this habit, is that detailed (*Entom. Record*, x., pp. 106—107) by Williams, who notes that larvæ were found on ivy near Southend, April 8th, 1898, spun up in due course, the first on May 30th, ♀ emerged July 7th, taken out on 8th, ♀ carried in a tin box and afterwards hung up on branch of tree in a muslin cage, about 4 feet from ground, but 2 males only arrived; on the way back, at 3 p.m., 13 males attracted by the ♀ within closed tin box, and, on the 10th, more were attracted by same ♀. Another ♀ emerged July 11th, and towards Leigh (the ♀ being in tin box, and this inside a closed leather bag) males were attracted in numbers; whilst near Hadleigh Castle, as he held the tin in his hand, the males came up to it, against the wind, dashing round, sometimes three or four at a time, and occasionally settling on the tin. Fifteen absolutely perfect specimens were taken home, but a hundred or more could easily have been captured if required. On the afternoon of July 20th (nine days later) the bag (containing the tin in which the ♀ had been) was being carried near Leigh, when many males were attracted, and the bag being placed on the ground, some ♂ s entered it to investigate. Clifford notes that, in Kent, on August 1st, 1871, he placed newly-emerged ♀ s in a box, which was soon surrounded by males, whilst others flew around it in a circle. The presence of the males was recognised by the captive females, who became excited. No males came after 2 p.m., nor did any ♀ attract a ♂ after she had once paired. Daws says that in the Penzance district the males assemble in swarms to a newly-emerged female, and Burrows notes that at Land's End on August 11th, 1890, he found the males assembling to a wild ♀. Lampa writes (*Ent. Tids.*, 1886, pp. 155—158) on the assembling of this species,

* Under the name of *C. bombyci*, the life-history of this parasite is well described and illustrated by Bodidier (*Ann. Soc. Ent. France*, v., pp. 357—365, pl. viii).

which he considers to result entirely from the sense of smell. Wonfor records (*M. Micr. J.*, vi., pp. 251—252) that ♀ *L.* var *callunae* in Jersey will assemble typical ♂. *L. quercûs;* Thornhill records a similar fact (see *anteà*, p. 77), which is interesting in the face of Harding's statement (*Zool.*, v., p. 1731), that ♀ *callunae* would not attract ♂ *quercûs*. This, however, is less remarkable than Johnson's observation (*Int.*, ix., p. 62) of a ♂ *quercûs* being attracted by a virgin ♀ *Pachygastria trifolii* in Jersey (see also Zeller, *anteà*, p. 41). Bacot observes that if pairing is going to take place the male is usually much excited as soon as he is placed with the female, and copulation generally takes place at once; the moths do not remain paired more than 15 minutes, often less; a male has been known to pair with two females in quick succession, whilst Poskin, in 1898, observes (*Rev. Soc. Ent. Namur.*, iii., p. 22) that he had four newly-emerged ♀s in his laboratory at Gembloux, when, soon after midday, a ♂ flew against the window, and which, being admitted, at once paired with the first female it met; the copulation lasted about a quarter of an hour; immediately after separation, the ♂ paired with a second ♀, and then with a third, after which the ♂ tried to escape. Rühl says that the male flies by day in the Zürich district, whilst the ♀ is often beaten from bushes in July. The female oviposits when flying at dusk. We have taken it between 9 p.m. and 10 p.m. at Strood flying along hedgerows, and Ford notes one netted at night in 1891 at Hastings, which ejected more than 100 ova (see also *anteà*, p. 87). Jones records the capture of two females at light at Eltham (*anteà*, p. 41); Dewey observed them in abundance at electric light at Eastbourne, and Lowe records specimens coming up to the light at Aigle, July 3rd-4th, 1898; a male was captured at light at Salisbury in July, 1896, by Ridley, and Fenn captured a ♀ at light on July 17th, 1875, at Eltham. Bevis notes that on April 8th, 1883, between Siena and Monastero, he saw a male with a dry piece of blackthorn that had become attached to it by means of a thorn that had passed through its abdomen. It had evidently become entangled and broken off the piece which had lacerated its wings as well as abdomen, and, when observed, it was making a noise like a grasshopper on the wing. Barrett notes (*E.M.M.*, iii., p. 259) that, in August, 1866, he observed scores of males of this species trying to fly over the crest of the hill crowning Hindhead, while the wind, which was very powerful, constantly drove them back; they would come beating and tacking up the side of the hill, often dashing into the heath and getting up again, until they got fairly on the edge, when the wind would carry them back hundreds of yards and hurl them into the valley below, when the same performance would be gone through again. So numerous were they that though the wind made a perfect plaything of the net, over thirty were caught in an hour. Reid notes that in Aberdeenshire the imagines are destroyed in great numbers by "the black-headed gulls." Hedges, lanes, outskirts of woods, coast sandhills, sea-cliffs and downs are the chief habitats of typical *L. quercûs*, as moorlands are the chief home of *L.* var. *callunae*, which is, in this country, indeed, a moorland rather than a mountain race, although its most marked characteristics are more strongly developed on the moors among the Scotch mountains than elsewhere. Some of the habitats given for the typical form are noted as follows: The males fly swiftly up and down the cliffs in the afternoon sun at Dover and Folkestone (Pickett); hedges in Guernsey and Sark (Luff); the favourite localities in Notts appear to be hedgerows, but the males fly freely in wood ridings, and have been observed flying round, and settling upon, oak (Lievers); in lanes on bramble and hawthorn at Salisbury (Ridley); in woods and on hedges throughout Sussex (Nicholson); on the sandhills at Wallasey, Crosby and Formby (Freeman); larvæ always abundant on hedges in the Eastbourne district (Montgomery); on heather in the New Forest (Edelsten); hedges in the Brighton district (Merrifield); hedges in the Gloucester district (Merrin); hedges by roadsides in Lincoln district (Musham); whitethorn hedges at Reading, but on willow and broom on the banks of the Yar in the Isle of Wight (Holland); hawthorn and bramble hedges at Skipwith (Ash); on whitethorn hedges at Buckingham, especially abundant from 1869 to 1873 (Slade); very abundant in some years on the sandhills of the Lancashire and Cheshire coast (G. O. Day); especially so on the Wallasey sandhills, where 250 larvæ were taken in June, 1859 (Galliers); in damp hedgerows about Chester, feeding on meadow-sweet (Arkle); on the cliffs in great abundance between Weymouth and Portland (Burraud); on hedges at Benfleet (Whittle); very abundant on the sandhills at Culleenamore, the larvæ feeding on dwarf sallow (Russ); on the sandhills among sallow at Wallasey (Ellis); in hedges and country lanes, as well as moors and coast sandhills, at Durham (Robson); on the downs at Emsworth (Christy); on rough ground at edge of the cliff at Bembridge, the males flying in swarms (Kaye); heaths, hedges, meadows, parks railway banks in Hants and Berks, the males flying swiftly up and down ridings in woods, &c. (Clarke); low growing ivy in woodside hedges produce most unstung larvæ, a large proportion of those high up are ichneumoned (Williams); hedgerows at Darenth (Newman); hedges by roadside at Darenth, Lee, Eltham, Bexley and Chattenden, in the open forest at Loughton (Bower); chiefly in lanes about Norwich (Pitman); on sallow bushes by the seashore at Sandown, on hawthorn hedges near the sea at Southend, on bramble close to the seashore at Deal (Prout); on hedges in the Dept. Loir-et-Cher (Harrison). Nolcken says that in the Baltic Provinces the species prefers birch trees in swampy places, and Favre observes it as very common in the Valais throughout the whole region of deciduous trees.

TIME OF APPEARANCE.*—The type occurs throughout July

* We cannot insist too strongly on the apparent vagaries as to the time of appearance observable in certain broods of this species when reared artificially, Schulz notes (*Berl. Ent. Zeits.*, xlv., Sitz. p. 40) that he had eggs of var. *sicula*, from which larvæ emerged at the end of September, 1897, that they fed on through the winter on ivy, the first imago appearing February, 1898, a large number appearing in March, after which no more emerged till July, when a few made their appearance, the remainder, about 30, being still alive and going over the winter as pupæ. He further observes (*loc. cit.*, p. 61) that the larvæ of var. *alpina* leaves the egg in August, hybernates small, usually under the snow, pupates the following July or August, hybernates again as pupa, the imago emerging the following June. Eggs of this var., sent by him from the Alps to Klooss, in 1899, produced larvæ in August, in Berlin, which fed right on and pupated during December of the same year, occupying only some four months from egg to pupa. The dates of the emergence of the imagines are not stated.

and August (occasionally at the end of June, when the examples have possibly passed the winter as pupæ, and rarely at the commencement of September, when they have been delayed as larvæ) in England; average dates elsewhere, July 1st — 20th in Belgium (Lambillion); regularly in August in the Scilly Isles (Adkin); larvæ fullfed in May, imagines in July and August in the Channel Islands (Luff); larvæ fullfed in June, imagines in July, in the Zürich district (Rühl); larvæ fullfed in June, imagines in July, in Pomerania (Hering); males on the wing from July 10th—13th at Gipfel, on the Brocken (Bärtling); in July in Transcaucasia (Romanoff); June to September in Sicily [where it occurs as vars. *spartii (? viburni)*, *sicula* and *roboris*] (Minà - Palumbo); June to October in the Loire-Inférieure (Bonjour); second week in July in the Dept. Loir-et-Cher (Harrison); at the end of July and commencement of August, at Aix-les-Bains and Chambéry; the first and second weeks of August at Torre Pellice (Tutt); June 20th—July 26th are average dates in Austria, one from Kessen on September 7th (Fritsch); from the middle of June lasting well into July in the Baltic Provinces (Nolcken); a larva, August 6th, 1878, in the Iser-Gebirge, pupated the middle of the same month, but, though kept warm during winter, refused to emerge till June 19th, 1879, when it produced a normal ♂ in Arctic Norway, whither its possessor had travelled (Schilde); larvæ at Buchenau, in the Linz district, on May 14th, 1896, pupated May 6th—20th, emerged June 19th until beginning of July (Himsl). The following are dates on which imagines have been bred or taken: Between July 16th—August 16th, 1849—1859, larvæ best searched for about May 16th to end of first week in June in the Brighton district (Merrifield); July 31st, 1856, at Shanklin (Trimen); July 14th, 1857, at Wandsworth (Blackmore); imagines flying July 27th, 1858, at Marlow, larvæ from Marlow, spun up June 19th, emerged July 16th, 1859 (Clarke); larvæ common, May 12th—19th, 1860, imagines bred July 16th—29th, 1860; larvæ May 2nd—13th, 1861, imagines bred May 28th and onwards; larvæ April 28th, 1862, all at Lee; larvæ June 10th—14th, 1863, at Portscatha; imagines August 5th, 1866, at Bexley; August 3rd—8th, 1867, at Deal; larvæ May 1st, 1875, at Tilgate, bred July 18th, 1875; July 17th, 1875, a ♀ at light at Eltham; August 1st, 1875, at Deal; larvæ June 10th, 1885, at Lee (not seen in Lee district since), imagines July 13th—August 5th, 1889, at Deal; larvæ June 17th, 1893, at Chattenden; April 21st, 1894, larvæ common at Farningham; April 30th, 1895, larvæ abundant at Swanley; May, 1896, larvæ common at Eynesford (Fenn); average dates from June 26th to August 6th in Chatham district (Chaney); bred July 15th, 1866; ♀ August 14th, 1866, at light at Lee, another ♀ at light, July 20th, 1873, at Eltham, yet another ♀, July 9th, 1874, at light, at Lee (A. H. Jones); bred July 17th, 1871, from Wanstead, July 23rd, 1889, at Brentwood; caught August 11th, 1890, 2 males that were assembling to wild ♀ at Newlyn, nr. Penzance; July 22nd, 1893, at Bentley, August 5th, 1901, at Mucking (Burrows); larvæ May 7th, 1871, gave imagines July 26th—31st, 1871; a ♀ captured July 31st, 1871, at Southstoke; larvæ July 5th, 1892, pupated August 19th, &c., at Frimley; bred commonly at Oxton, August 13th, 1895, July 16th—29th, 1896, August 7th—11th, 1896, July

11th—20th, 1897, July 31st—August 4th, 1897, July 21st—August 6th, 1898, ♀ taken July 31st, 1897, laid eggs which hatched August 20th; July 22nd—August 6th, 1899, at Oxton (Studd); larvæ, May 24th —July 9th, 1873, at Norwich, produced imagines, July 4th, 8th, 12th, &c., 1873 (Laddiman); a pair *in cop.*, August 25th, 1875, at Emsworth (Buckler); August 4th, 1875, at Bulmershe, July 9th, 1876, at Wokingham, July 28th, 1889, at Goring, July 12th, 1891, at Padworth, July 24th, 1892, at Mortimer (Holland); August 6th, 1881, at Netley, larvæ at Hitchin, May 31st, gave imagines August 2nd, 1882, also fullgrown larvæ at Hitchin, May 30th, 1883 (Durrant); bred July 25th, 1882, August 6th, 1885, August 27th, 1889, from Purbeck larvæ (Bankes); pupated June 22nd, emerged August 17th, 1882, at Carmarthen (Wilson); bred a ♀, August 3rd, 1883, in Guernsey, males assembled freely to her in garden (Lowe); in May, 1885, males, at St. Ives (Norris, *Ent.*, xix., p. 178); July 27th, 1885, at Bletchingley, July 22nd, 1896, at Hitchin (Barclay); July 8th, 1882, July 10th, 1885, July 12th, 1887, July 29th, 1895, at Reading, July 8th, 1894, July 12th–19th, 1895, at Folkestone (Butler); August 4th, 1886, and following days; on the first-named day ♂s assembled to ♀ when in a boat more than a mile from shore; July 18th, 1895, males flying in south Devon; July 22nd—23rd, 1895, males assembled to female in Isle of Wight, the ♀ attracted most strongly when about 48 hours old (Prideaux); July 2nd, 1887, at Armagh (Johnson); larvæ at Portland, September 11th, 1895, larvæ, April 19th, 1889, produced imagines July 23rd—August 21st, 1889 (Brown); ♀ bred June 27th, 1889, males attracted same date, others, July 4th, 1889, at Rainham (Raynor); July 31st, 1890, at Whitwell (Freeman); August 24th, 1890, at Bridport, August 18th, 1891, at Street, August 25th, 1894, at Braunton, larvæ June 22nd, 1899, at Lynton, gave imagines July 29th, 1899 (Bartlett), larva May 28th, 1890, at Benfleet, gave an imago July 31st, 1890, another larva June 8th, 1896, gave imago July 19th, 1896; imagines just commencing to emerge July 11th, 1894, at Southend; larvæ June, 1897, bred July 15th, 1897, and following days, also one imago from these 1897 pupæ, emerged July 18th, 1898, all from Benfleet (Whittle); July 21st, 1890, between Aberdovey and Glandovey (Arkle); August 12th, 1890, at Weston-super-Mare (Lifton); June 28th—July 17th, 1890, at Brockenhurst (Blagg); imagines in early June, 1891, at Brentwood (Mera); ♀, July 24th, 1891, at Eissell (Morley); swarming on the cliffs at Swanage in early August, 1891 (Alderson); August 15th—21st, 1891, at Bembridge (Kaye); July 17th, 1891, males at Pembroke (Jeffreys); July 11th, 1891, a ♀ drying its wings at Theydon Bois; many moths emerged from July 12th, 1891, onwards, from Wicken larvæ of the year, but some pupæ went over until the summer of 1892 July 27th, 1894, males flying at Dartford; males common at Polegate, August 1st and 2nd, 1894, apparently indifferent to wind and heavy rain (James); July 21st, 1892, in New Forest (Simes); captured July 29th—August 15th, 1891, July 27th, 1893, August 6th, 1894, August 6th, 1895, July 21st, 1896, at Sandown; bred from same locality, July 28th, 1894, August 2nd—12th, 1899, September 26th, 1900 (after being 3 months in pupa); captured July 30th, 1898, at Torquay, September 4th, 1900, at Niton; bred July 16th, 1893, from Deal July 9th, 1893, from Southend, July 24th—26th, 1894, from Pett, several males assembled July 27th, 1894, in New Forest, ♀ newly emerged, July 28th, 1894, in the New Forest (Prout); in July, 1893, at Barmouth (Helps); in June at York (Walker); July 21st, 1894, July 15th, 1896, July 20th, 1898, at King's Lynn (Atmore); end of July, 1894, at Cromer, a ♀ caught July 26th, 1894, laid eggs, which produced larvæ that pupated May and June, 1895, the imagines emerging from June 4th, 1895, onwards (Nicholson); larvæ, May 28th, 1894, at Bungay, emerged July 11th, 1894 (Clutten); larvæ, June 13th, 1894, at Cannock, emerged July 20th, 1894 (Freer); June 4th, 1886, July 29th, 1895, at Emsworth (Christy); July 10th—August 17th, 1894, these dates are about an average for most years at Mansfield; July 4th, 1895, till end of month, first noticed in 1898 on August 1st, and in 1899 on July 15th, at Penzance (Daws); July 21st, 1895, from Beverley (Hewett); July 21st, 1894, at Wisbech, July 12th, 1896, at Monks Wood (Glenny); July 7th, 1895, at Lynton, bred June 15th, 16th, 1896, at Worcester (Rea); larvæ, June 11th, 1895, emerged July 19th, 1895, from Polegate, imagines July 24th, 25th, 1897, at Eastbourne; larvæ, April 13th, 1895, gave imagines July 13th, 1896; imagines also taken July 21st — 28th, 1896, July 19th—August 4th, 1897, August 2nd, 1898 (Montgomery); larvæ, April 26th, 1896, at Epping, pupated May 9th, and larvæ, June 24th, 1897, from Epping, produced imagines same year as captured (Bayne); larvæ, June 3rd, 1894, at Galway, on ling, pupated June 9th, 1894, emerged July 30th, 1895 (Allen): larvæ common at Folkestone, May, 1896—1897, earliest larva pupated June 12th, 1896, latest, July 3rd in 1897, earliest date of emergence of imagines, July 12th, 1896, latest, August 2nd, 1897; captured two males flying in hot sunshine, August 4th, 1897, at Folkestone (Lane); July 3rd—12th, 1897, July 12th—19th, 1898, at Boxworth (Thornhill); June 20th, 1896, at Delamere Forest (Arkle); June 4th, 1897, at Rhinefields (Tremayne); July 10th—24th, 1897, at Barmouth (*E. M. M.*); taken at Hitchin, July 12th, 1896, also a larva found, May, 1898, spun up at end of June, ♂ imago emerged July 28th, 1898 (Cottam); July 21st—August 16th, 1898, at Hayling Island (May); August 1st, 1898, at Cheddar Gorge (Griffiths); larvæ, June 15th, at Enfield, produced imagines that emerged July 28th, 1898 (Edelsten); July 24th, 1898, at Leicester (Dixon); males abundant, August 4th, 1898, at Sidmouth (Studd); August 11th, 1899, at Polegate (Carr); larva well grown on whitethorn, May 21st, 1899, at Polegate, produced ♀ July 21st, 1899; two well grown larvæ, May 28th, 1901, at Monks Wood, gave ♂ and ♀ July 15th; these paired, and 70 ova were laid, which hatched August 2nd—4th, 1901 (Russell); July 12th, 1900, bred a ♀ at Hazeleigh, attracted 3 ♂s at 3 p.m., on July 19th, and 3 more at 5 p.m. on July 24th (Raynor); larvæ, May 11th, 1901, at Blackpool, spun up June 2nd—23rd, imagines emerged July 18th—25th, 1901, but two pupæ are going over the winter (Clutten); July 26th—30th, 1901, common at Chambéry, August 1st—10th, 1901, common at Torre Pellice (Tutt).

LOCALITIES.—Possibly many of the following may refer to var. *callunae*, although an attempt has been made to differentiate between the localities whence the variety and the type have come; where, however, no hint has been given by correspondents, the reference is included in this list. In Ireland, the Hon. Emily Lawless says the insect is common everywhere, and appears to be typical *quercûs*; on the other hand, Kane thinks that all the Irish specimens are referable to *callunae*. In Scotland it is very doubtful whether true *quercûs* occurs, a few *callunae* emerge the same year as pupation takes place, but there seems to be no segregation of the physiological peculiarities characteristic of *quercûs*, even in the southern counties. ANGLESEA: Anglesea (Arkle). [ARGYLL: Kilberry (Cottingham).] [ARMAGH: Armagh (Johnson).] BEDS: Potton, abundant (Bond-Smith). BERKS: Reading (Butler), Wokingham (Clarke), Padworth, Mortimer, Bulmershe (Holland). BUCKS: Marlow (Clarke). Buckingham (Slade), Black Park (Stevens). CAMBS: common everywhere (Balding), Cambridge (Jenyns), Wicken Fen (Christy), Ely (Cross), Boxworth (Thornhill), Burwell Fen (Lee). [CARDIGAN: Glandovey (Arkle).] CARMARTHEN: Langland Bay, near Swansea, Tenby (Robertson), Carmarthen (Wilson). [CARNARVON: Conway valley, abundant, Crafnau valley (Bland), Llanwrst (Cotton).] CHESHIRE: generally distributed, but common on the coast (Day), coast sandhills (Porritt), Wallasey (Freeman), Bowdon (Chappell), Chester, Delamere Forest (Arkle), Stockport (Johnson). [CORK: Queenstown (Bond), Skibbereen (Wolfe), Cork (Birchall).] CORNWALL: very abundant in the Penzance district, Paul, etc. (Daws), Bude (Image), Whitsand Bay (Dell), Scilly Isles, abundant (Adkin), Looe (Horton), Newlyn, Lands End (Burrows), north Cornwall – Port Isaac (Sheldon), Portscatho (Fenn). [CUMBERLAND: Carlisle (Morris). (Routledge states that var. *callunae* is the only form found in the Carlisle district).] DENBIGH: Colwyn Bay, Little Orme (Whittaker). DERBY*: not common (Brown), Chellaston, Little Eaton (Payne), Ellastone, Ashbourne (Lighton), Derby (Tunaley). DEVON: Sidmouth, abundant (Majendie), North Devon (Lockyer), Lundy (Bacot), Topsham (Ross), Barnstaple (Mathew), Newton Abbot (Vicary), Plymouth (Reading), Buckerell (Riding), Torquay (Oldham), Braunton, Street, Dartmouth (Bartlett), Lyme Regis (Helps), Lynton (Rea), Oxton, near Exeter (Studd), Salcombe (Turner), Horrabridge (Still), Ilfracombe (Griffiths), Lynmouth (Briggs), Dawlish (H. J. Turner). DORSET: generally distributed (Dale), Swanage (Cowl), Portland (Partridge recorded this as *callunae*, which Richardson doubts), Dorchester, Weymouth (Forsyth), Lyme Pregis (Bacot), Purbeck (Bankes), [DUBLIN: near Dublin (Vigors).] DURHAM: sea-coast near Hartlepool (Gardner). ESSEX: Chelmsford (Miller), Canvey Island, Wanstead, Brentwood, Rainham, Mucking (Burrows), Leigh, common (Dollman), Feering, Wickham (P. Reid), Epping (Bayne), Bulmer, Sudbury dist., common (Ransom), Colchester (Harwood), Southend (Battley), Sewardstone (Rose), Great Hallingbury (Bird), Chingford, Walthamstow (Meldola), Benfleet (Whittle), Bentley (Williams), Hazeleigh, common, Maldon, Woodham Ferris (Raynor), Loughton (Bower), Theydon Bois (James), Abridge, near Theydon (Pickett). [FERMANAGH: Enniskillen (Allen).] FLINT: Overton, Rhyl (Perkins). [GALWAY: Galway (Allen).] GLOUCESTER: Bristol district, generally distributed, Painswick, etc. (Watkins), Gloucester district, general (Merrin), Northleach (Todd), Cirencester (Harman), Newnham (Lifton). HANTS: Isle of Wight · Niton, Sandown, abundant (Prout), Shanklin (Ince), Yarmouth, Lyndhurst, Freshwater, Bembridge (Kaye), banks of the Yar, St. Helens (Holland), Netley (Durrant), Wishanger (Newland), New Forest (P. Reid), Winchester† (Hewett), Basingstoke (Holdaway), Frimley (Studd), Ringwood (Nicholson), Fleet (Russell), Christchurch (Bristowe), Rhinefields (Harvey), Emsworth (Christy), Pamber (Clarke), Bisterne (*Substitute*, p. 29), Hayling Island (May), Portsmouth (Pearce), Lymington, Hurst Castle (Hawes), Brockenhurst (Blagg), Romsey (Buckell). HUNTS: St. Ives (Norris), Monks Wood (Glenny). HEREFORD: Hereford (Chapman), Leominster (Hutchinson), Tarrington (Wood). HERTFORD: Hertford (Stephens), Hitchin district (Durrant). ISLE OF MAN (Clarke). KENT: generally abundant, but now rather rare in the south-east metropolitan district—Lewisham, Grove Park (Fenn), Strood, Rochester, and Chatham districts abundant; Woolwich and Plumstead district, Darenth, Deal, Dover, Folkestone, etc. (Tutt), Shorncliffe (Rogers), Herne Bay (Butler), Walmer (Shepherd), Blackheath (Pitman), Lee, Eltham, Bexley, Mottingham, Chattenden (Bower), Wrotham (Carr), Shooter's Hill, Farningham, Swanley, Eynesford (Fenn), Dartford (James), Kidbrook (West), Margate (Colthrup). [KERRY: Kerry (Lawless).] LANCS:

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* Sheldon states that Breadsall Moor, near Derby, produces var. *callunae*, the larvæ feeding on heather.

†Hewett notes that "at Winchester, larvæ found in May and June, spin up in June, some emerge end of July, the majority the following May, but most larvæ are full-fed at end of May."

generally abundant in coast districts (Day), Blackpool (Clutten), St. Anne's-on-Sea (Baxter), Southport (Porritt), Stockport (Johnson), Stalybridge (White), Liverpool (Walker), Formby (G. O. Day), Crosby (Freeman), Moss-side, near Manchester (Chappell), Lancaster (Sumner), Winster, Rowdsey Moss (Cotton), Wigan (Giraud), Haverthwaite (Arkle). LEICESTER: rare in Leicester district—Quorn (Bouskell), Knebworth, Ansty, Evington, Wislow, etc. (Dixon), Loughborough (Moss), Braunstone (Storer), Forest Rock (Rowley), Gumley (Matthews). [LIMERICK: Castle Cornell (Marsden).] LINCOLN: Hartsholme (Carr), Woodhall Spa, Panton, Mablethorpe (Raynor), Lincoln (Musham). [LONDONDERRY: Derry (Campbell).] [MERIONETH: near Barmouth (Helps), Aberdovey, (Arkle).] MIDDLESEX: Wandsworth (Blackmore), Harrow (Melville), Ealing (Adye), Mill Hill (South), Enfield, Enfield Lock (Edelsten). MONMOUTH: Llandogo (Nesbitt), Abergavenny (Chapman), Wye Valley (Patten). NORFOLK: generally distributed (Balding), Cromer (Nicholson), Great Yarmouth (Harmer), Norwich (Pitman), Whitwell (Freeman), King's Lynn (Atmore), Wisbech (Glenny). NORTHAMPTON: Oundle (Whall), Peterboro, common (Mousley), Northampton (Tomalin). NOTTS: generally distributed over the county (Lievers), Chilwell (Pearson), Mansfield, abundant (Daws), Worksop (Alderson). OXFORD: Oxford (Fuller), Southstoke (Studd), Witney (Stone), Nettlebed (Henderson), Warren, Henley (Clarke), Goring (Holland). PEMBROKE: Pembroke (Jeffreys). RUTLAND: Uppingham (Fox). SHROPSHIRE: Wyre Forest (Wainwright). [SLIGO: Culleenamore, common (Russ).] SOMERSET: Taunton, Frome (St. John), Weston-super-Mare (Lifton), Bridport (Bartlett), Cheddar Gorge, abundant (Griffiths), Clevedon, common (Mason), Castle Cary (Macmillan). STAFFORD: generally distributed (Daltry, Stafford (Bond), Stoke (Devon), Ashton-under-Lyne (Kershaw), Burton-on-Trent (Brown), Cannock (Freer), Stone (Bostock). Madeley (Daltry). SUFFOLK: common (Bloomfield), Ipswich (Freeman), Bungay (Clutten), Felixstowe (Morley), Bentley (Burrows), Sudbury district, common (Ransom), Waldringfield (James). SURREY: Wimbledon, Mitcham (Briggs), Redhill (Turner), Nunhead, Hindhead (Barrett), Ripley (Stevens), Bletchingley (Barclay), Eissell (Morley). Addington (Colthrup). SUSSEX: almost throughout (Nicholson), Brighton district, everywhere, Blatchington (Merrifield), Newhaven (Reeve), Hastings, St. Leonard's, Guestling (Bloomfield), Angmering (Dollman), Polegate, Eastbourne, Abbots Wood (Montgomery), Tilgate (Fenn), Bognor (Trimen), Hayward's Heath (Crallan), Lewes (Nicholson), Hailsham (James), Groombridge, Crowborough Beacon (Blaber), Pett (Prout), Worthing (Fletcher). WARWICK: Birmingham (Johnson), Rugby (Rowland-Brown), Sutton Coldfield (Wynn). [WESTMEATH: Rathowen, Cromlyn (Battersby), Westmeath (Birchall).] [? WESTMORLAND: Witherslack, Clougha Pike, Heysham Moss (Arkle)]. WILTS: Salisbury (Ridley). WORCESTER: common, Tiddesley Wood, etc. (Rea), Worcester (Edmunds), Bockleton (Decie), Wyre Forest (Wainwright). YORKS: Western amsty of county (Waite), plentiful on coast (Porritt). Beverley (S. Walker), Rotherham, Melbourne (Hewett), Sheffield (Wellman), Skipwith, abundant (Ash), Bradford (Firth), Hull (Boult).

DISTRIBUTION.—AFRICA: Canary Islands* (Speyer). ASIA: Altai (Speyer), Siberia, Asia Minor—Brussa, Kis Aolé, Armenia (Staudinger), Cilicia, on the ruins of the old Corycus (Holtz). AUSTRO-HUNGARY: Bukovina (Hormuzaki), Pressburg (Rozsay), Bohemia, common (Nickerl), Galicia, distributed and not rare (Garbowski), Lemberg (Nowicki), Upper Styria—S. Lambrecht (Kodermann), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Brünn (Müller), Biala, Bregenz, Cilli, Kessen, Linz, Trotzberg (Fritsch), Tyrol. common to 6,000ft. (Hinterwaldner), Taufers, Innsbruck (Weiler), Hermannstadt (Czekelius), Epiries, common (Husz), Chemnitz (Pabst); Hungary—Trencsen, Teplitz (Vángel), Gölnitz (Hudák), Glockner, Fiume (Mann), Upper Carinthia—Salzburg (Nickerl), Lavantthal (Höfner); Carinthia—Pörtschach (Wagner). BELGIUM: common almost everywhere (Donckier), Virton, common (Bray), Namur (Colignon). CHANNEL ISLANDS: Guernsey (Blaber), Jersey (Hawes), Herm, Sark (Luff). DENMARK: distributed, and rather common (Bang-Haas). FRANCE: throughout (Berce), Aube (Jourdheuille), Douai (Foucart), Auvergne (Sand), Eure-et-Loir, common (Guenée), Haute-Garonne, nowhere rare, type at Bouconne, St. Jean, Cier-de-Rivière (Caradja), Aude (Mabille), Loire-Inférieure (Bonjour), Saone-et-Loire (Constant); Seine-Inférieure, common (Viret), St. Quentin

*Speyer suspects this should be referred to *L.* var. *spartii*. We suspect it would much more likely be one of the southern forms—var. *viburni*, or var. *meridionalis*, or even var. *sicula*.

(Dubus), Puy-de-Dôme (Guillemot), Morbihan, very common (Griffith), Gironde (Trimoulet), Doubs, very common (Bruand), dept. Var (Cantener), Loir-et-Cher (Harrison), Caussols (Bromilow), Seine-Inférieure—Pont-de-l'Arche (Dupont), Aix-les-Bains, Chambéry (Tutt), Sarthe (Desportes), Normandy—Tancarville (Leech). GERMANY: everywhere, not rare (Heinemann), north-west Germany, almost everywhere (Jordan), Thuringia, distributed and not rare (Krieghoff), Dessau (Richter), Alsace (Peyerimhoff), Pomerania (Hering), Brunswick (Heinemann), Rhine Palatinate (Bertram), Würtemburg (Seyffler), Giessen (Dickore), Lower Elbe dist. (Zimmermann), Waldeck (Speyer), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle—Dessau (Stange), Munich (Kranz), Rudolstadt (Meurer), Mecklenburg (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia (Schütze), Dresden (Steinert), Prussia, everywhere common (Schmidt), Silesia (Wocke), Upper Lusatia (Moeschler), Nassau (Rössler), Ratisbon (Schmid), Hanover frequent (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), Gipfel-on-the-Brocken (Bärtling), Thuringia-Gotha, Lauchaer, etc. (Knapp). ITALY: pretty common throughout (Curò), Lombardy (Turati), Modena, very common (Fiori), Roman Campagna—Boscolungo, common (Calberla), Sicily (Minà-Palumbo), Siena, Monastero (Bevis), Torre Pellice, Villar (Tutt). NETHERLANDS: rarer than *trifolii* (Snellen), everywhere common, Breda, etc. (Heylaerts). ROUMANIA: rare and local to 700m—800m., very common at 1500m — 1800m. (Caradja). RUSSIA: Baltic Provinces (Sintenis), Treiden (Bienert), Moscow district (Albrecht), Wolmar (Lutzau), Volga district, not rare (Eversmann), Transcaucasia, generally distributed—Borjom, Helenendorf, Lagodekhi, Guéroussi (Romanoff), St. Petersburg (Erschoff). South Russia (Moeschler). SCANDINAVIA: not rare up to 66° N. lat., not met with in the polar circle (Aurivillius). Norway—south and central, not infrequent (Siebke), to 63° N. lat. in Norway, to 66°N. lat. in Sweden, to 64°N. lat. in Finland (Reuter). SPAIN: Catalonia (Martorell y Peña), Barcelona (Cuní y Martorell), Andalusia—Granada (Rambur), Galicia-Santiago (Macho-Velado), Ferrol (Walker), Bilbao, common (Rössler). SWITZERLAND: generally distributed in the lower districts, giving place to var. *alpina* in the mountains (Frey), Grisons (Killias), Weissenburg (Huguenin), Dole (Baker), Aigle (Lowe), Zurich district, generally distributed (Rühl), Visp and Saas valleys (Jordan), near Martigny, Mt.-Chemin, Fully, Saillon, Sion, Sierre, Brigue (Favre).

Family: EUTRICHIDÆ.

Nothing has been more unexpected in working out the characters of the various species of this superfamily in detail than the certainty that the Metanastriids belong to the Eutrichid, and not to the Pachygastriid, side of this superfamily, and our conclusions, based largely on the material in the British Museum collection*, lead us to suggest the following main subdivisions of the family *Eutrichidae*.

I. Subfam.: METANASTRIINÆ.

1. Tribe: *Macrothylaciidi—Macrothylacia* (type *M. rubi*, L.). With generalised characters, but more definitely referable to the Eutrichid than the Pachygastriid side of the Lachneid tree.

2. Tribe: *Gloveriidi-Gloveria* (type *G. olivacea*, Hy.-Edw.).

3. Tribe: *Metanastriidi - Metanastria* (type *M. hyrtaca*, Cram. (*repanda*, Walk. *teste* Kirby).

II. Subfam.: DENDROLIMINÆ.

1. Tribe: *Dendrolimidi—Dendrolimus* (type *D. pini*, L.). A very distinct evolutionary branch from the Metanastriid stem, with less specialised characters than those exhibited by the Cosmotrichids and Eutrichids *(sens. strict.)*.

III. Subfam.: COSMOTRICHINÆ.

1. Tribe: *Cosmotrichidi-Cosmotriche* (type *C. potatoria*, L.). A specialised group, branching independently from the Metanastriid base.

IV. Subfam.: PINARINÆ.

1. Tribe: *Pinaridi—Pinara* (type *P. obliqua*, Walk.), *Suana*, *Taragma*, &c.

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* We have no great faith in some of the associations made in the British Museum collection, between certain larvæ, cocoons, pupæ, and imagines. In some cases, the cocoons, pupæ, &c., have clearly no connection with the imagines with which they are placed. We have neglected obviously bad associations, nevertheless others less obvious may have been inadvertently admitted.

V. Subfam.: EUTRICHINÆ.

1. Tribe: *Odonestidi*—*Odonestis* (type *O. pruni*, L.), &c.

2. Tribe: *Eutrichidi*—*Eutricha* (type *E. quercifolia*, L.), *Gastropacha* (type *G. ilicifolia*, L.), &c.

The above simply suggests the main lines on which the structural peculiarities appear to run. The Macrothylaciids certainly appear to fall into the same subfamily as the Metanastriids *(sens. strict.)*, although in different tribes. This will indicate our disagreement with Kirby, who sinks *Metanastria*, Hb., as being included in *Dendrolimus*, Germ. We are quite unable also to appreciate the lumping necessary to make up Kirby's genus *Dendrolimus* (*Cat.*, pp. 813—816), in which we find *pini*, L., *aconyta*, Cram., *hyrtaca*, Cram., *bipars*, Walk., *capensis*, Linn., *mexicana*, Druce, and many other species included. In the British Museum collection, the material (cocoons and imagines) belonging to *Metanastria hyrtaca*, Cram., certainly suggests distinct affinities with the Macrothylaciids, although hardly of a generic character, whilst the relationship of *M. latipennis* thereto is still more marked, although the latter appears to be distinctly a form with characters suggesting affinity with both the Macrothylaciids and Dendrolimids *(pini)*, these intermediate characters being shared by *Metanastria ampla*, Walk. (referred by Kirby to *Lebeda)*, the ♀ showing very distinct Dendrolimid tendencies. *M. punctata*, Walk., is also near *M. ampla*, but still nearer to *D. pini*, possessing a cocoon somewhat resembling that of the Cosmotrichids, the larva also with characters reminding one of *Cosmotriche* (*potatoria*) and *Dendrolimus* (*pini*). *M. rubi*, also classed in the British Museum coll. as a *Metanastria*, has less distinct Eutrichid affinities than any of the species already mentioned, and, as we have elsewhere stated (*posteà*) somewhat at length, its nearest relative (so far as we have detected) appears to be *M. psidii*, Sallé. *Gloveria* (*olivacea*, H.-Edw.) is as distinctly Metanastriid as are many of the species included in the British Museum collection in *Metanastria*, and would appear to have more in common with *Macrothylacia rubi*, than the latter has with such forms as *capensis*, Linn. (*pithyocampa*, Stoll) and *obscura*, Walk., which probably again have more in common with *Pachypasa otus*. One suspects, from a study of the specialised imagines, that *Syrastrena* (*minor*, Moore) and *Bharetta* (*cinnamomea*, Moore) belong to the Metanastriid rather than to the Eutrichid (*sens. strict.*) stem.

So far as larval characters are available, it is clear that Kirby's family *Pinaridae* belongs to the Eutrichid stem. Hampson rightly unites (but much too closely), in the British Museum collection, such species as *serratilinea*, Gn. (placed in *Napta*, Kirby, *Cat.*, p. 830), *cajani*, Vins. (placed in *Libethra*, Kirby, *Cat.*, p. 820) and *marginepunctata*, Guér. (placed in *Borocera*, Kirby, *Cat.*, p. 857), all of which are distinctly Eutrichid, though in varying degrees. *Suana*, as represented by *concolor*, Walk., is also Eutrichid. It is strange how these evidently related species tend to exhibit characters found in different subfamilies, for, whilst the ova of *serratilinea* are of the banded type (well illustrated in the egg of *Eutricha quercifolia*), and laid roughly in rows, those of *cajani* are laid round a twig, and whilst the cocoon of *Suana* (*concolor*) is Cosmotrichid, those of *cajani* and *marginepunctata* have a tendency to the compact form of *Pachygastria* (but are flexible and thin), and that of *serratilinea* appears to be intermediate, Cosmotrichid in general character, but tending to the stumpiness of those of *cajani* and *marginepunctata*. So far as can be judged from the pupa and cocoon of *Bhima* (*undulosa*), there is some alliance indicated with the species just mentioned, but the tufted abdomen of the imago indicates considerable diversity. *Taragma* (*siva*), from its cocoon and shrunken larval skin, would appear to be Cosmotrichid, whilst the egg is almost Pœcilocampid in colour, but not in structure. *Pachypasa* (*otus*) is distinctly Eutrichid from the larval structures, but *Lebeda* (*nobilis*), of which there are no eggs, larvæ, cocoons, or pupæ in the collection, appears to be rather Metanastriid than Eutrichid. *Trabala vishnou*, Lef., although a tufted (♀) species, has larva and cocoon which appear to show Eutrichid characters, but the adult larva of this is very specialised, and there is a certain suggestion of *Pachygastria* about the dorsal hairs, whilst the pupa is very rounded and smooth. As a matter of fact, this species appears to combine the characters of separate Lachneid groups in a remarkable manner; the imago has suggestions of *Cosmotriche* (*potatoria*), *Macrothylacia* (*rubi*), and *Lasiocampa* (*quercûs*); the cocoon suggests *Cosmotriche*, but is very specialised; the larva, also very specialised, suggests *Pachygastria* (*trifolii*) and *Eutricha* (*quercifolia*), but one cannot say, on the material, which resemblances are due to convergence and which to real relationship; one requires young larvæ to settle some of these points. *Arguda flavovittata*, Moore, placed in *Radhica* by Kirby (*Cat.*, p. 810), is apparently Eutrichid, whilst *berhoba*, Moore, and *vita*, Moore, placed in *Odonestis* by Kirby (*Cat.*, p. 811), and *rosea*, Hamps., in *Radhica* (*teste* Kirby, *Cat.*, p. 811), are all certainly related to *Odonestis* (*pruni*), and show a distinct affinity thereto. One might fairly, perhaps, consider that the Metanastriids exhibit sufficient general characters to suggest a closer alliance than any other Eutrichids with the Pachygastriid stem, but still with the main (egg, cocoon, and some imaginal) characters of the present specific forms distinctly Eutrichid and not Pachygastriid. Nor does Dyar's tree (*antea*, vol. ii., pl. vii) help us here. This author certainly brings *Gloveria* and *Macrothylacia* somewhat near together, but still follows the old views that the alliance is such as to bring them both close to *Lasiocampa* and separate them widely from the Eutrichids, the various subfamilies of which he distributes in such a manner as to suggest for them no real connection. He widely separates, as we have already pointed out (*loc. cit.*, pp. 460—462), Eutrichids on both sides of his tree, and we have to unite his phyla, B, C, and J (as well as part of D), for our Eutrichid stem. There is no need to repeat here the critical arguments adduced (*loc. cit.*, pp. 458—463) to show that the Dendrolimids, Cosmotrichids, and Eutrichids (*sens. stricto*) are distinctly related, and we have already expressed in tabular form (*antea*, p. 111) our views of the main subdivisions of the family *Eutrichidae* so far as we have been able to study them. Bacot insists (*in litt.*) that *Odonestis* (*pruni*), usually closely associated by the authorities with *Dendrolimus* (*pini*), has a young (prehybernating) larva that he can barely separate specifically from that of *Eutricha* (*quercifolia*) in the same stage, whilst from the structural characters presented by the newly-hatched larva of *Dendrolimus*, the latter, he says, appears to be rather nearer *Cosmotriche* than *Eutricha*. In the *Journal of the*

New York Ent. Society, 1896, pp. 22—26, Dyar gives a summary of the American species of *Dendrolimus*, based on the characters of the ♀s, but we are not altogether certain that the American species are truly congeneric with the Palæarctic *D. pini*.

The Eutrichid egg is somewhat different from the Pachygastriid (Lasiocampid) egg. It is, however, of the same general flat type, somewhat similar in outline, with only traces of the black points at the angles of the polygonal reticulation so characteristic of the egg of *Lasiocampa*. It has, generally, in addition, a series of concentric ovals of a different tint—purplish, green, etc.—from that of the paler ground colour of the egg. There is some variation in the mode of egg-laying; many species lay only a few eggs in the same place, and these somewhat irregularly—*Eutricha quercifolia*, etc.—others place them more or less in rings or irregular masses, several in a batch—*Macrothylacia rubi*, *Cosmotriche potatoria*, etc.—whilst Dyar notes that the eggs of *Dendrolimus howardi* are laid in irregular clusters without any covering (the latter character, of course, being characteristic of all Eutrichids known to us), whilst Fletcher observes (*Ent.*, xxxiv., p. 198) that, at Wei-hai-Wei, on October 4th, 1899, the small fir-bushes were covered with ova of *D. pini*, most of which had already hatched out, the young larvæ being about half-an-inch long. The larger (micropylar) end of the egg appears usually to be eaten away by the Eutrichid larva on emergence.

Graber states (*Morph. Jahrbuch.*, xiii., 1888, pp. 609, 610) that he found the abdominal segments of the developing embryo of *Eutricha quercifolia* at first devoid of appendages, and that, when the latter appeared, they developed only on those segments on which they persist in the adult, and, on this ground, he is inclined to consider the prolegs secondary appendages (*vide*, *anted*, vol. i., p. 22). The newly-hatched Eutrichid larva is characterised by having tubercles i and ii large many-haired warts, iii a large many-haired wart, iv + v a large many-haired wart, whilst there is a large supplementary prespiracular wart towards the front edge of the abdominal segments 1—7 (*anted*, vol. ii., p. 439). The presence of a dull larval head in newly-hatched larvæ of *Eutricha* (*quercifolia*) and *Dendrolimus* (*pini*), whilst those of *Cosmotriche* (*potatoria*), *Macrothylacia* (*rubi*), etc., have shiny heads in this stage, suggests the more specialised character of the former. The full-grown Eutrichid larvæ are particularly specialised, and that of *Cosmotriche* (*potatoria*) is possibly almost as specialised in its own peculiar way, as are those of *Dendrolimus*, *Odonestis*, and *Eutricha*, which, in specialisation for protective purposes, are perhaps unequalled (*anted*, vol. ii., pp. 441-442) among any lepidopterous larvæ. Bacot notes certain resemblances between the larvæ of *D. pini* and *C. potatoria*, and observes that a faint dark mediodorsal line is present in the first instar of the larva of *Dendrolimus pini*, the 2nd and 3rd thoracic, and the 8th and 9th abdominal, segments being darkened on the dorsal area. This darkening is especially well-marked on the meso- and metathorax and is strongest on the low transverse ridge that bears tubercles i, the space between being pale yellow, suggesting the similar yellow blotches observable in *Cosmotriche potatoria*. Practically, the coloration is the same as in the latter species, but the colours are much fainter in *D. pini*, and the pale double oblique stripes present in *C. potatoria* are only faintly visible in *D. pini*. In the second instar, the larva of *D. pini* alters greatly in appearance, is long, thinner, lies closer to the pine-needles on which it rests, and resembles, in general character, rather *Eutricha* (*quercifolia*) than *Cosmotriche (potatoria*); in this stage, in the position formerly occupied by tubercles i (from mesothorax to 8th abdominal), are remarkable, scale-like hairs *, dark in colour, broad, flat, square- (or ragged-) ended; tapering to base, the scales being more numerous and larger on the meso- and metathorax and 8th abdominal segment than elsewhere; there are also some white, grass-leaf-shaped hairs on various parts of the body, a few on anterior edge of scutellum, a very marked ridge of them on mesothorax (just behind position of i) and a slight ridge in same position on metathorax; a few small ones on the lateral area of each segment from mesothorax to 8th abdominal; on the 8th abdominal, the scale-like hairs have a lovely blue or purple gloss on them; the dark colour of the area (occupied in 1st instar by tubercle i) agrees with that exhibited by the larva of *C. potatoria*. There is not such a strong development of secondary hairs in *D. pini* (2nd instar) as in *C. potatoria* in the same instar, and there is not the same suggestion of shagreen on the skin as in the larva of the latter. Comparing the larvæ of *C. potatoria* and *D. pini* at this stage, one sees at once that the colour-scheme is theoretically the same—strongly developed, however, in *C. potatoria*, only faintly traceable in *D. pini*—in the latter apparently developing towards an unicolorous larva, with the exception of certain local startling or warning markings. In the larva of *C. potatoria* the dorsal area is practically bright yellow with a series of large, oval, central, dull blue blotches, one on each segment from 1st to 8th abdominal, joined to each other by two black spots set only slightly apart and showing a streak of the yellow ground-colour between them; the black dorsal spots (similar to those of *Dimorpha versicolora* in 2nd instar) are situated on the outer or subdorsal edge of the blue dorsal patches; this arrangement nearly fills up the central dorsal area, but there is a broad, yellow, subdorsal band, and again, below this, the yellow and blue mottlings in about equal proportions, the blue chiefly above and the yellow beneath, but much more broken up by being arranged roughly into double oblique stripes; blue was probably the original ground-colour, but it has been much encroached upon by the spreading of the yellow. In the 3rd instar the scale-like hairs of the larva of *D. pini* already described are very marked and steel-blue in colour, whilst the white grass-leaf-like hairs are also more strongly developed. The remarkable larval scales*, already mentioned as being found on *Eutricha quercifolia* and *E. americana*, are figured by Packard (*Proc. Amer. Phil. Soc.*, xxxi., pl. x., figs. 15-17 and pl. xi., fig. 18), as well as those of *Heteropacha rileyana* (*loc. cit.*, pl. xi., fig. 19). Dyar considers (*Journ. N.Y. Ent. Soc.*, 1896, pp. 22 *et seq.*) that the short hairs of the adult larva of *Dendrolimus howardi* are of a defensive nature, and states that they become detached when the larva is handled, and, entering the skin, produce some irritation and finally small blisters which last for

* See also *anteà*, vol. ii., p. 437, where similar larval hair-scales are described as present in the larvæ of *Eutricha quercifolia* and *E. americana*.

several days. Of the larval habits of *D. pini*, Fletcher notes (*Entom.*, xxxiv., p. 198) that the larvæ occur in thousands at Wei-hai-wei, on fir-trees, in May, and are fullfed about the middle of June. The larvæ occur in two distinct shades—orange and grey. When annoyed they eject a clear watery liquid, and curl their heads down, thus prominently exposing the big, blue, hairy tufts, composed of short easily-detachable bristles. If further annoyed, they lash about with the fore-part of the body and try to bring these tufts into contact with the aggressor, and one left a number of short blue hairs embedded in Fletcher's skin. These hairs are also woven in the texture of the cocoon so as to form a regular *chevaux-de-frise*, they are not easily extracted from the skin, but break off, leaving the points embedded and would, no doubt, prove highly urticative to persons with a tender skin. The Eutrichid larvæ are generally solitary, but those of *Dendrolimus howardi* are stated (*Journ. N. Y. Ent. Soc.*, 1896, p. 23) to be gregarious, forming a web or tent, and Toumey says that great bands of web hang from the branches immediately around the tent, like long streamers.

It may be here noted that Suckow's investigations into the development of the female generative organs and the accessory structures were carried out on larvæ of *Dendrolimus pini*. He found the two filamentous oviducts to be prolonged beyond their point of attachment between the 7th and 8th abdominal somites, as two separate broader and longitudinally striated bands which end in contact with two small white knobs. They shorten gradually in the quiescent caterpillar and are thickened at the commencement of pupal life, and, by their union, they form the vagina. The two knobs just mentioned are, at the outset, separated from one another by a slight space, and are fixed to the hypodermis, whilst a nerve derived from the terminal ganglion of the chain passes to each of them. During the time that the formation of the vagina is taking place, the knobs approach each other and unite; moreover, they are brought by the contraction of the muscles and skin in pupation into opposition with the attached ends of the two oviducts. They are destined to give rise to four swellings—the rudiments of the bursa, the receptaculum and the two sebaceous glands. These conclusions are criticised by Jackson (*Studies Morph. Lep.*, pp. 155 and 170).

There are two very distinct forms of cocoon made by the Eutrichid larvæ known to us, *viz.*, the smooth parchment-like form exhibited by that of *Cosmotriche potatoria*, and the more loosely-woven form, largely intermixed with hairs, seen in its extreme form, perhaps, in the cocoon of *Eutricha quercifolia*. The cocoon of *Macrothylacia rubi* is probably to be referred to the latter group. Dyar's description of the cocoon of *Dendrolimus howardi* (*Journal New York Ent. Soc.*, iv., p. 26) suggests a rather near relationship to *Cosmotriche*. He describes it as "thin, almost papery, of dark-brown silk, single, but with some loose silk without, elliptical, less definite in shape than in *Clisiocampa*, the ends thinner than the central portion."

Standfuss records having experimented on eggs of *Odonestis pruni* and *Dendrolimus pini*, which he exposed to a temperature of 34°C. (93°F.) during the process of laying by the females and afterwards kept at this temperature until the time of hatching. As a result they produced larvæ in two-thirds or less of the normal time*, and then emerged as perfect insects in the same year, *i.e.*, without hybernation of the larva —of *O. pruni* 100 per cent., and of *D. pini* 81 per cent. The larvæ and pupæ were kept as far as possible at a mean temperature of 25°C. (77°F.). Part of the eggs laid by the same females as those used in the above experiment, which had already been laid in a temperature of about 22°C., and were kept in this until hatched, afterwards remaining as larvæ and pupæ in the same mean temperature of 25°C. as the first portion of the broods, produced a considerably smaller number of perfect insects without hybernation of the larvæ, *viz.*, *O. pruni*, 64 per cent., *D. pini*, 28 per cent. Standfuss concluded that the acceleration of development which the larva had already undergone in the egg had transferred the energy to the later stages of growth, and he pointed out that the shortening of the period of development is, in very many cases, associated with an obviously altered aspect of the imagines, *e.g.*, *Eutricha populifolia* compared with its var. *aestiva* (*obscura*, Heu.), and *Odonestis pruni* with its var. *prunoides*, and suggests that this alteration in the aspect of the imagines of the late broods must be influenced by the temperature to which these individuals have been exposed in the egg stage. He has further dealt somewhat at length with the differences presented by the two broods, where, as is frequently the case, in a more or less complete manner and under more or less favourable conditions, the species is completely or partially double-brooded. There can be no doubt that a study of the phenomena presented by complete and partial double-broodedness would give important clues to the geographical origin, and the phylogenetic age, of different forms of various species. Standfuss, referring (*Ent.*, xxvii., p. 73) to the difference between *Eutricha populifolia* and its var. *aestiva* (=*obscura*, Heu.), and *Odonestis pruni* and its var. *prunoides*, asks: "Are the two differently-formed broods in instances like this of different phylogenetic age? *Eutricha populifolia* is probably of northern origin, although in the north the species never produces two broods, whilst in the more southerly parts of its distribution—Carinthia, Piedmont, and south-east France—it often, possibly regularly, has a second brood. Thus, *E. populifolia* would be the type and the second generation, *aestiva*, the variety." As to the differences observable in colour and size, in these seasonally dimorphic (or trimorphic) Eutrichids, Standfuss asserts that such usually result in being larger and more strongly pigmented when developed in late spring and early summer, and smaller and more weakly pigmented in late summer or autumn. He notes (*Entom.*, xxviii., pp. 73-74) that a pair of *Eutricha quercifolia*, of which the male measured 58mm. the female 89mm. across the wings, produced offspring, of which, on being reared at a temperature of 25°C.—30°C., and after a sojourn of 70-85 days in the larval and 12-15 days

* Belling records (*Berl. Ent. Zeits.*, xlv., *Sitz.* p 43) that a Berlin collector, by keeping the insects in an uniform, moist and warm temperature, has reared three generations of *E. populifolia* in a year, the second generation, from egg to imago occupying only 25 days. The 2nd brood is known as var. *obscura*, Heu., the 3rd brood as var. *autumnalis*, Jaen. Petersdorff also notes (*loc. cit.*, p. 52) the rearing of three broods of *E. populifolia* and two of *E. quercifolia* in one year. See also *Ent. Rec.*, xii., p. 11.

in the pupal condition, the males measured only 35mm.-37mm., and the females 36mm.-39mm., no hybernation of the larva having taken place. On the other hand, eggs of *Dendrolimus pini*, ♂ 59mm. and ♀ 74mm., yielded descendants expanding ♂s 65mm.-68mm., ♀s 84mm.-86mm., after 150-172 days of larval feeding, and 25-37 days in the pupal condition. Standfuss further notes (*loc. cit.*) that the form and appearance of the insects, produced by means of forcing under a raised temperature, were most marked in *Eutricha populifolia* of all those species upon which experiments were made. The second and third broods of this species, *viz.*, var. *obscura*, Heu. (*aestiva*, Stand.), and var. *autumnalis*, Jaenich, exhibit, especially the latter, a more deeply-indented border to the wings than does the form resulting from hybernated larvæ. . . . . Both these varieties, however, reared in shorter time and also at a higher temperature, become darker than the ordinary form of *E. populifolia* (obtained from hybernated larvæ) by an increase in the dark elements of the pattern. He further suggests that *Gastropacha* (*Epicnaptera*) *tremulifolia* and *Eutricha populifolia*, which, he says, resemble each other extraordinarily in the imaginal, and to a certain extent in the earlier, stages, have possibly been differentiated as species as a result of the fact that, in earlier periods of the earth's history, their ancestors, whilst in the larval condition, did not react in the same manner to changes of temperature, and that the difference exhibited by *G. tremulifolia*, hybernating as a pupa, and *E. populifolia*, hybernating as a larva (and rapidly emerging from the pupa), may have arisen as a necessary consequence of a divergence in the larval habit at the time of the establishment of the species.

The sexual dimorphism, so distinctly marked in the Macrothylaciids and Pachygastriids, particularly the specialised features exhibited in the antennal structure, and the difference in coloration (being, as one would surmise, due to a response to the different habits exhibited by the sexes, the males flying swiftly by day, and assembling to the females in the afternoon or at dusk), is largely lost in, or has never been gained by, many of the higher Eutrichids — although retained to a certain extent in *Cosmotriche*—the difference in the habits of the sexes being less marked, and a much greater resemblance between the sexes being noticeable in the general shape and coloration of the wings. The males of *C. potatoria*, however, differ largely from the females, but, in *Dendrolimus*, *Odonestis*, *Gastropacha*, and *Eutricha*, the coloration and shape of the wings approach somewhat in the sexes, evidently in response to their resorting to a common habit for the purpose of protection, the resemblance to dead leaves being undoubted. The sexual difference in size is, however, maintained, for the females have a great body, necessary to hold a considerable number of comparatively large eggs, and they have also a proportionally large wing-area to carry the body. In some Eutrichids (*e.g.*, the Pinarids) the males are exceedingly small compared with the females of the same species. As a result [except in *Cosmotriche potatoria*, which, especially in its strongly developed antennæ, wide variation in ground colour (yellow to deep brown), a tendency by polymorphic colour-variation for the extremes of colour normal to either of the two sexes to be developed in the other sex, and in its habits (the males flying and assembling at early dusk and later appearing at light to the almost total exclusion of females), approaches the Lachneid (*sensu strict.*) side of the tree, rather than the other Eutrichids], there is no great range of sexual colour-difference in the remaining more specialised British Eutrichids. The general tendency in *Gastropacha tremulifolia*, *G. ilicifolia*, *G. suberifolia*, *Dendrolimus pini*, and, to a less extent, in *Eutricha quercifolia*, is to become simply grey in both sexes, a result induced either in response to the conditions of environment, or as a direct outcome of identity of habit in the sexes. As may be expected, however, there is, in these species, a considerable range of variation in the direction of a brighter, or darker, or duller red or red-brown tint, a very common feature throughout the group, and having its origin probably in a phylogenetic basis. Of the numerical relation existing between the sexes in certain Eutrichid species reared by Standfuss, we obtain the following details :

Odonestis pruni : 1880—89 ♂s, 81 ♀s; 1882—128 ♂s, 125 ♀s=217 ♂s and 206 ♀s.

Dendrolimus pini : 1879—782 ♂s, 745 ♀s.

Gastropacha ilicifolia : 1882—68 ♂s, 64 ♀s; 1892—187 ♂s, 170 ♀s=255 ♂s, 234 ♀s.

We have already (*anteà*, vol. ii., p. 445) given some notes on the Lachneid antennal structure. Chapman writes : "The general character of the Lachneid antenna is similar to that of many other families ; it closely resembles in many details that of the Lymantriids. It is a pectinate (or plumose) antenna with two plumules to each antennal joint, arising not very far apart on its underside, so that they do not spread laterally, but to some extent hang down side by side below the antenna, lop-eared fashion. In the male antenna these are always well developed ; in the female they are much shorter, but are never quite obsolete. The number of joints appears to be very variable, *e.g.*, in *L. quercûs* from 58 to 78. They are often somewhat oblique, that is, the ventral side is nearer the base than the dorsal. The dorsal area is clothed with scales, the ventral side and plumules have none. In *Lagoa*, the Cochlidids, and the Arctiids, very similar antennæ have the outer surfaces of the plumules clothed with scales. Here, and in the Lymantriids, Dimorphids (Endromids), and in *Eriogaster** (*Cnethocampa*), the plumules bear no scales. The outer aspect has a smooth surface, except that it is covered with very minute spicules, and the inner surface is clothed with regularly-arranged, rather long, hairs. The extremity of the plumule is often a little swollen or clubbed, and carries one or two, usually two, strong bristles, and, in addition, a thick, short, robust spine, that varies a great deal in size, &c., in different species."

Günther hints (*Berl. Ent. Zeits.*, liv., pp. 11—12) that the differently tinted specimens of *Dendrolimus pini* may select resting-places that agree with their own particular colour tint. Considering the great variability in the tint of the pine-trunks on which the imagines of this species rest, the explanation that the cause of the variation of this insect is due to natural selection preserving those

*For the synonymy of the genus *Eriogaster* (see *anteà*, ii., p. 450).

forms agreeing best with the resting-places is evident, but that there is any selection of particular resting-places by individual moths does not appear to be at all likely, although Bacot believes unconscious selection of a resting-place to be very possible. Stichel says that the variation of the insects and their resting-places corresponds in such a manner that the chance of any moth resting accidentally on a spot where it will not readily be seen is very great.

Of the Eutrichids, Schultz recorded (*Illus. Woch. für Entomologie*, ii., p. 494) no fewer than 48 gynandromorphous examples belonging to 9 species, *viz.*, *Macrothylacia rubi* 1 specimen, *Cosmotriche potatoria* 9 specimens, *C. albomaculata* 1, *Eutricha quercifolia* 2, *E. populifolia* 1, *Gastropacha ilicifolia* 1, *G. tremulifolia* 1, *Dendrolimus pini* 28, *D. undans* (*fasciatella*) ab. *excellens* 4. He later added (*loc. cit.*, iii., p. 311) 14 further examples, *viz.*, *Macrothylacia rubi* 1, *Dendrolimus pini* 2, *D. undans* ab. *excellens* 10, *Eutricha populifolia* var. *obscura* (*aestiva*) 1. Most of these records were obtained from comparatively few sources and collections, and no doubt could easily be multiplied if lepidopterists had any idea of their scientific value.

No experiments have been tried, to our knowledge, in hybridising the allied species of this group. We have already noted (*anteà*) that Durrant observed a pairing between *Lasiocampa quercûs* ♂ and *Cosmotriche potatoria* ♀, and Löffler obtained a pairing between *Dendrolimus pini* ♂ and a *Lymantria monacha* ♀, at Grunewald, near Berlin (*Berlin. Ent. Zeits.*, 1888, p. 24), both pairings that one could scarcely expect to be fruitful.

Supposed cases of parthenogenesis in the Eutrichids have been recorded (*vide*, *anteà*, vol. i., p. 29), the species noted being *Eutricha quercifolia*, *Dendrolimus pini*, and *Cosmotriche potatoria*, as well as *Macrothylacia rubi* (*post.*, p. 123), but many careful observations in this direction are still required.

Many of the Eutrichid imagines follow those of the Malacosomas in the manner in which they are attracted to light, and, like them, some of the species are only attracted in the male sex. Thus males of *Cosmotriche potatoria* fly to the light in great numbers on Wicken Fen and elsewhere on suitable nights, though scarcely a female is ever attracted. Schultz observes (*Berl. Ent. Zeits.*, liv., p. 9) that, in Berlin, in some years, countless numbers of *Dendrolimus pini* are attracted to the street lamps, and fall down on the pavement, where they are crushed by carriages and pedestrians, in some places leaving behind "spots" of grease several feet in diameter. It is a remarkable fact that *Eutricha quercifolia*, also attracted in large numbers by light, is so attracted in both sexes.

Subfam.: METANASTRIINÆ.

We have already suggested (*anteà*, p. 111) that the subfamily *Metanastriinae* is divisible into at least three tribes—*Macrothylaciidi*, *Gloveriidi*, and *Metanastriidi*—of which the first-named seems to be the most specialised, and the last-named much the most generalised, a wider gap existing between the second and third than between the first and second tribes. Nor do we wish to suggest that these are the only tribes to be included in this subfamily; on the other hand, many species, that have not yet been sufficiently studied to lead one to assert with certainty that they belong to separate tribes, appear, superficially, to be quite out of place in any of the tribes at present defined. Not only is this so, but our other Eutrichid subfamilies (*antea*, pp. 111—112) contain many, at present, uncollated tribal divisions beyond those that we have indicated, whilst it is quite possible that other subfamilies, fully equal in value to those already suggested, will have to be created. At first sight the Macrothylaciids appear to have much in common with the Malacosomas and Pachygastriids, and yet, in reality, they are very distinct from both. The eggs of the typical species of the tribe—*Macrothylacia rubi*—are not unlike those of *Lasiocampa*, yet show a distinct resemblance to the Eutrichid egg, which is not noticeable in *Lasiocampa*, whilst Bacot also notes that the egg of *M. rubi* shows a distinct relationship with those of the Eutrichids (*potatoria*, *quercifolia*, &c.), both as regards colour and pattern (*in litt.*). On the other hand, the mode of egg-laying usually adopted roughly resembles the more thorough and artistic work of *Malacosoma*. The Macrothylaciid cocoon, however, is quite *sui generis*, and reminds one rather of those of some Eutrichids, being quite unlike those of the Pachygastriids and Malacosomas. The imagines, also, have the Lasiocampid habit, the males flying swiftly by day, assembling readily to newly-emerged females, the latter egg-laying after dusk. Hübner, in the *Verzeichniss*, p. 186, unites (see, *antea*, vol. ii., p. 450) *rubi* with *hyrtaca*, Cram., and *aconyta*, Cram., in his coitus *Metanastriae*, hence the subfamily name. In 1866, Rambur separated *rubi* under the generic name we use in this work, leaving *hyrtaca* and *aconyta* as possible types of Hübner's genus. Moore, in 1883 (*Lep. Ceylon*, p. 147), declared *hyrtaca** to be the type of *Metanastria*, thus leaving *aconyta*, as a possible type of any later genus should it be found not to be congeneric. Aurivillius considers the two species, included by Hübner in *Metanastria* with *rubi*, as nearly related thereto, a conclusion with which one must agree, in the broad sense. The actual limits of the tribe *Macrothylaciidi* have yet, however, to be worked out. In the British Museum collection, as we have already stated, *Macrothylacia*, Rbr., is included in *Metanastria*, Hb., but the latter genus is there used in such a comprehensive manner that it allows almost the whole subfamily *Metanastriinae* with its many tribal divisions, each containing many more or less closely allied genera to be included. The want of information as to the structural peculiarities presented by the early stages of most of the species prevents one from being able to determine, in more than a tentative manner, what these relations really are. The only species in the collection whose imagines bear any really close resemblance to *Macrothylacia rubi* is that labelled *Metanastria psidii*, Sallé, but the relationship † of these species is not at all clear, and one suspects that the similarity is due rather to convergence than to any real community of descent, a suspicion borne out by the localities of the respective species, *rubi* being a Palæarctic and *psidii* a Guatemala-Mexican species. There is a broad similarity in the colour of the wings, the character

* The alliance between *rubi* and *hyrtaca* is such that the genus or tribe containing *hyrtaca* must be included in the same subfamily as that containing *rubi* (Bacot). Kirby places (*Cat.*, pp. 814-815) *hyrtaca* and *aconyta* next each other in his heterogeneous genus *Dendrolimus*.

† Certainly *psidii* is not congeneric with *rubi*, and equally certain it does not belong to the genus *Metanastria* (sens. restr.), which has *hyrtaca* for type.

of the two transverse lines and the hind marginal shade of the forewings, and a broad parallel resemblance in the sexual differences exhibited by the two species. A general uniformity of wing coloration exhibits conspicuously, in both species, the nervures of the fore- and hindwings, whilst the increased scaling and intense coloration, noticeable at the bases of the hindwings of *rubi*, are also present in *psidii*, and are further edged by an ill-developed transverse line in some of the males of the latter species. In some aspects, *M. psidii* appears to preserve a combination of the characters of *M. rubi* and *Pachygastria trifolii*, the general shape of the wing and the ill-developed white discal spot suggesting the latter. The larva of *M. psidii*, so far as can be judged from the dried examples in the British Museum collection, is rather close to that of *M. rubi*. The relationship of the Metanastriid species is much more marked in the females than in the males, which are, as is, indeed, usual in the Lachneids, more specialised, and hence more diverse in their appearance. Thus the female imagines of *M. psidii* and *M. rubi* closely resemble each other, whilst the males, although convergent, as we have shown above, present certain differences such as the greater width between the transverse median lines of the forewings in *M. psidii*, the outer of which takes a decided oblique turn towards the apex of the wing, whilst the presence of a small white central spot is very distinctive. The outer marginal band is less developed in *M. psidii* than in *M. rubi*, and the single transverse line on the hindwings of the male of *M. psidii* fails in the female. [It may be worthy of mention that O. W. Barrett observes (*Can. Ent.*, xxxii., p. 235) that the hairs of the larva of *M. psidii*, Sallé, are barbed at the tip and very irritating, in the same way as those of *Holisondota propinqua*, but contain no poison.*] Other Metanastriid species show characters that strongly suggest that the Macrothylaciids had origin within the subfamily *Metanastriinae*. One further suspects that the ancestral base of the latter was also not far from the point at which the Eutrichids originated. The South African *Metanastria pithyocampa* and *M. ferruginea* (from Natal) have the space between the two central lines of a different colour from that of the general surface of the wing, thus turning the two lines into the margins of a band; the lines are much more oblique than in *M. psidii*, and the remnant of the outer marginal band in the males of both species rather stronger than is that of *M. rubi*. In these species, however, the shape and shortness of the wings, the length of the abdomen, and the prominence of the head in the males, give them a much more Eutrichid appearance than has *M. psidii*, which, in turn, possesses it in some faint degree when compared with *M. rubi*. Those species usually referred to the Metanastriids, however, of which *punctata*, Walk., may be considered the type,

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*Stowell states that, being stung by the hairs of the larva of *Macrothylacia rubi*, the urtication produced did not finally disappear until the fifteenth day (*Zoologist*, p. 7898), whilst South (*Ent.*, xviii., p. 5), Sharp (*loc. cit.*, p. 324), Jenkyns (*loc. cit.*, xix., p. 42), Long (*loc. cit.*, p. 45), Lawford (*Ent. Mo. Mag.*, xxxii., p. 69), Blandford (*Proc. Ent. Soc. Lond.*, Feb. 5th, 1896, pp. iii-iv), and others, draw attention to the urticating properties of these hairs which are not barbed in any way and resemble those forming the urticating fur of the larva of *Lasiocampa quercûs*.

appear to be much nearer to the Eutrichids (*sens. strict.*) than to the Macrothylaciids, and the structural peculiarities of the blown larvæ of *M. punctata* support this view, showing distinct affinities with *Dendrolimus pini*, *Cosmotriche potatoria*, etc. There is, it is true, in the larva of *M. punctata*, an indication of a scanty dorsal fur similar to that of the larva of *M. rubi*, yet the strongly developed lateral thoracic pencils, and the transverse meso- and metathoracic dorsal tufts of hairs, convey the idea that the position is much nearer to the lower Eutrichids than to *Macrothylacia*. One is forced, by these and other considerations, to the conclusion that the subfamily *Metanastriinae* belongs really at the base of the Eutrichid stem, and that the Macrothylaciids, originating within the Metanastriid phylum, must be grouped therewith and not with the true Lachneid (or Lasiocampine) stem. It will be interesting, when opportunity offers, to examine the early stages of many of the species at present included in the British Museum collection under the generic name *Metanastria*.*

At the meeting of the Entomological Society of London, May 1st, 1901, Hampson exhibited two females of an apterous Lachneid from the Transvaal, with cocoon and ova, bred by Colonel J. M. Fawcett, 5th Lancers. The larva, he states, is very much like that of the British *Macrothylacia rubi*. The female does not emerge from the cocoon, its antennæ being aborted and all the joints coalesced with a flabellate organ with slight striæ indicating the joints, the fore tibiæ short with traces of tibial claws. The male is unknown, and as Colonel Fawcett was on active service at the time of the emergence of the female, he was unable to expose her for the purpose of attracting the male.

Vángel notes a case of parthenogenesis in *M. rubi* (*Rovart. Lapok*, iii., pp. ix and 59). St. George, in the *Arch. Mikros. Anat.*, xxx., p. 429, pl. xxv, has used the larva of this species, amongst others, for his investigations into the formation of spermatocysts.

Tribe: MACROTHYLACIIDI.

Genus: MACROTHYLACIA, Rambur.

SYNONYMY.—Genus: *Macrothylacia*, Rbr., "Cat. Lép. And.," pp. 352, 358-360 (1866); Kirby, "Cat.," p. 834 (1892); Auriv., "Iris," vii., p 152 (1894); Dyar, "Can. Ent.," xxx., pp. 4, 5 (1898); Tutt, "Proc. Sth. Lond. Ent. Soc.," 1898, pp. 1-11 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 70 (1898); Staud., "Cat.," 3rd ed., p. 122 (1901). *Phalaena (-Bombyx)*, Linn., "Sys. Nat.," xth ed., p. 498 (1758); xiith. ed., p. 813 (1767); "Faun. Suec.," 2nd ed., p. 292 (1761); Müll., "Faun. Frid.," p. 39 (1764); "Zool. Dan. Prod.," p. 117 (1776); Esp., "Schmett. Eur.," iii., p. 69 (1783); Vill., "Linn. Ent.," ii., p. 122 (1789); Bkh, "Sys. Besch.," iii., p. 99 (1790); "Rhein. Mag.," i., p. 364 (1793). *Phalaena*, Scop., "Ent. Carn.," p. 197 (1763); Fuess., "Verz.," p. 34 (1775); Meyer, "Fuess. Mag.," i., p. 269 (1778); Göze, "Ent. Beit.," iii., p. 267 (1781); Retz., "Gen. et Spec. Ins.," p. 36 (1783); Brünn, "Fuess. Neu. Mag.," iii., p. 71 (1785); Brahm, "Fuess. Neu. Mag.," iii., pp. 145, 149, 157 (1787). *Bombyx*, Fab., "Sys. Ent.," p. 565 (1775); "Sp. Ins.," ii., p. 178 (1781); "Mant. Ins.," ii., p. 113 (1787); "Ent. Sys.," iii., pt. 1, p. 427 (1793); [Schiff.,] "Schmett. Wien.," p. 56 (1775)†; Esp., "Schmett. Eur.," iii., pl. ix., figs. 1-6 (1782); View., "Tab. Verz.," p. 34 (1789); Brahm, "Ins. Kal.," p. 197 (1790); Don., "Nat. Hist. B. Ins.," ii., p. 87 (1793); Hb., "Larv. Lep.," iii., Bomb. ii.,

*One suspects that this genus forms the Lachneid dustbin, used by the Brit. Museum authorities for those Macrothylaciids, Eutrichids, etc., that were not provided with distinct generic names when described, and whose facies hardly rank them with the higher Eutrichids, and certainly exclude them from the Pachygastriids.

† On the original date and title of the "Vienna Catalogue," *vide*, Ann. Mag. Nat. Hist. (7), vi., p. 158.

Veræ. P. *b* (? 1800); "Eur. Schmett.," ii., fig. 174 (? 1803); p. 144 (? 1805); Ill., "Sys. Verz. Wien.," n. Ausg., i., p. 108 (1801); Schrk., "Fauna Boica," ii., Abth. 1, p. 274 (1801); Haw., "Lep. Brit.," pt. i., p. 83 (1803); Godt., "Hist. Nat.," iv., p. 134 (1822); Bdv., "Eur. Lep. Ind. Meth.," p. 48 (1829); "Gen. et Ind. Meth.," p. 71 (1840); Dup., "Icon. des Chen.," ii., pl. vii., fig. 2 (*circ.* 1840); "Cat. Méth.," p. 78 (1844); Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 69 (1871); Snell., "De Vlind.," p. 186 (1867); Berce, "Faun. Franç.," ii., p. 192 (1868); Nolck., "Lep. Fn. Estl.," i., p. 128 (1868); Newm., "Brit. Moths," p. 43 (1869); Cuní y Mart., "Cat. Lep. Barc.," p. 69 (1874); Mill., "Ann. Soc. Linn. Lyon," xviii., p. 13 (1869); Guén., "Lép. Eure-et-Loir," p. 83 (1875); Curò, "Bull. Soc. Ent. Ital.," viii., p. 151 (1876); Frey, "Lep. der Schw.," p. 97 (1880); Lampa, "Ent. Tids.," vi., p. 42 (1885); Jord., "Schmett. N.-W. Deutsch.," p. 96 (1886); Rühl, "Soc. Ent.," v., p. 178 (1891); Carad., "Iris," viii., p. 92 (1895); Tutt, "Brit. Moths," p. 56 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 58 (1898). *Lasiocampa*, Schrk., "Fauna Boica," ii., Abth. 2, pp. 153, 154 (1802); Germ., "Bomb. Spec.," ii., p. 47 (1812); Leach, "Edin. Ency.," ix., p. 132 (1815); Oken, "Lehrb. Naturg.," i., p. 708 (1815); Curt., "Brit. Ent.," iii., expl. to pl. ci (1827); "Guide," p. 142 (1829); Stephs., "Ill. Haust.," ii., p. 39 (1828); "Cat. Brit. Ins.," p. 46 (1829); "List. Br. An. Br. Mus.," 1st ed., p. 45 (1850); 2nd ed., p. 42 (1856); Meig., "Eur. Schmett.," ii., p. 202 (1830); Wood, "Ind. Ent.," p. 21, fig. 40 (1839); Humph. & Westd., "Brit. Moths," p. 57 (? 1843); Sta., "Man.," i., p. 153 (1857); Humph., "Gen. Brit. Moths," p. 24 (1860); Bang-Haas, "Nat. Tids.," (3), ix., p. 412 (1874); Buck., "Larvæ, &c.," p. 78 (1889); Barr., "Lep. Brit.," iii., p. 32, pl. xciii (1896). *Bombix*, Latr., "Hist. Nat.," xiv., p. 181 (1805). *Gastropacha*, Ochs., "Die Schmett.," iii., p. 270 (1810); Evers., "Faun. Volg.-Ural.," p. 156 (1844); H.-Sch., "Sys. Bearb.," ii., p. 106 (1847); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 26 (1851); Spey., "Geog. Verb.," i., p. 414 (1858); Hein., "Schmett. Deutsch.," p. 206 (1859). *Metanastria*, Hb., "Verz.," p. 186 (? 1822). *Bombyx (-Lasiocampa)*, Led., "Verh. z.-b. Ges. Wien," ii., Abh., p. 75 (1853). *Lachnocampa*, Wallgrn., "Skand. Het.," ii., pp. 89, 91 (1869); Auriv., "Nord. Fjär.," p. 63 (1889); Ström, "Danm. Somm.," p. 80 (1891); Reut., "Act. F. F. Fenn.," p. 28 (1893). *Eriogaster*, Meyr., "Handbook, &c.," p. 322 (1895).

Rambur's diagnosis of the genus (*Cat. Lép. And.*, p. 359) reads as follows:

Macrothylacia, nobis.—Tête petite, front non gibbeux, épistome saillant, antennes assez fortement bipectinées chez le mâle, ayant les dents un peu courbées a l'extrémité; munies d'une petite épine tournée un peu en dedans, à peine bidenticulées chez la femelle; chez celle-ci le thorax et surtout l'abdomen extrêmement épais, velus; ce dernier assez grêle chez le mâle, terminé par une touffe de poils allongés; pattes assez fortes, ayant l'épiphyse peu sensible et les éperons bien visibles; ailes grandes, larges, couvertes d'écailles peu serrées, longuement divisées en lanières fines ressemblant à des poils, franges peu larges; nervule des premières partant après le troisième rameau et aboutissant au quatrième de la troisième nervure; secondes ayant la marge antérieure très-dilatée surtout à la base qui est très-saillante et arrondie, recevant deux rameaux accessoires, dont un épais et courbé; aréole petite, fermée par un rameau court, épais, premier rameau de la deuxième nervure très-rapproché de la première et tendant à s'y unir; nervule d'abord droite et formant un angle au quart de sa longueur, puis oblique et aboutissant au dernier rameau de la troisième nervure; abdomen du mâle très-aminci à l'extrémité, premier segment en dessus, plus étroit que la suivant, membraneux à son bord antérieur, huitième étroit, long en dessus, très-court en dessous; pièces génitales externes peu saillantes, stylet nul, sa base formant de chaque côté une saillie un peu épineuse, au-dessous de laquelle on en voit une autre plus épaisse et obtuse qui n'est que la base des branches de la pince, entre elles se voit le pénis en ouverture arrondie, terminé par une épine courte et forte, accompagné de deux tiges assez épaisses, courtes, supportées par une base étroite; en avant existe une excavation sur les côtés de laquelle est une point courte, crochue, aplatie. *Chenilles* épaisses et longues, cylindriques, très-velues, se tenant à terre, presque polyphages, passant l'hiver, quoique déja écloses au mois de juin, faisant une coque molle, allongée en forme de sac; chrysalide très-épaisse, attenuée aux deux bouts chez la femelle, s'amincissant lentement vers l'extrémité, chagrinée sur le thorax, rugueuse sur l'abdomen, qui est garni de très-petits poils roux, subépineux, plus forts à la partie anale qui est très-obtuse—*Macrothylacia rubi*, Linné, Sepp, ii., tab. 9.

The only Palæarctic species in this genus, *rubi*, was placed by

Schrank, Germar, and other of the earlier authors in *Lasiocampa*, and, in spite of Hübner having indicated its true position (*Verzeichniss*, p. 186) almost eighty years ago, modern authors have, possibly largely owing to Staudinger's *Catalog* having become a basis for makers of modern lepidopterological books on the Continent, united representatives of various genera, tribes, subfamilies and families with it under the same generic title. Rambur, in 1866, correctly created the genus *Macrothylacia* for *rubi*, and, later, in 1869, Wallengren, apparently quite independently, founded the genus *Lachnocampa* for the same species, the latter necessarily falling as a synonym of Rambur's earlier name. Aurivillius states that, "although *Macrothylacia rubi* is nearly related to the species of the genus *Lasiocampa*, yet it appears to be more natural to place it in a separate genus as Rambur and Wallengren have done." He then describes (*Iris*, vii., p. 152) the genus *Macrothylacia* as follows:

IMAGO: Eyes uniformly haired. The last joint of the palpi shorter and less distinctly deflexed. Nervures 6 and 7 of forewings always distinctly stalked. Basal cell of hindwings shorter, reaches scarcely to the middle of the discoidal cell, and sends out, towards the costal margin, two very strong supplementary nervures, which are simple or forked. The forehead and the front tibiæ are, as in division A.a. of *Lasiocampa* (see *anteà*, p. 2), unarmed. The forewings have two pale transverse lines, and a small central spot or none. ♂ antennæ with long pectinations. ♀ antennæ with very short pectinations. Abdomen with densely-haired sides and "ausstülpbaren," and usually bent downwards. LARVA: The larva has dense long hairs, and is, besides, dorsally clothed with appressed "felt-hairs." All the segments uniformly haired. Head unicolorous, black, without marking. PUPA: The pupa is blackish with brown incisions, and with very short stiff hairs (the leg-, antenna-, and wing-cases are, however, naked). It is longer, narrower, and with a thicker shell than the pupæ of the genus *Lasiocampa*, and rests in a large, long, soft, and semitransparent silken cocoon.

The further description of the genus would only be a repetition of the special features of the single Palæarctic species in the genus described in detail below.

MACROTHYLACIA RUBI, Linné.

SYNONYMY.—Species: *Rubi*, Linn., "Sys. Nat.," 10th ed., p. 498, no. 14 (1758); 12th ed., p. 813, no. 21 (1767); "Fauna Suec.," 2nd ed., p. 292, no. 1103 (1761); Scop., "Ent. Carn.," p. 197, no. 492 (1763), Müll., "Faun. Frid.," p. 39, no. 351 (1764); "Zool. Dan. Prod.," p. 117, no. 1350 (1776); Wilkes, "Nat. Hist.," pl. liv (1773); Fab., "Sys. Ent.," p. 565, no. 35 (1775); "Sp. Ins.," ii., p. 178, no. 51 (1781); "Mant.," ii., p. 113, no. 59 (1787); "Ent. Syst.," iii., pt. 1, p. 427, no. 65 (1793); [Schiff.,] "Schmett. Wien.," p. 56 (1775); Fuess., "Verz.," p. 34, no. 638 (1775); Meyer, "Fuess. Mag.," i., p. 269 (1778); Göze, "Ent. Beit.," iii., p. 286 (1781); Esp., "Schmett. Eur.," iii., pl. ix., figs. 1-6 (1782), p. 69 (1783); Brünn, "Fuess. Neu. Mag.," ii., p. 71 (1785); Brahm, "Fuess. Neu. Mag.," iii., pp. 141, 149, 157 (1787); "Ins. Kal.," p. 197, no. 101 (1790); View., "Tab. Verz.," p. 34 (1789); Vill., "Linn. Ent.," p. 122 (1789); Bork., "Sys. Besch.," iii., p. 99, no. 27 (1790); "Rhein. Mag.," i., p. 364 (1793); Don., "Nat. Hist. Brit. Ins.," ii., p. 87, pl. lxviii (*rect.* lxix) (1793); Hb., "Eur. Schmett.," iii., pl. xxxix., figs. 174, 281 (? 1800), p. 144 (? 1805); "Larvæ Lep.," iii., Bomb. ii., Veræ P. b. figs. 1*a-d* (? 1803); "Verz.," p. 186 (? 1822); Schrk., "Faun. Boica," ii., Abth. 1, p. 274 (1801); Abth. 2, p. 154 (1802); Ill., "Syst. Verz. Wien.," n. Ausg., i., p. 108 (1801); Latr., "Hist. Nat.," xiv., p. 181 (1805); Ochs., "Die Schmett.," iii., p. 270 (1810); Germ., "Bomb. Spec.," ii., p. 47 (1812); Oken, "Lehrb. Naturg.," i., p. 708 (1815); Leach, "Edinb. Enc.," ix., p. 132 (1815); Godt., "Hist. Nat.," iv., p. 134, pl. xiii., figs. 1-2 (1822); Curt., "Brit. Ent.," expl. pl. ci (1827); "Guide," p. 142 (1829); Stphs., "Ill. Haust.," ii., p. 39 (1828); "Cat. Brit. Ins.," no. 46 (1829); "List Br. An. Br. Mus.," 1st ed., p. 45 (1850); 2nd ed., p. 42 (1856); Bdv., "Eur. Lep. Ind. Meth.," p. 48 (1829); "Gen. et Ind.," p. 71, no. 579 (1840); Meig., "Eur. Schmett.," ii., p. 202 (1830); Wood, "Ind. Ent.," p. 21, fig. 40 (1839);

Dup., "Icon. des Chen.," ii., pl. vii., fig. 2 (*circ.* 1840); "Cat. Méth. Lep. Eur.," p. 78 (1844); Evers., "Faun. Volg.-Ural.," p. 156 (1844); H.-Sch., "Sys. Bear.," p. 106 (1847); Heyd., "Lep. Eur. Cat.," ed. 3, p. 26 (1851); Humph. and Westd., "Brit Moths," 2nd ed., i., p. 57, pl. xi., figs. 1—4 (1851); Led., "Verh. z.-b. Ges. Wien.,' ii., Abh., p. 75 (1853); Sta., "Man.," i., p. 153 (1857); Speyer, "Geog. Verb.," i., p. 414 (1858); Hein., "Schmett. Deutsch.," p. 206 (1859); Humph., "Gen. Brit. Moths," p. 24 (1860); Staud., "Cat.," ed. 1, p. 30 (1861); ed. 2, p. 69 (1871); ed. 3, p. 122 (1901); Rbr., "Cat. Lép. And.," ii., p. 358 (1858); Snell., "De Vlind.," p. 186 (1867); Nolck., "Lep. Fn. Estl.," i., p. 128 (1868); Berce, "Faun. Franç.," ii., p. 192 (1868); Mill., "Ann. Soc. Linn. Lyon," xvii., p 13, pl. 94, fig. 7 (1869); Wallgrn., "Skand. Het.," ii., p. 91 (1869); Newm., "Brit. Moths," p. 43 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 412 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 69 (1874); Guén., "Lép. Eure-et-Loir," p. 83 (1875); Curò, "Bull. Soc. Ent. Ital.," viii., p. 151 (1876); Frey, "Lep. Schweiz," p. 97 (1880); Lampa, "Ent. Tids.," vi., p. 42 (1885); Jordan, "Schmett. N.-W. Deutsch.," p. 96 (1886); Buckl., "Larvæ," &c.," iii., p. 78, pl. xlvi., figs. 4*a*—*c* (1889); Auriv., "Nord. Fjär.," p. 63 (1889); "Iris," vii., p. 152 (1894); Rühl, "Soc. Ent.," v., p. 178 (1891); Ström., "Danm. Somm.," p. 80 (1891); Kirby, "Cat.," p. 34 (1892); Reut., "Act. F. F. Fenn.," p. 28 (1893); Carad., "Iris," vii., p. 92 (1895); Meyr., "Handbook," p. 322 (1895); Tutt, "Brit. Moths," p. 56 (1896); "Proc. South Lond. Ent. Soc.," pp. 1—11 (1898); Barr., "Brit. Lep.," iii., p. 32, pl. xciii (1896); Dyar, "Can. Ent.," xxx., pp. 4, 5 (1898); "Ent. Record," xi., p. 142 (1899); Grote, "Illus. Zeits. für Ent.," iii., p. 70 (1898). *Rubus*, Haw., "Lep. Brit.," pt. 1, p. 83, no. 7 (1803).

ORIGINAL DESCRIPTION.—*P. Bombyx* elinguis, alis reversis cervinis immaculatis; strigis duabus albis; subtus nullis. [Roes., "Ins.," app. t. 49; Wilk., "Pap.," 25, t. 3, *a*. 19.] Habitat in *Rubo*, *Salice*. Larva lævis, pilosa, ferruginea, nigro annulata. Alarum fascia posterior desinit in medio alæ, nec, ut in *P. annularia*, qua multoties major est, excurrit ad apicem (Linné, *Systema Naturae*, xth ed., pp. 498-9). To this he adds: "'Faun. Suec.,' 1103; Scop., 'Ent. Carn.,' 492; Ammiral, 'Ins.,' t. 32. Alæ absque puncto; striga posterior flexuosa, obsoletior" (xiith ed., p. 813).

IMAGO.—Anterior wings reddish-brown (♀ greyish- or yellowish-brown) with two pale yellowish transverse lines, one before and one beyond the centre, a grey submarginal shade, cilia concolorous with the wing, but shiny; posterior wings unicolorous reddish-brown, almost of the same tint as forewings, cilia paler and shiny.

SEXUAL DIMORPHISM.—There is considerable difference in the sexes, the males being smaller, more brightly coloured, and with much more strongly pectinated antennæ than the females. The males vary from 50mm.-57mm., the females from 56·5mm.-70mm., the latter, therefore, being, as a rule, much larger, heavier-looking insects, the abdomen being unusually large and distended with eggs when the specimens are freshly emerged. The difference in colour between the sexes is most marked, and the deep red-brown of the normal males appears to be an outward reflex of the energy of this sex compared with the more sluggish females. Chapman notes of the antennæ: ♂. About 60 joints, of Lasiocampid form, *i.e.*, plumules hanging down from stem; length 12mm., of plumules 1·6mm., each plumule carries about 50 transverse rows of hairs on its ventral aspect, about 3 to each side in each row, the central line of the plumule has finer hairs, which, at the apex, invade the dorsal rather than the ventral aspect of the plumule; the end of the plumule is not thickened, but is bent forward, and the curve is continued by a rather long, thick bristle or spike, about ·15mm. long, jointed, as these bristles are in all the Lachneids, and having a somewhat bulbous base, and, at half its length, a notch, as for the origin of a hair; behind it is a smaller straight bristle. ♀. About 52 joints and a length of 9mm.—10mm.; the irregular dorsal scaling envelops a large proportion of the antennal surface; the pectinations are reduced to projections, about half the width of the antennal shaft in length, each carrying a bristle or spike as in the male, and with the notch well developed; this spike is large, and makes an addition of about its own length to the pectination; there is one slighter bristle, or sometimes two, behind this as in the male; each pectination has a few slender hairs basally, but for the rest of its ventral surface is clothed with very fine small hairs.

Female with supernumerary hindwing.—On June 5th, 1874, Speyer found a ♀ *M. rubi* at Rhoden, which had, besides the 4 normal wings, arising independently from the thorax at the base of the left hindwing, whose base it covers from above, a supernumerary wing that runs to the inner angle, which it completely reaches. Its length is, therefore, that of a normal hindwing, but its breadth does not exceed 6mm., and, as it is narrowed somewhat on each side medially, it appears as a longish flap, arising from a broader base. The texture, scaling and colour are normal, and the gently arched costa is somewhat bent inwards and short-haired, the blunt end (the outer margin) of the flap fringed. The winglet is traversed by 4 moderately strong parallel longitudinal nervures, of which three run out to the outer margin, the fourth is shorter and ends on the costa at two-thirds of its length; these arise at or near the base of the wing. The left normal hindwing is a little smaller than the right, and not quite so thickly scaled, although of normal form and neuration; its inner margin is, however, torn and crumpled. The formation of the additional winglet has not been without its effect on the normal one, and has, probably, caused the insect some difficulty in freeing itself from the pupal shell, to which the injury to the wing-margin is probably due. The body and other three wings are those of an ordinary well-developed female of ordinary colour and markings (Speyer, *Stett. Ent. Zeit.*, xlix., p. 206).

Gynandromorphism.—The only references to gynandromorphous examples of this species, known to us, are the following:

α. A male the abdomen of which was filled with eggs (Purrmann, *Zeitschr. f. Entomologie Breslau*, ix., Vereinsnachr., p. xxv). [No further details are given.] (Schultz, *Ill. Woch. für Ent.*, i., p. 383).

β. There is a reference by Schultz (*Illus. Zeits. für Ent.*, iii., p. 169), to Moureau, "Bull. Soc. Entom. de la Gironde," No. 8. We cannot determine this reference, nor do we know to what publication it refers.

Variation.—There is considerable variation in size and colour in both sexes of this species, as also in the character of the transverse lines. It is almost impossible to classify the aberrations, which run into each other in most instances by imperceptible gradations. There are two very distinct types of male coloration, bright foxy-red, and deeper, duller brown-red (often almost grey), whilst the greater or less development of the pale shade between the outer median line and the outer marginal shade gives a very distinct character to certain examples, especially when the basal area is also pale. The males may be grouped as:

Ground-colour bright fox-red.

1. With widely separated transverse lines to forewings=ab. *rufa-separata*, n. ab.

2. With normal transverse lines to forewings=ab. *rufa*, n. ab.
3. With approximating transverse lines to forewings=ab. *rufa-approximata*, n. ab.
4. With touching transverse lines to forewings=ab. *rufa-conjuncta*, n. ab.
5. With transverse lines uniting to form a pale median fascia across forewings=ab. *rufa-fasciata*, n. ab.
6. With one transverse line absent on forewings=ab. *rufa-unilinea*, n. ab.
7. With transverse lines obsolete on forewings=ab. *rufa-obsoleta*, n. ab.
8. With transverse lines different on right and left forewings=ab. *rufa-dissimilis*, n. ab.
9. With the area between the two median transverse lines darker than the ground-colour=ab. *rufa-virgata*, n. ab.

GROUND-COLOUR DULLER RUST-RED.

1. With widely separated transverse lines to forewings=ab. *ferruginea-separata*, n. ab.
2. With normal transverse lines to forewings=ab. *ferruginea*, n. ab.
3. With approximating transverse lines to forewings=ab. *ferruginea-approximata*, n. ab.
4. With touching transverse lines to forewings=ab. *ferruginea-conjuncta*, n. ab.
5. With transverse lines uniting to form a pale median fascia across forewings =ab. *ferruginea-fasciata*, n. ab.
6. With one of the transverse lines absent on forewings=ab. *ferruginea-unilinea*, n. ab.
7. With transverse lines obsolete on forewings=ab. *ferruginea-obsoleta*, n. ab.
8. With transverse lines different on right and left forewings=ab. *ferruginea-dissimilis*, n. ab.
9. With the area between the two median transverse lines darker than the ground-colour=ab. *ferruginea-virgata*, n. ab.

GROUND-COLOUR PALE (THE TINT OF THE PALE ANTEMARGINAL SHADE SPREAD OVER FOREWINGS).

1. With widely separated transverse lines to forewings=ab. *pallida-separata*, n. ab.
2. With normal transverse lines to forewings=ab. *pallida*, n. ab.
3. With approximating transverse lines to forewings=ab. *pallida-approximata*, n. ab.
4. With touching transverse lines to forewings=ab. *pallida-conjuncta*, n. ab.
5. With transverse lines uniting to form a pale median fascia across forewings= ab. *pallida-fasciata*, n. ab.
6. With one transverse line absent on forewings=ab. *pallida-unilinea*, n. ab.
7. With transverse lines obsolete on forewings=ab. *pallida-obsoleta*, n. ab.
8. With transverse lines different on right and left forewings=ab. *pallida-dissimilis*, n. ab.
9. With the area between the two median transverse lines darker than the ground-colour=ab. *pallida-virgata*, n. ab.

The females are still more difficult to classify. Roughly, they divide into two colour groups, grey and reddish-grey, with almost as much variation in the character of the transverse lines as in the males :

GROUND-COLOUR GREY WITHOUT ANY REDDISH TINT.

1. With widely separated transverse lines to forewings=ab. *grisea-separata*, n. ab.
2. With normal transverse lines to forewings=ab. *grisea*, n. ab.
3. With approximating transverse lines to forewings=ab. *grisea-approximata*, n. ab.
4. With touching transverse lines to forewings=ab. *grisea-conjuncta*, n. ab.
5. With transverse lines uniting to form a pale median fascia across forewings =ab. *grisea-fasciata*, n. ab.
6. With one transverse line absent on forewings=ab. *grisea-unilinea*, n. ab.
7. With both transverse lines obsolete on forewings=ab. *grisea-obsoleta*, n. ab.
8. With transverse lines different on right and left forewings=ab. *grisea-dissimilis*, n. ab.

9. With the area between the two median transverse lines darker than the ground-colour=ab. *grisea-virgata*, n. ab.

GROUND-COLOUR PALE REDDISH-GREY (possibly the "cervinus" tint of Linné, and hence the type).

1. With widely-separated transverse lines to forewings=*cervina-separata*, n. ab.
2. With normal transverse lines to forewings=*rubi*, Linn.
3. With approximating transverse lines to forewings=ab. *cervina-approximata*, n. ab.
4. With touching transverse lines to forewings=ab. *cervina-conjuncta*, n. ab.
5. With transverse lines uniting to form a pale median fascia across forewings=ab. *cervina-fasciata*, n. ab.
6. With one transverse line absent on forewings=ab. *cervina-unilinea*, n. ab.
7. With both transverse lines obsolete on forewings=ab. *cervina-obsoleta*, n. ab.
8. With transverse lines different on right and left forewings=ab. *cervina-dissimilis*, n. ab.
9. With the area between the two median lines darker than the ground-colour=ab. *cervina-virgata*, n. ab.

These forms cover possibly the greater range of the variation observable in the species in the British Islands. It is exceedingly difficult to give any really complete tabulation of the whole range of varietal forms, *e.g.*, the males vary considerably in the tint of the hindwings, some being distinctly paler, others distinctly darker, than what may be termed the normal. Somewhat parallel forms with the male ab. *pallida*, occur among the females, the pale antemarginal shade spreading over the whole of the forewings except the outer marginal area and inner part of the median band, but, in this sex, the outer marginal area is usually less band-like than in the males, and may, as in some examples of the latter sex, be entirely wanting. Stephens notes (*Illus.*, ii., p. 39) our forms *unilinea* and *fasciata* as follows :

var. β. The anterior wings with only one (the hinder) posterior striga above.
var. γ. The anterior wings with the two strigæ united and forming a broad whitish band.

In Webb's collection we noted the following peculiar *male* aberrations : (1) Both fore- and hindwings yellow-brown in tint, with two yellowish transverse lines and redder narrow hind marginal band to forewings. (2) Fore- and hindwings pale fawn in colour, transverse lines whitish, outer marginal area of forewings slightly darker. (3) Reddish with yellowish-grey submarginal shade. (4) Almost unicolorous fox-red with the transverse lines darker shaded. (5) The forewings with the inner line obsolete. Of the *females* one notices : (1) A light grey form with scarcely a trace of red in the tint. (2) Yellow-grey in colour. (3) The greater part of the wing yellowish-grey, but the outer marginal band typical brownish, and the central area darker. (4) Deep fuscous, with a thick sprinkling of grey over the forewings. (5) Distinct red-brown, with grey outer line and greyish basal area. Robson notes that, until 1897, he was unable to get an aberration at Hartlepool ; in that year, however, he bred many, including—males with extra dark scales between the pale lines of forewings, others with the two transverse lines approximating, even meeting medially, or uniting throughout to form a pale transverse median fascia, some with the band between the pale lines wide, some with outer margin of band straight, others with it curved. Examples with narrow median bands were much more common than those with wide ones. He further notes (*E.M.M.*, xxxiii., p. 201) among these 1897 specimens the following: (1) An exceedingly small male, not more than quarter the size of a fully-developed moth, which bore evidence of starvation in having the wings almost devoid of scales; the pale lines, too, which form the edge of the band, are in close contact for their entire length, so that in lieu of a band there is merely a double ochreous line, (2) Two other males, both under-sized, had these lines in contact on the inner margin and partly across, three or four of them closely approximating, with a portion of the area (usually darker than the rest of the wing) filled up with the same pale ochreous scales. The curves of the transverse lines vary very much in different specimens, and are not always alike in both wings. There is considerable diversity in shade, but all are cold brown, never approaching the richer red-brown of southern examples. There is rather less variety in the markings of the females, but they are of the same general character. The curves of the transverse lines differ considerably, the latter sometimes approaching each other on the inner margin, and the direction of the outer lines varies especially, from almost straight to a distinct curve in one specimen, with a band of average width, the space between the lines entirely filled in with pale whitish-grey; no corresponding specimen appears among the males, where the band is only pale when narrow. Some of the females have a tendency towards the brown hue of the ♂s, but these are all large and evidently well-nurtured specimens. Hills observes that the Folkestone examples vary, some of the males being redder and more uniform in tint, others darker and browner, the browner with the paler central area more distinct; the females are all grey, some with the inner part of the central band much darker than in others, occasionally the hindwings are exceptionally dark. Now and again semidiaphanous examples occur, and the pale median lines may be absent, confluent, or confluent only at inner margin or centre. Tremayne notes one in which the united lines form an arch on the forewing, and Battley a female with a light circle between the two transverse lines of right forewing, whilst on the left forewing one of the nervures ends abruptly in the centre of the wing. Barrett records a ♀ from Belfast with both transverse lines absent from the right forewing, which has merely a whitish oblique cloud, and another with the first line bordered outwardly with black-brown; Mason possesses a ♂ of a pale drab colour. Vaughan observes that in June, 1884, he obtained dark well-marked males differing from southern examples at Kilmartin. Rossiter notes the specimens as specially brown from the Hebrides, and Clarke that the Isle of Man form appears darker than the English one. Hoffmann states that the females are as frequently grey as brown in the Upper Hartz, whilst Knech records very dark females from Chiasso in Tessin, and Millière figures (*Iconographie*, *Ann. Lyon*, xvii., pl. 94, fig. 7, 1869) a curious bleached aberration of the ♀, devoid of markings, from Lederer's collection. No aberration of this species appears to have been described except the following:

a. var. (et. ab.) *pygmaea*, Reut., "Act. Soc. F. F. Fenn.," ix., p. 28 (1893).—Multo minor, corpore obscuriore, strigis transversis alarum anticarum rectis, magis approximatis, obsoletis, extrorsum obscurius et magis distincte terminatis, ♀; nolgit. al. expans. 44mm.—Isynnerhet halskragen, vinglocken och thorax mörkare än hos hufvudformen; af framvingarnes tvärlinier framstå nästan endast de mörkare och mera skarpt markerade bruna yttre skugglinjerna; vingarne, isynnerhet de bakre, mer tunnfjälliga än hos hufvudformen. St. Michel (Ehnberg). (Reuter).

This is treated as a variety by Reuter, and may well be so in its most northern localities, although one suspects that it is usually rather an aberration than a local race. There are 4 very small British examples in the Stephensian collection in the British Museum, 2 ♂s and 2 ♀s, which are referable to this form. Dalglish notes an abnormally small ♀ taken at Sandbank, Argyllshire, which has a suffusion of rich pink along the costa and round the margins of all the wings.

EGG-LAYING.—The eggs are ordinarily laid in a more or less cylindrical group round a stout grass stem, generally a few inches from the base. Egg-clusters found May 30th, 1896, June 8th, 1898, June 17th, 1899, June 17th, 1900, at Reigate (Prideaux); frequently also laid thus upon a heather-twig, often fairly regularly, and reminding one not only of a little group of heather-buds, but also of the egg-laying of *Malacosoma*. Bacot notes a similarly-laid batch in the British Museum collection; he has also noticed others attached in small irregular masses around stems or grass-culms; in one batch, laid in an irregular band, the eggs are attached to the culm as well as to each other, but set at various angles, some few having the long axis at right angles to the grass blade, others at various angles, so that the corner between the side and nadir of the egg is touching the culm, one egg being noted as having been laid with the micropyle next the point of attachment, the nadir being outwards and possibly pushed from its original position by the weight of the female's body. The position chosen is exceedingly variable, and the mode of attachment very irregular and uncertain. Thus Watkins notes finding a batch on a thistle-plant on Painswick Hill, June 12th, 1874; Hawes found a batch on a black fence, June 20th, 1885, near Abbott's Wood; Bartlett beat some out of an oak tree at Bristol, these hatched July 2nd, 1891; Burrows found an irregular bunch of eggs on a grass head at Leigh, June 5th, 1894; Riding found some laid on a pine trunk about 6ft. above the ground, and discovered some on the tip of a bramble leaf and others on the stalk of a grass *(Anthoxanthum odoratum)*; Lofthouse discovered eggs on May 28th, 1901, on the bark of a fir-tree near base of trunk, laid close together, near Guisbro'; Gordon sent us a batch laid on a stone by the side of a small loch at Corsemalzie, and Montgomery found a batch laid on a heather stem when the eggs very much resembled the previous year's inflorescence, and we suspect that on the heaths this is the normal mode of egg-laying; Turner obtained a cluster of eggs on heather in appearance very similar to a spray of dead flowers; Fowler states that in the New Forest they are deposited in June in little clusters of 20 or so, on twigs of heather, and that their bluish-grey tint makes them closely resemble pieces of lichen, whilst Barnes observes that they are frequently laid three or four in a bunch at the base of a leafstalk of one of the foodplants. Various batches that he has had have hatched between June 21st (in 1897) and August 1st (in 1899). Harrison obtained a batch laid round and round a stem of *Juncus effusus*, and occupying about an inch of the length of the stem.

Ovum.—Roughly elliptical in outline, although flattened at the sides and ends, a deep oval depression not quite central on the upper surface (one of the long sides); the shape varies, in some the micropylar end is slightly narrower, in others it is rather wider than its nadir; roughly the length : breadth : height : : 4 : 3 : 3; the surface is shiny, polished (looks to the naked eye almost as if varnished), but covered with a very fine polygonal reticulation; pale grey in colour with dark fawn (inclining to brown) shading about the more prominent parts of the egg; the micropyle proper forms a deep, minute blue-black point placed in a small, rounded olive-brown spot at (usually) the blunter end of egg; the micropyle consists of very minute rounded cells centrally, which grade off into the polygonal surface cells; the olive-brown outer spot is in its turn placed centrally in a white patch [Described April 12th, 1897, under a two-thirds lens from eggs laid March 27th, 1897; received from Mr. Butler of Reading]. The eggs referred to (*anteà*, vol. ii., p. 436) as attached to a stone, and as being possibly those of *L.* var. *callunae*, were, we have now no doubt, those of *M. rubi*. The description that we made of them reads as follows: 1·8mm. long, 1·2mm. broad, 1·1mm. high; almost a perfect oval in outline, but rather broader and very slightly flattened at the micropylar end. The upper surface with a slight oval central depression (that looks darker than the surrounding surface, but is not in reality so). The colour of the egg is pure white, very minutely pitted, but with no markings except a few scattered, minute, opalescent, greyish-brown patches around the shoulder of the egg. The floor of the shallow micropylar basin is also greyish-brown in colour with a minute central raised white point (the micropyle proper) [Described June 29th, 1898, under a two-thirds lens, from eggs sent by Mr. Gordon, who found them on a stone by the side of a loch in Wigtownshire]. Bacot notes the egg as 2·1mm. in length, 1·6mm. in width, and 1·5mm. in thickness; the micropylar end slightly larger than its nadir; outline forms a short, rather rounded oval only slightly flattened on sides; of a dull brownish-grey, the flattened area of the sides being of a darker olive-grey, and with two similarly coloured bands or lines round the edges and ends; the micropyle marked by a distinct dark spot, and there is a slightly marked dark dash on the nadir; opaque, of a strong horny appearance, surface highly varnished, a small and very faint network or reticulation is to be seen, the reticulations becoming finer and more sharply marked towards the micropyle [Described June 7th, 1900, from eggs received from Rev. G. H. Raynor of Hazeleigh].

Egg-parasites.—2100 examples of *Telenomus phalaenarum* were bred from 200 eggs of this species (Bignell), see also *anteà*, vol. i., p. 14, also *Le Nat.*, i., p. 4., where the Marquis de Lafitole briefly records "a number of *Chrysides*" bred from these eggs, and pp. 29-30 where Lafaury comments on this record, and points out that the Marquis omits to say whether one parasite or more infested each egg, but that neither Réaumur (t. vi., *Mém.* ix., p. 295) nor Degeer (t. i., p. 592) had observed more than one from each; on the other hand his (Lafaury's) friend, M. Alexandre Duverger, had an infested batch of eggs in which it was found on examination that the number of parasites to each was invariably *seven*.

Habits of larva.—The newly-hatched larva eats a quantity of its egg-shell; it assumes a modified *Sphinx*-attitude when at rest, the thoracic segments raised, the 1st and 2nd abdominals also raised and slightly curved, the legs drawn up and head turned downwards; it has also the power of retracting the prolegs, the hooks being then within the latter, and there is no doubt that the ability to do this is exceedingly advantageous when the larva rolls up, as it does to escape observation when disturbed. The larva feeds on steadily until about the middle of October when it is fullfed, then goes down among the roots of its foodplants (possibly sometimes under the soil), hybernates until the end of February, comes up, and suns itself without feeding and then pupates in April. The larva appears to roll itself in a ring for hybernation, and may be wintered well among heather closely planted in a wooden tub and with a covering (muslin, &c.) for the protection of the plant. In Switzerland, it hybernates as an adult larva under moss, dried leaves, stones, &c. (Favre). Robson notes that, around Hartlepool, on every fine sunny day from June to April, the larvæ may be seen crawling about or stretched at length on withered tufts of grass, basking in the rays of the morning sun, retiring soon after midday without going far down; the larvæ become more abundant as the season advances, and the sexes may easily be distinguished in this stage by the great difference in size; when they are fullfed in autumn they retire below the surface of the ground; after the new year they appear to be very susceptible to warmth, and were once noticed as early as January 10th, although March is the normal month for their reappearance; on February 10th, 1897, fifty were picked up and they were equally abundant for several days. The larvæ are best found in early morning, when there is a heavy dew, at Church Stretton, where they are most abundant (Bradburne). The larva rolls up and quickly drops away when disturbed (Dalglish); the larvæ when fullfed in October occur in colonies on the Dorset heaths, each colony, however, consisting of many individuals; they delight in the sunshine, but roll themselves into a tight ring when disturbed (Bankes); on the moors about Corsemalzie the larvæ are very abundant, sometimes many (40 or 50) are to be found in quite a small area, then a large tract with none, when other colonies will be met, generally near a species of white-leaved grass, but they also feed on sallow, &c., here they are always rarer in the spring than in the autumn (Gordon); the larvæ appear to feed on grass at Clevedon until about three-parts grown, then they collect in small colonies on the nearest bramble, continuing to feed on this and grass until they enter their winter-quarters (Mason); the larvæ appear largely to modify their habits according to locality, for, in September, 1897, they were abundant at the tops of the tall Devonshire hedges near Dartmouth, where they were repeatedly observed to select hazel as a foodplant (Prideaux); Noel observed that three larvæ found at East Budleigh, fed till October 19th, 1871, then disappeared and were found curled in a ring about half an inch under the soil. Leach says that when the larvæ hybernate they sometimes enter loose mould. Reading observes that the larvæ may be found on the heaths, downs, and commons near Plymouth, hybernating under the earth beneath furze-bushes; Nicholson states that larvæ he had, went down into the earth for the winter and reappeared in April when they spun their cocoons. Hewett notes that the larvæ hybernate among heather, come up in March, sit about on the heather, and spin up without further feeding, whilst Robinson affirms that larvæ he had constantly came out at night even in mid-winter to nibble the leaves and continued to do so till they spun up; Doubleday observes, however, that the larvæ do not feed in spring, but, after reviving from their hybernation, stretch themselves out in the sun for a few days and then spin their cocoons. Haggart says that the larvæ are to be seen on the first fine days of spring, wandering about on the moorlands about Galashiels seeking for a suitable place for pupation. Cooke found larvæ on the move on Wallasey sandhills on February 12th, 1882, and Watkins observes that larvæ found in October, 1867, began to crawl about after hybernation on February 23rd, 1868, Partridge, however, observed larvæ on December 1st, 1889, and again on December 15th, crawling on heather among unmelted snow at 1100 feet elevation at Farchynys, in Merioneth. Corbin states that the larvæ hybernate on the surface of earth under moss, and may be sometimes found in winter in nature, under dead leaves on hedge-banks, always in a slightly contracted ring, quite fullgrown, the larvæ not going into hybernation till late, and then not feeding again in spring, although they enjoy the sun's rays after their winter's sleep. Fowler observes that the larvæ hybernate in the New Forest when fullfed, and may be found slowly crawling about during warm days in March. Perkins notes (*Ent.*, xvi., p. 250) that, at Wotton-under-Edge, this species and *Adscita statices* often appear in greater numbers than ever after the herbage of their habitats has suffered from fire. The abundance of the larvæ is sometimes almost incredible. Long stretches of the downs directly behind Folkestone are sometimes covered so that it is impossible to walk without crushing them, and we have seen the Deal sandhills almost as thickly covered. Chapman records that in a glen off Loch Killary, co. Mayo, on September 18th, 1888, he saw an enormous number of the larvæ of this species, often five or six in a square foot of space; a dozen could be picked up anywhere without moving, and from any given standpoint from one to two hundred could be seen. They were as numerous as this for several miles, for a width of probably half a mile. On this side (the south) they were protected from the north and west; on the opposite side, where they could have more sun and be equally protected from the west, they were about the average of the rest of the district observed, *viz.*, about one every eight or ten yards. In some other glens there were exceptionally a dozen or so in sight at once. Very few were quite fullfed, most in the last skin but one, and many younger. At one to a square foot there would be about 50,000,000 on the area observed. Theobald notes that, in the autumn of 1895, the North Downs in the neighbourhood of Wye were literally covered with hordes of the larvæ, mostly full-grown, some being quite active until the end of November, and crawling about until then among the grass. The noise made by them when feeding at night, he adds, was quite astonishing. None were observed on the downs until they were nearly full-grown. Carter observes that on Baildon Moor, near Bradford, the larvæ occurred in such profusion in 1874 that one could scarcely walk without treading them under foot. A similar abundance was observed in September and October, 1894. Ash notes that the larvæ were also excessively abundant in the latter year on Skipwith Common. In 1856, the larvæ were reported as occurring at Bisterne in marvellous numbers, strewing the ground; indeed they were in such numbers that a person walking across the heath known as the "warren" had to be cautious lest he should tread on them. Horne reports them as being in thousands in most years on the high ground around Aberdeen, and Wylie that, in certain seasons, they are extremely abundant on the mosses in Perthshire; in the autumn of 1897 the larvæ were feeding on nearly everything on Methven Moss. McArthur says that in the Isle of Lewis the larvæ were in amazing abundance about the middle of September, about three parts grown and almost everywhere. The larvæ swarm in Sketty Park, where there is no heath, and were so abundant in September, 1891, that it was difficult to avoid treading on them (Robertson); unusually abundant the same year at Clevedon, where, also, there is no heath, the larvæ feeding on grass till about three-quarters grown, when they collect in small colonies on bramble until fullfed, and then enter into their winter-quarters; the larvæ will feed well on bramble in confinement, but also eat all the grass in their enclosure (Mason). In spite of the usual autumnal abundance of the larvæ, there is rarely any great number found in the spring, and one suspects that large numbers perish during the hybernating period. All lepidopterists complain of the difficulty of rearing the species if kept in confinement throughout the winter, and thus it is usual for British lepidopterists to force them. Cartmel appears to have been the first to adopt the now well-known method of forcing the larvæ by bringing them indoors in winter and placing them near a kitchen fire. By this means he succeeded in breeding many imagines in January, 1856, from larvæ that he had collected fullfed the preceding October. Robson places each fullfed larva in a paper box at least 2 inches square (chip boxes are too small and result in cripples), in early spring, and gives (*E.M.M.*, xxxiii., p. 199) a long detailed account as to how to rear the species, the larvæ being collected from January 10th-March 13th, dependent on season, when they have come up to sun themselves. He places them, at once, as we have just noted, into a separate paper box (these paper boxes being kept on a shelf over the kitchen fire), in which the larvæ almost immediately commence to spin up and are thus forced so as to emerge early, *e.g.*, larvæ February 10th-13th, 1897, spun cocoons February 14th-20th, imagines emerged April 4th on. It is remarkable that, in some cases, the forcing appears to hasten the assumption of the pupal period, but usually to lengthen the pupal stage. Thus, larvæ, forced from February 10th-13th, 1897, produced imagines in an average of $58\frac{1}{2}$ days (the longest period 64 days, the shortest 53). Those found March 21st-April 11th, 1897, produced imagines in an average of 28 days (the longest period being 35, the shortest 21). In all cases the first to appear were ♀ s, the males appearing three or four days later. With regard to this point, *viz.*, that the earlier found larvæ, though pupating almost as quickly as those found later, were so much longer in producing the perfect insect, Robson writes: "All were exposed to the same conditions after capture, and I should have expected them to have remained about the same time in the pupal stage, yet the earlier found larvæ required from 53 to 64 days to produce imagines, and the later ones only 21 to 35 days, the first lot being therefore almost 3 times as long in the pupal condition as the second." Robson says that this suggests a bearing on the impossibility of forcing at once fullfed autumnal larvæ, and that the latter, though fullfed, may not be mature, and probably require considerable time for certain internal changes to take place before they can go on, and that such fullfed autumnal larvæ will die rather than spin their cocoons although four or five months later they will spin their cocoons but still require time to undergo the final changes and take the needed time in the pupal stage. The experience of Studd and Moss *(postea)* does not appear to support that of Robson as to early forcing always resulting in an extended pupal period, and Baynes notes that he collected autumnal larvæ in 1860, that they were subjected to forcing treatment and spun up November 24th, the larvæ emerging between December 21st, 1860, and January 6th, 1861. Studd notes that the insect is easily forced at any time during the winter, *e.g.*, December—March, and he observes that emergences took place on January 13th—February 4th, 1897, January 24th—March 6th, 1899. The larvæ placed in heat (about 80°F.), spin up in a few days and emerge in from 10 days to a fortnight after pupation. Moss records that he kept larvæ in a cold frame in the winter of 1892—3, the grass and moss were frozen in January, but the larvæ were taken indoors—kept in a temperature of 80°F., pupated within five days, and in ten days more commenced to emerge. Buckler gives (*E.M.M.*, xi., p. 188) an excellent account of how to hybernate this species successfully, *viz.*, on the short turf of a lawn under a garden hand-glass with a movable top, a frame being sunk into the ground about three inches, and the larvæ supplied with heather until they cease to feed. The top glass was occasionally removed to promote ventilation and to prevent mouldiness, and the larvæ formed hibernacula in little cavities hollowed out in the turf close to the roots of the grass. The larvæ came up on sunny days in spring, and between the 21st and 24th most of them disappeared beneath the grass and made their cocoons, imagines appearing between April 29th and May 17th, 1873. Hewett writes: "To winter *M. rubi*, plant a root of heather out of doors. knock the bottom out of a small tub or box, put it round the heather and cover it with perforated zinc. The larvæ may be under snow; they will come up in March, and appear to be pleased to have new shoots of heather to sit on and spin among, but they eat nothing more." Holland noted that the larvæ being exceptionally abundant at Reading, in October, 1890, he knocked the lid and bottom from a large box, nailed perforated zinc over it, planted heather in the garden in a thick mass, turned the caterpillars into the middle of it, placed the box over and earthed up the bottom edge a bit. Nothing was done during the winter but brush a heap of snow from the zinc once or twice; in spring the larvæ came up in the sun to dry their coats, and soon spun cocoons in the heather, coming through as moths well with very few deaths. Finlay states that in October, 1894, the larvæ were plentiful on the moors about Morpeth; he collected about 200, put them in two large boxes out of doors, each box with five or six inches of *Sphagnum* moss for the larvæ to hybernate in; in one box the moss got very wet, and the larvæ died; the other remained dry, and some 120 imagines were bred from the larvæ, so that excessive wet and not cold is evidently most injurious. The following notes as to dates, &c., on which larvæ have been found have been collected: Swarms during August to November in many places, then hybernates, and appears again in March and April; abundant in September at Ischl (Hormuzaki); August 6th—19th, 1860, in hundreds at Rannoch on the moors (Keays); September 11th—12th, 1860, at Deal, common, August 13th, 1874, at Rannoch, September 3rd, 1884, at Deal, September 3rd, 1890, at Leigh, abundant, September 24th, 1894, at Deal and Folkestone, abundant (Fenn); April 7th—15th, 1861, larvæ and pupæ on Chat Moss (Chappell); swarming on heaths in Jersey, in September, 1860 (Johnson); April 15th, 1870, at Southport (Porritt); November 8th, 1871, October 3rd, 1886, collected 47 larvæ — 2 on blackberry, 2 on wild rose, 3 on willow, and 40 on oak— at Brentwood, August 13th, 1890, at Newlyn, September 3rd, 1897, at Brentwood (Burrows); fullfed larvæ March 30th, 1866, at Bensham (Watson); larvæ spinning up at Wallasey, April 8th, 1872 (Daltry); September 29th, 1872, in great numbers at Danbury, August 29th, 1890, abundant at Caterham, October 2nd, 1894, in Epping Forest, October 26th, 1898, at Shoreham, Kent (Bower); at Chattenden, September 20th, 1876, at Folkestone, August 11th, 1892 (Adkin); common at Folkestone, August 29th, 1873, at Rannoch, August 21st, 1874 (A. H. Jones); larvæ on move, February 12th, 1882, at Wallasey (Cooke); September 17th—19th, 1885, at the Lizard (Riding); October 11th, 1886, and seen most years since in October, at Wareham (Bankes); October 8th, 1887, nr. Ipswich, abundant, September 12th, 1892, at Aylsham, September 22nd—30th, 1895—1897, at Wallasey (Freeman); small larvæ, June 17th, 1868, on Painswick Hill, eggs, June 12th, 1874, at Painswick, larvæ, 1st moult, July 11th, large but still feeding on August 18th, September 21st, 1891, larvæ about 1 in. long, July 11th, 1895, half-grown, August 31st, 1898, on Edge Hill, fullfed larvæ disappear about October 18th (Watkins); July 14th — 20th, 1890, at Tan y Bwlch, October 3rd — 17th, 1896, in Delamere Forest (Arkle); September 30th, 1890, at Portland, September 27th, 1898, at Oxted (Sheldon); July 19th — 31st, 1891, at Brockenhurst (Mitchell); September 10th—October 17th, 1891, July 26th, 1893, small, on Strensall common (Hewett); fullgrown larvæ, March 30th, 1891, at Yatton, August 14th, 1891, at Dartmouth, October 4th—12th, 1894, at Warminster (Bartlett); August 9th, 1892, at Monymusk (Mutch); August 1st, 1892, at Portelet, August 12th, 1895, at Minehead (Kaye); July 15th—24th, 1893, in Wicken Fen (Mitchell); swarming on July 29th, 1893, about Hartlepool (Robson); July 1st—21st, 1894, July 10th—24th, 1897, at Barmouth (Kenward); very abundant, September 24th, 1894, near Meldon (Finlay); September 30th, 1894, in numbers on the moors 4 miles north of Hexham, also abundant, August 26th, 1898, at Gilsland, 38 miles west of

Newcastle, on the borders of Cumberland and Northumberland (Nicholson); September 27th, 1895, in abundance at Great Ayton, hatched June 13th, 1901, fullgrown on September 5th, from Guisbro' (Lofthouse); November 9th, 1895, on the Pentlands (Evans); July 10th, 1895, at Worcester (Rea); September 12th, 1896, nearly fullfed, February 8th, 1898, quite fullfed, in Reading district (Butler); July 18th—26th, 1898, in New Forest, small (Carr); October 19th, 1898, at Torquay (Sich); September 1st to October 30th, 1900, in great numbers in the Isle of Man (Clarke); larvæ crawling over the roads between Torre Pellice and Villar, August 3rd—17th, 1901, a week later at Bobbie (Tutt). Fallou gives (*Bull Soc. Ent. Fr.*, (6), viii., pp. clx—clxii) some notes on the habits of the larva, and further notes (*loc. cit.*, ix., p. xxii) on its foodplants. Schilde has recorded (*Ent. Nachr.*, viii., p. 47) an instance of frozen larvæ reviving. In *Bull. Soc. Ent. France*, (5), iii., pp. cxxx—cxxxi, there is a note of *Botrytes* in the larva, and one may further call attention to an account of fungi found on this species, *Psyche*, 1891, p. 8.

LARVA.—The *newly-hatched* larva eats a quantity of the eggshell. The head is black, smooth and shiny, a few hairs on face. The division between the lobes distinct but not deep. The body is jet black in colour, except at the segmental incisions which are pale yellow. The scutellum bears two conspicuous tubercles covered with rather long hairs. The prothoracic ear-like tubercles (prespiracular) are situated in front of the spiracles, and are fairly well developed. The dorsal tubercles on all the segments are covered with long hairs, some white, others black. In the *first instar* (when well-grown, June 21st, 1900) the larva is rather long, slender, cylindrical or nearly so, with a tendency to (or appearance of) flattening on ventral area, due partly, if not wholly, to hairs on marginal tubercles; tapers slightly from thoracic segments to anus, and with an ill-developed hump on the 8th abdominal segment; prolegs rather long, well raised from resting-surface. *Head:* Small (on emergence it is comparatively large), rounded, with a well-marked tendency to a trapezoidal outline, slightly notched at crown; black, surface polished, with fine, rather long, scattered, whitish hairs; antennæ rather prominent, partly due to having brown upper joint and whitish base. *Body:* The thoracic segments shorter and stouter than those of abdomen, the latter becoming longer and more slender towards anus; colour velvety-black on dorsum and upper lateral areas, losing velvety appearance, and paling to a smoky hue on lower lateral and ventral areas; intersegmental folds on dorsal, subdorsal, and upper lateral areas brilliant yellow, especially noticeable between pro- and mesothorax, and between meso- and metathorax, where yellow area is increased; the larva very hairy for so early a stage; the hairs long, fine, minutely serrated, mostly black, but a few (usually the longest) white; the prothorax with a black chitinous scutellar plate, the anal segment with a small dorsal plate; tubercles large, wart-like, each bearing many hairs, they are, however, not chitinous or horny except as regards the bases of individual hairs; dorsal tubercles placed trapezoidally on all segments from mesothorax to 8th abdominal inclusive—i considerably larger than ii, ii remaining, however, a large many-haired wart; on prothorax there is a line of 4 large warts on the front of the scutellum, and two (one on either side of median line) at posterior edge of segment, ill-developed, flat, with their hairs rather diffused; on the 9th abdominal, only two dorsal tubercles are present, very large, possibly i and ii united on either side; of lateral tubercles, iii is about equal to ii in size, placed far above spiracles which are small, dark-coloured, and inconspicuous; a large supplementary prespiracular wart (see, *anteà*, vol. ii., p. 439) on anterior edge of abdominal segments 1 to 7 (inclusive), being weak on the 1st, whilst on the 8th it ceases to be a wart and is represented by only two or three hairs; iv and v form a large sub- and postspiracular wart about equal to iii; whilst below and anterior to spiracle on 1st abdominal segment are two supplementary primitive single-haired tubercles rather near together, on remaining abdominal segments only one of these is present; below these again is a large marginal wart, double (? vi + vii), on segments that bear prolegs, single on other segments; much larger, however, on the 7th abdominal where one gets the impression that two side-by-side tubercles have combined; on prothorax a large prespiracular tubercle (? iii) gives rise to the conspicuous, loose, ear-like brush of hairs; where the yellow colour of the intersegmental area encroaches on the edges of the segments the latter are speckled with black, hinting to shagreen-spotting at some past period in its evolutionary history; no traces of spicules on skin-hairs detected; the abdominal segments divided into four subsegments, tubercle i is on the 2nd, ii on the 4th, iii on the 3rd, subsegment. Of the single-haired primitive tubercles not mentioned in the preceding description, there is one on the first subsegment of abdominals, in same plane as iii; on the meso- and metathorax there is a many-haired wart on 1st subsegment, rather higher than this single-haired tubercle on abdominal segments; on second subsegment of abdominal segments, there is a single-haired tubercle (on some segments two) about midway vertically between i and iii; beneath the prespiracular (situated on 1st subsegment) is a row of 4 single-haired tubercles in line one below the other; posterior to and slightly below the marginal tubercle is situated another single-haired tubercle; the single-haired pre-subspiracular tubercle (? vi) is on the 2nd subsegment; i on the 8th abdominal is slightly raised. In the *second instar* (June 30th, 1900), the *head* is dull instead of shiny, has a downy appearance and is covered with fine hairs. *Body:* The hairs much more numerous; a plentiful growth of secondary hairs arising from skin-surface greatly obscuring the warts which are also less conspicuous owing to flattening; the 8th abdominal segment still slightly humped; many black hairs spring from the yellow transverse bands; the long dorsal and lateral hairs white; the shorter and secondary hairs brown or black; the long hairs from the marginal tubercles form a downward sweeping fringe; the majority of secondary or skin-surface hairs simple, but already a few specialised needle-like urticating hairs (forming dorsal fur in adult larva) are present on each segment; a short longitudinal mediodorsal black stripe crosses the transverse yellow band between meso- and metathorax. In the *third instar* when the length is about one inch, the ear-like and lateral tubercles are still present; the yellow line that separates the segments is doubled between the meso- and metathorax; a few light brown hairs are now present on the dorsum (Bacot, *in litt.*). The difference between the larva with its chocolate-brown ground-colour and yellow intersegmental belts previous to its last moult and the rich red-brown hairy adult larva with black intersegmental belts is very striking (*vide.*, Buckler, *Larvae*, &c., vol. iii., pl. xlvi., figs. 4–4*a*). The *adult larva* is described by Bacot as follows: *Head:* tending to be trapezoidal in shape, slightly notched at crown; surface dull; blue-black in colour, very hairy; mouthparts shiny black; antennæ small; median suture of head brown. *Body:* tapers somewhat from 1st abdominal segment to head, and very slightly from 4th abdominal to anus which is blunt; true legs shiny black; ground colour of body velvety-black, exceedingly hairy especially on dorsal area, the hairs of two kinds—(1) A dense fur-like coat of urticating spindle-shaped hairs covering dorsal, and greater part of subdorsal, areas from prothorax to anal segment, the hairs bright (but dark) coppery-red in colour. (2) Fine, soft, simple, tapering hairs of different lengths, and varied in colour; many very long, especially on dorsum, where there is a distinct median line or ridge of long, bright, rich brown, closely-set hairs; the ridge most conspicuous on middle abdominal segments; below dorsal fur and just above spiracles is a series of small tufts of short white hairs, forming with the more scattered and darker lateral hairs a grey lateral fringe; beneath the spiracles the hairs much more sparsely scattered, white or brown in colour; the ventral area also sparsely haired; the short dorsal (urticating) hairs absent on intersegmental areas, where the velvety-black skin is in fine contrast to the coppery-red fur; also four narrow intersegmental black streaks across dorsum showing lines of division between the five subsegments; a series of distinct dark dashes (caused by absence of dorsal fur) present on either side and extending upwards from edge of dorsal fur for about 1·5mm., these dashes really a widening of the bare intersubsegmental areas (at third subdivision) to almost width of ordinary intersegmental area (Bacot, *in litt.*). Newman describes the larva as: Head narrower than prothorax, the width of which is increased by a fleshy protuberance on each side of the head; with this exception the body is uniformly cylindrical and clothed throughout with downy hairs. The colour until the last change of skin is intense velvety-black, with a yellow band on both the anterior and posterior margins of the pro- and mesothorax, and on the posterior margin only of the remaining segments except the 8th and 9th abdominals, and these bands are rendered peculiarly vivid by contrast with the black ground colour: these yellow bands are dorsal only, scarcely extending halfway down the side; each of them is slightly interrupted in the middle. In the last stadium these yellow bands are entirely lost and the hairs on the back are of a golden-brown colour. Fenn describes the larva as: Head round, velvety-black, and hairy; body long, cylindrical and densely hairy (except at the incisions), the hair long and soft; belly flattened; when *full-fed*, black on the sides and at the incisions; the back broadly tawny, interrupted on the sides by the dark ground-colour; dorsal hairs dark tawny; lateral hairs grey or black tipped with whitish; legs black; belly and prolegs velvety-black; sometimes with inconspicuous dull orange subdorsal spots at the incisions (*in litt.*, September 5th, 1875).

Variation of larva.—Briggs notes that on Septembe 8th-9th, 1860, at Duntroon, Argyllshire, he found a brood of larvæ much darker in colour than those obtained from Folkestone *(in litt.)*.

Comparison of larvæ of Macrothylacia rubi and Lasiocampa quercus.—In the larva of *L. quercûs* the five transverse ridges of urticating hairs that make up the dorsal fur on each abdominal segment show more distinctly than in the larva of *M. rubi*, and a perhaps adventitious resemblance between the larvæ of the two species is heightened by a similar series of subdorsal black slashes, produced by the widening of the bare inter-subsegmental areas in the larva of *M. rubi* at the 3rd subsegment, but in that of *L. quercûs* at the first. On some segments, the larva of *M. rubi* shows a tendency to develop the dark streak or slash at the 1st as well as at the 3rd division of the subsegment, but the larvæ of *L. quercûs* examined show no corresponding tendency to develop a widening at the 3rd. (Bacot, *in litt.*, May 9th, 1900).

Pupation.—The cocoon is generally placed more or less vertically among its foodplant, and forms a long tube securely attached thereto. Day found, April 18th, 1897, near the top of Penmaenmawr, a great number of cocoons of *M. rubi*, many just formed, some containing larvæ not yet pupated, others with newly formed pupæ; these cocoons were spun in the coarse moss which grows to a depth of six or more inches among the bilberry and heather; the top of each cocoon, slightly projecting above the moss, made it quite easy to distinguish where a cocoon was placed, the little dark brown end appearing just above the level of the moss. Lambillion observes also that the long cocoon stretches straight up from the roots of grass or heath in the Namur district, and Bostock that they are spun up among the heather on Cannock Chase, whilst they were found to be exceedingly abundant in 1887 on a large tract of heathy ground at the Lizard. McArthur notes that the cocoons are frequently to be met with in the Isle of Lewis among the short heath or moss, and Barnes that in the Reading district they are woven among the heather and rubbish at the roots of nut and birch bushes. Robson asserts that the pupæ move freely up and down in the cocoon in order to take advantage of the sun. Pupation takes place usually in March and April all over the British Islands.

Cocoon.—The cocoon often measures 2—3 inches in length, and forms a sort of loose tube, generally fixed more or less vertically among the larval foodplants. The cocoon has a loose outside part, a closer and compact inner structure; still the cocoon is thin and not tough as is that of *L. quercûs*, &c.; the inside is smooth; the pupa, if touched, shows considerable activity whilst in the cocoon. If the fullfed larvæ are placed in rather small chip boxes for pupation, a certain percentage nearly always makes round cocoons, and the pupæ in these are usually malformed; it is best to use a fairly large loose paper box in which each fullfed larva may spin when reared in confinement (Robson). The cocoon is enormously disproportionate to the size of the moths, being sometimes as much as 3 inches in length, composed of a sort of thin felt, in the manufacture of which the hairs of the larva are largely employed; it is of a dark brown colour, semi-transparent, the enclosed pupa readily seen, occupying about a third of the interior (Newman). Day describes the cocoon as being of the colour of dark brown paper, very long—about two inches—ruggedly finished off at the bottom, but with the top nicely rounded and closed in; the texture of the cocoon tough but not stiff, and not affording much protection to its inmates from pressure. It is, however, very watertight, a much-needed character on wet mountain sides. Fowler notes it as nearly three inches long, slung like a hammock, the pupa lying in the centre. A cocoon is figured by Buckler (*Larvae*, &c., iii., pl. xlvi., fig. 4*c*).

PUPA. — ♀. [Described from one empty and one imperfect pupa-case containing dead females, the frontal shield of the pupa-case being absent]. Length 31·5mm., 11mm. in diameter at greatest girth (about end of 4th abdominal segment). Tapers only to a very slight extent, is bluntly rounded at extremities; surface slightly shiny for the most part, but wing-, antenna-, and leg-cases are dull, the sutures between them being shiny; the intersegmental areas of free abdominal segments much smoother, and of a paler, brighter brown than the remainder of pupa; the general surface tending to rugose, this character being well marked on the dorsum and especially on the thorax; colour dark mahogany-brown, almost black on wing-cases, &c.; the sexual organs distinctly marked; the spiracles form a long oval, only slightly raised above surface on 2—7 abdominal segments, a spiracular scar only on the 8th; the anal area covered with very short bright brown bristles, also a belt of slighter backward-pointing bristles on each of the abdominal segments strongest on dorsum; wing-cases extend to end of 4th abdominal segment; a faint but clear marginal line (? Poulton's) is present on the wing-cases; a narrow slip of hindwings shows from the 3rd thoracic to commencement of 4th abdominal; the tips of second pair of legs reach to level of spiracle on 4th abdominal segment; in one ♀ pupa examined the extreme tips of third pair of legs showed just beyond apex of forewings (? a most unusual character*); the antennæ not very broad, rather sharply bent inwards for about half their length, and extending to same level as first pair of legs, *viz.*, end of 3rd abdominal segment; the suture dividing the eyeplate into two portions is readily distinguished; the mouth-parts not at all clear, chiefly owing to rugosity of surface. There appears to be a certain similarity between the pupa of this species and that of *Malacosoma castrensis*, but the smaller mouth-parts that could be so clearly made out in the latter species are either absent or obscured by the surface rugosity in *M. rubi;* the two somewhat large covers (maxillæ) between the first legs are very distinct (Bacot, May 9th, 1900). ♂ [Three dead ones received from Mr. Robson]. From 25mm.-29mm. in length, and 8mm.-10mm. in width at greatest girth. The differences between the ♂ and ♀ pupa very slight, except in the sexual organs, which are, of course, distinct. The ♂ pupa is rather more pointed, and smaller at anus in proportion to girth (but there is some individual difference in this respect among ♀ pupæ); the antennæ rather broader and longer than in ♀ pupæ (but here again there is some difference in individual specimens); they reach (in ♂ pupa) nearly or quite to end of 2nd legs. Some examples of both sexes are curved ventrally, and have the segments compressed; others (and these have died with the segments extended apparently when the imagines were ready to emerge) are almost or quite straight. In none of the specimens

* We are not so sure that this is very unusual in this species. We have ourselves observed it, *vide* our description (*posteà*, p. 143).

(3 ♂ s and 2 ♀ s) now under examination can I find trace of 3rd pair of legs externally. (I suspect that a ♀ pupa already described as showing the extreme tips of this pair, must have been abnormal in this respect) (Bacot, May 20th, 1900). Our own description of the pupa reads as follows: The head, thorax, wings, and limbs are dull black, the abdomen shiny black. The head not prominent, the mouth-parts ventral. The labrum divided by a median line, mandibles small, round, one on either side of labrum, the labial palpi (centrally) very small, the maxillæ (between the 1st pair of legs) and the first two pairs of legs well-developed, the bases of the second pair being hidden by the antennæ. The antennæ with central shaft and inner and outer series of pectinations. The antennæ and second pair of legs end at about three-fourths from the base of the wing along the costa. The wings have a peculiar silky appearance, the hindwings extending beyond the forewings from the metathorax to the apex. The glazed eye, extending from near the base of the antenna to the base of the first leg, is a well-developed structure, although inconspicuous from its resemblance to the ground colour. The tip of the third pair of legs is just noticeable beyond the apices of the wings. The prothorax is frontal, well-developed, and covered with short golden-brown bristles, with a slight shining longitudinal median ridge (continued over the mesothorax); a very distinct sutural division exists between the pro- and mesothorax, the inconspicuous prothoracic spiracle being placed at the lower end of the suture. The mesothorax well-developed, the sides extending into the broad anterior wing-bases. The metathorax narrow and ill-developed. The abdominal segments are strongly hooped, the movable incisions falling between 4-5, 5-6, and 6-7; the dorsum of the 1st, 2nd, and 3rd abdominal segments wrinkled, the 4th segment very wide, the 7th and 8th wider than the 5th and 6th; there is also a faint trace of a mediodorsal ridge. Each segment bears a transverse ridge of thick, short, golden-brown bristles; so numerous are these that the brown colour is quite distinct to the naked eye. The cremastral area is rounded, rough, and very thickly studded with similar short bristles, but totally useless for attachment. The movable incisions are very smooth. The abdominal spiracles, somewhat lunular in shape, with a slightly raised elliptical rim, very distinct on the second and following abdominal segments, although those on the 5th and 6th are nearly covered by the depth of the movable incisions. The sexual organs are very conspicuous. The ventral area is not so strongly covered with bristles as are the lateral and dorsal areas. The abdominal incisions orange-brown, very prominent and conspicuous. Lyonet figured (*Anat. Ins.*, pl. xxiv., fig. 12) the female sexual organs of this species (see, *anteà*, vol. ii., p. 54).

Parasites, &c.—The species appears to be very much affected with parasites in all the early stages. *Apanteles difficilis**, Nees,

* Emerges from young larva before third moult (Bignell). Arkle notes (*Ent.*, xxx., p. 69) the appearance of examples of this species in December from larvæ in confinement, the rest going over the winter; the specimens were referred to this species by Bignell (*loc. cit.*, p. 122). Bignell writes (*Ichn. S. Devon.*, p. 16): Bred from *M. rubi*, Aug. 17th, 1883; the larva was attacked in 2nd moult; eleven cocoons were produced; they remained in this stage 14 days; the cocoons are flesh-coloured; the parasitic larvæ on leaving their host do not cluster their cocoons, nor do they leave the body of the victim simultaneously, consequently they are scattered; from 1 to 20 come from a single caterpillar; some remain through the winter; the majority, however, are only in pupal stage from 10-14 days.

11 bred August 17th from a young larva in the second moult, the parasites being 14 days in pupa (Bignell); *A. ruficrus*, Haldy. (Billups); *Amblyteles armatorius*, Forst. (Billups); *Cryptus migrator*, Fab. (Hart); *Tachina larvarum** from pupa (Robson); *T. puparum* from cocoon (Jeffery); *Apanteles juniperatae*, Bé. (Meldola); *Ophion undulatus*, Gr. (Perris): *Schizoloma amicta*, Fab. (Ratzeburg). Clarke notes a fullfed larva completely filled with 56 nearly full-grown ichneumon larvæ. Briggs observes that from April 1st—8th, 1869, he found many larvæ dead or dying; from one of these 12 large dipterous larvæ subsequently came out, one of the imagines emerging on May 21st. He then very pertinently asks: What can be the economy of this parasite—there can be no larvæ of *M. rubi* in which it could oviposit at this date? Larvæ very abundant at Folkestone in August, 1892, but scarcely one seen without ichneumon eggs attached to it (Adkin); halfgrown larvæ in August, 1877, near Wotton-under-Edge, with several pale brownish cocoons of a species of ichneumon attached to the hairs of its back and sides, each egg separate and standing at right angles to its body. On August 24th, 3 or 4 ? *Microgaster* flies emerged (Perkins, *Ent.*, x., p. 258); a larva picked up in Woolmer Forest evolved similar cocoons, September 12th, and died next day (Robinson). [We may here note that Crewe records that, in the Scilly Isles, in the autumn, the bee-eater (*Merops apiaster*) feeds on the larvæ of *M. rubi*, beating them to death on the ground, as a thrush does a snail, and then swallows them whole.]

Foodplants.—Practically polyphagous (Chapman); when young on hawthorn, later on *Carex*, *Taraxacum officinale*, &c. (Lambillion), *Potentilla* (Farren), heather, beech, oak, *Juncus*, grasses (Gordon), *Rosa spinosissima*, *Geranium sanguineum* (Robson), dwarf sallow (Ellis), raspberry (Rühl), clover (Paul), rose (Hodgkinson), *Lotus corniculatus*, *Rubus caesius*, *Viola canina*, *Thymus serpyllum*† (Stowell), aspen (Brown), bilberry (G. O. Day), *Spiraea* (Pitman), sallow (Bower), *Erica* (Kaye), bramble (Greer), *Poa aquatica* (Thouless), *Lathyrus pratensis* (Leach), *Fraxinus elatior* (Garbowski), *Calluna vulgaris*, *Betula* (? *Alnus*) *glutinosa*, *B. alba* (Newman), *Polygonum aviculare* (Tutt), *Trifolium repens* (de Selys), dewberry (Adkin), white osier (Mera), plum (Barnes), lesser burnet, hazel (Prideaux), *Vaccinium myrtillus*, *Erodium cicutarium* (Barrett), willow, strawberry (Baynes), *Potentilla reptans* (Favre).

Habits and habitat.—The interesting habits of this species have given rise to many notes from a great number of observers. The swift-flying male, dashing wildly in the afternoon sun, and evening twilight, attracted before or at dusk in amazing numbers by the newly-emerged female, that booms heavily along later in the evening or soon after dark, seeking a place to oviposit, and, similarly to the occasional custom of the females of some other species of this super-family being now and again attracted by light, where the male *M. rubi*

* Larvæ of this species did not leave the caterpillar of *M. rubi* until after hybernation, 2, 3, or more in one larva (Bignell).

† Stowell notes (*Zool.*, p. 7898) that of 36 larvæ collected on the cliffs (Isle of Man), on September 26th, 11 were feeding on *Lotus corniculatus*, 8 on *Calluna vulgaris*, 5 on *Rubus caesius*, 3 on *Viola canina*, and 2 on *Thymus serpyllum*.

is possibly never found, is a source of never-ending interest to the field naturalist. Barnes insists that, in spite of the irregular manner in which the males fly, they invariably do so in a direction roughly circular, passing the same place again and again. Prideaux observes that the snapping sound that accompanies the flight of the ♂ can be distinctly heard when one is flying round the observer (*Ent. Rec.*, xiii., p. 224). Poulton notes that the males fly with great rapidity in bright day-light, while the females sit perfectly motionless, but in the evening they fly slowly and deposit their eggs. Walker observes that at Rathmullan on the east shore of Lough Swilly from May 21st—31st, the fine evenings afforded excellent sport, the males tearing madly about in an open heathy place near a wood, and looking almost scarlet in the rays of the setting sun. Holland says that the males dash about Sketty Park and the neighbouring fields for the last hour and a half before the sun goes down, not one moth, but lively groups in mad career. Bankes observes that in the Isle of Purbeck the male dashes wildly over the heaths in the sunshine and also in the late evening. In the early evening they are readily attracted by a newly-emerged ♀, and we have had them fly around us, evidently attracted by a virgin ♀ shut up in a box inside our pocket. Prideaux observes (*Ent. Rec.*, xiii., p. 224) the emergence of a ♀ on June 1st, 1901. It appeared to be calling on the first evening, but on June 2nd and 3rd (cool, dull evenings) when taken out, from 6 p.m.-7 p.m., seemed to exert no direct influence on wild ♂ s, though one or two were seen in her vicinity. On the 5th, however (sunny and warm), ♂ s began (at about 5 p.m.) to be seen in the garden (close to their locality), and, on the ♀ being taken out about twenty were seen in the course of an hour, one as late as 9.45 p.m. He adds that, in his experience, the males of this species have nothing like the acuteness, boldness, or assiduity shown by *Lasiocampa quercûs* under similar conditions, seeming to have difficulty in precise location, and being easily frightened off. Zeller notes (*Stett. Ent. Zeit.*, xli., p. 129) a remarkable instance of the attractive scent attached even to the cocoon and a dead ♀, for, on June 7th, 1849, he discovered a ♂ attracted by a ♀ cocoon to which was attached a piece of the thorax and the greater part of the abdomen of a ♀, dry, and several ants busy, so that the eggs were exposed. The ♂ had its head deep in the grass-tuft in which the cocoon was placed, and was fluttering head downwards round the cocoon, when Zeller picked the insect up and afterwards released it. Finlay was probably the most successful collector in assembling this species; in some seasons he captured large numbers of males, in one evening as many as 80, and all came practically between 6.15 p.m. and 7.45 p.m. Haggart says that the males assemble freely at Galashiels from about 8 p.m. On the evening of June 21st, 1899, he took some 30 fine males in about an hour by this method, between 8.30 p.m. and 9.15 p.m. Gordon says "assembling" is very successful in the late afternoon on the moors round Corsemalzie, the males flying from about 5 p.m. until after 9 p.m.; Jefferys reared a ♀ on May 20th, 1895, and on June 4th, 1895, three males were attracted, the ♀ paired with one of these at 7.30 p.m., and by 10 p.m. she was depositing freely. Reid notes the males as flying on the Scotch moors, hills, and in open woods, from sundown to dusk, but also on dull afternoons, whilst Christy saw them flying in the afternoon sunshine in Sutherland, and Lane captured specimens flying in the early morning, May 28th, 1898. Nolcken says that the males swarm in the open woods of the Baltic Provinces, flying in the afternoon sun among the pine trees, also on the Hasik turf-moor. In Tyrone the males fly swiftly over the mountain moorlands (Greer); they are taken very freely on the Manx coast near Port Soderick by assembling (H. S. Clarke); in the south they fly almost all the afternoon and early evening in the rides of Chattenden woods and along the edges of the woods that clothe the chalk-hills at Cuxton (Tutt); they fly in the sunshine about 5 p.m. in early June at Oxted (Sheldon); in the afternoon sun on the chalk downs at Box Hill (Bower); freely at sunset in North Staffs (Blagg); flying at about 8 p.m. on Wicken Fen (Carr); flying most plentifully between 5 p.m. and 7 p.m. in the evening at Penrith and Aberdeen (Varty); flying chiefly between 5 p.m. and 6.30 p.m., rarely noticed after 7 p.m., in the Middlesboro' district (Lofthouse); dash about wildly before dusk on the Cotswolds (Bartlett); Lambillion observes that, in Belgium, the males fly during the evening and until about 9 p.m.; most abundant between 7 p.m. and 8 p.m. on Strensall Common (Hewett). The female is rarely seen wild. Tugwell observes that the sexes fly at different times of the day, the male is to be seen flying madly along during the afternoon, whilst the female flies at dusk; he noticed one of the latter sex in the New Forest in July, 1873, flying over a bog at night, evidently ovipositing. Prideaux first heard and then saw a ♀, buzzing over the grass about 8.45 p.m., on June 5th, 1901, but, although followed up, she was soon lost. Clarke says that the female oviposits at dusk, and Holland that he has taken the female at dusk at Sketty Park laying its eggs among the coarse grass; Bartlett observes that the female hides among the grass, and Walker found but one at Rathmullan, and that at rest. Bayne has observed females flying at dusk in Epping Forest, whilst Robertson states that at Swansea the females occasionally come to light. Burrows also notes that, on June 2nd, 1886, a female came to light at Brentwood, Dallas-Beeching has captured it similarly at Tunbridge Wells, Carr at Shoreham on June 11th, 1899, and Prideaux at Bristol, whilst Benteli captured a single ♀ at the electric light at Berne in 1893. Fowler says that he has occasionally seen the ♀s flying over the heather, straight as an arrow, and, although so large-bodied, they fly so swiftly as usually to avoid capture. Eastwood notes that males were assembling to a ♀, sitting on heather and already *in copulâ*, in Inverness, on June 10th, 1891, and that of these he captured nine. Lane found a female resting on grass about midday, on May 23rd, 1899, at Folkestone, and another sailing over the Beaulieu Heath, in the New Forest, at 8.30 p.m., on May 28th, 1898. Gregson notes a female *in cop.*, before the wings were fully stretched, at 9 p.m., and Pickett observed the males flying swiftly in the afternoon sun at Folkestone, and females sitting on bare ground among long grass and heath, their colour much resembling that of the ground. Dalglish says that in June, 1887, at Glen Mallon, the males were observed freely on the wing, and a few of both sexes were obtained freshly-emerged, whilst suspended from their cocoons, expanding and drying their wings. Barnes notes, in the

Reading district, a ♀ that was resting on a twig of heath, hanging by her forelegs, whilst others were found on the lower branches of heath and birch. The habitats of this species are as varied as can well be imagined. Essentially a moorland insect, it is to be found right up to the summits of most of our higher mountains, on almost all hillsides, rough pastures, waste places, heaths, bogs, and even the low-lying fens and coast sandhills. It occurs on the chalk-hills at Cuxton and Folkestone, on the coast sandhills at Deal, in the rough fields around Chattenden woods, and in the rides of the wood itself. It occurs on the tracts of heath at Wareham, but also in Portland, where there is no heath (Bankes); abundant on all the moors and sandhills in Aberdeenshire (Horne); on all the hillsides and moors in the south-west of Scotland (Dalglish); larvæ exceedingly abundant on all Scotch moors from August to October, but near Emsworth on downs, where tbere is no heather (Christy); common on all the heaths at Keswick (Beadle); abundant on railway banks and dry heaths at Weymouth (Forsyth); on all the open heaths in the New Forest and neighbourhood (Moberly); on cliffs and railway banks in Southend district (Whittle); on the low-lying brambles on the heaths about Sidmouth (Wells); on the downs at Brighton (Blaber); ♀s ovipositing on the bog in the New Forest (Tugwell); on the bogs near Crangwell (Lawless); and on all the bogs around Clonbrock (Dillon); on the mountain-sides around Barmouth (Kenward); in osier beds near Acton in great abundance, the larvæ feeding on osier (Mera). Swarms all along the coast, both on the sandbanks and cliffs, also on all the moors and mosses in both Northumberland and Durham, ascending to nearly 2000 feet in the Cheviots, whilst the larvæ are to be found feeding on hedge-banks around Hartlepool and Stockton; hybernated larvæ are particularly abundant on the banks by the sea-shore in the spring of 1897 about Hartlepool (Robson); abundant on the Lincolnshire coast (Gascoyne); common on the railway banks about Barnes (Williams); common in the stubble-fields at Alphington feeding on clover (D'Orville); swarming on the heaths in Jersey in 1860 (Thorburn); heaths and chalk downs in Berks (Clarke); on open moors at Minehead (Kaye); larvæ in hundreds on the Manx mountains in September, but scarce in spring (Clarke); common on the hillsides near Bath (Greer); in abundance on a wet common near Norwich (Pitman); on the moorland districts of Dartmoor (Studd): on grassy slopes and on heaths in Gloucestershire, the larvæ sunning themselves on grass culms (Lifton); occurs on all the waste moors, mountains and bogs in Ireland (Kane); chiefly on the common at Strensall, but sometimes in the wood close by (Walker); prefers heaths at Carlisle (Day); on heaths, downs and commons in the Plymouth district (Reading); in damp places on the moss at Great Ayton (Lofthouse); in swarms on Brighton downs in October, 1895 (Blaber); on the heaths at Melrose (Beveridge); on the heaths at Lewes (Nicholson); on the commons near Brentwood, and on the heaths at Ipswich (Mera); on all the hills in the Painswick district (Watkins); on all the heaths round Wilsden (Butterfield); on the heaths in the Wye Valley (Vaughan); larvæ prefer the grassy corners of heaths about King's Lynn (Atmore); males fly in rough fields on outskirts of Abbott's Wood; they also occur freely on the heather-clad slopes behind the dene at Lowestoft, and on the railway banks near Harlesden (Montgomery); swarms in some seasons in Burwell Fen (Farren); males on the wing just before dusk on Wicken Fen (Carr); on the downs at Aylesbury (Bayne); on Denny Bog in the New Forest (Tremayne); swarms on the moss at Forres (Norman); most abundant in October by roads and on dry wastes in Belgium (Lambillion); larvæ common after the last mowing in the meadows of the Zürich district (Rühl); larvæ in great numbers among grass in the Upper Hartz (Hoffmann).

Time of appearance.—At the end of May and commencement of June almost all over the British Islands—Sutherland, Argyle, Kent, Cornwall, Tyrone, Galway, &c.—in May at Aberdeen (Horne); end of May and beginning of June in Belgium (Lambillion); middle of May on into July in the Baltic Provinces (Nolcken); imagines in June in Upper Hartz (Hoffmann); May 6th to June 19th for Vienna district, April 16th at Salzburg (Fritsch); common in June, at Oxton, the males flying over the heaths in hundreds (Studd); July 28th, 1844, at Preston (Hodgkinson); June 20th, 1856, at Bisterne (*Subs.*, p. 28). June 1st, 1857, 28 males on Langwith Common, near York (Anderson); June 1st—7th, 1858, at Ambleside (Buckton); June 1st—11th, 1858, at Machynlleth (Alington); June 10th, 1859, at Kirriemuir (White); larvæ at Ballachulish, Spaen Bridge, September 18th, 1860, placed in a warm position, pupated and imagines emerged between December 21st, 1860, and January 6th, 1861 (Keays); June 8th, 1862, at Darenth, June 17th, 1863, at Portscatho, abundant, May 14th, 1864, at Abbey Wood, May 18th-28th, 1866, at Herne, common, May 19th, 1875, at Lyndhurst, June 12th, 1884, at Chattenden, common, May 30th, 1881, May 11th—22nd, 1882, at Box Hill, June 20th, 1885, June 12th, 1886, June 14th, 1887, June 17th, 1893, at Chattenden, common, June 13th—27th, 1891, June 9th, 1892, at Oxshott abundant, May 16th—29th, common at Tor Cross (Fenn); fullfed larvæ at Bensham, March 30th, 1866, began to spin April 8th, a pair emerged May 9th, eggs laid May 14th, hatched May 25th (Watson); June 9th, 1868, at Contin (White); June 11th, 1868, at Cirencester (Harman); June 9th, 1875, at Rannoch (A. H. Jones); June 1st, 1872, at Shortwood (Watkins); June 17th, 1876, at Heckfield, June 24th, 1889, at Bulmershe, June 12th, 1891, at Wokingham, June 28th, 1891, on Streatley Downs, May 22nd, 1893, at Burghfield (Holland); June 20th, 1873, at Douglas (Porritt); May 30th, 1881, May 11th, May 22nd, 1882, at Box Hill, June 12th, 1885, June 17th, 1887, June 10th, 1891, June 10th, 1892, June 6th, 1893, June 1st, 1896, at Chattenden (Bower); June 6th, 1881, at Bradford (Carter); May 25th—June 9th, 1881, at Strensall Common, June 23rd, 1881, at Sandburn, June 2nd, 1882, at Strensall, June 10th, 1882, at Sandburn, May 31st, 1890, on Thorne Moor, May 31st, 1892—June 21st, 1892, May 14th, 1895, at Strensall, May 19th—May 28th, 1895, bred several males and females, May 14th—June 14th, 1896, at Strensall Common (Hewett); June 2nd, 1885, May 22nd—June 2nd, 1886, June 11th, 1887, June 14th, 1894, bred at Brentwood, June 5th, 1894, "assembled" at Leigh (Burrows); June 9th, 1886, at Gelt, June 14th, 1892, at Faugh Moss, July 1st, 1894, at Gelt, June 10th—July 10th, 1896, on Hayton Moss, near Carlisle (Routledge); June 6th, 1886, June 5th, 1887, June 6th, 1892, June 6th, 1894, June 4th, 1900, at Reading (Butler); June 7th, 1887, in New Forest (Pearson); June 13th, 1887, May 16th, 1893, in Isle of Purbeck, ♀ bred June 12th, 1887 (Bankes); June 6th, 1888, June 29th, 1894, June 13th, 1897, at Carlisle (Wilkinson); May 20th, 1890, June 13th, 1891, at Aberdeen (Horne); June 9th, 1890, at Chattenden, May 22nd, 1893, at Brentwood (Mera); June 11th, 1890, June 8th, 1892, at King's Lynn (Atmore); May 21st, 1890, at Benfleet, bred June 1st—7th, 1894, June 5th, 1894, bred a ♀ which attracted a ♂ on June 6th, 1897, at Eastwood, bred June 16th, 1898, from larva obtained April 10th (Whittle); June 14th—21st, 1891, May 22nd, 1892, June 3rd, 1895, in Epping Forest, June 3rd, 1894, at Aylesbury (Bayne); June 10th, 1891, males assembling to a ♀ sitting on heather, near Inverness (Eastwood); June 16th, 1891, and following days at Leigh Woods, June 25th, 1894, at Dursley (Griffiths); June 13th, 1891, at Brockley in Somerset, June 22nd—July 13th, 1891, at Leigh, May 25th—June 21st, 1892, at Bristol (Bartlett); June 9th—18th, 1891, ♂s flying at about 6.30 p.m., June 3rd, 1892, ♂s flying, June 9th, 1892, a ♀ on gaslamp, June 16th, 1892, a ♀ buzzing over grass at Bristol; May 24th, 1895, ♂s flying in the Isle of Wight (Prideaux); May 30th—June 6th, 1891, in New Forest (James); May 30th, 1891, at Brockenhurst, May 21st—June 7th, 1892, in the New Forest (Ridley); June 11th, 1892, May 6th, 1893, at Loughton, June 13th, 1893, at Moreton, June 4th, 1895, at Ringwood (Bloomfield); May 28th, 1893, June 20th, 1894, at Cannock Chase, June 18th, 1898, at Burnt Wood (Freer); May 21st, 1893, at Bawsey (Glenny); bred June 14th (♀), 15th (♂), 1894, at Aberdeen; larvæ, September 24th on into October, 1894, at Aberdeen, went down into moss, the last on December 10th, began to pupate in January, taken indoors May 10th, imagines appeared May 30th (♀), May 31st (♀), June 1st (♀), June 2nd (3 ♀s, 1 ♂), June 3rd (2 ♀s, 2 ♂s), June 4th (2 ♀s, 2 ♂s), June 5th, (1 ♀, 3 ♂s), June 6th (♀, ♂), June 7th (6 ♀s, 2 ♂s and 3 ♂s crippled), June 8th (♀), June 9th (♂), June 10th (♂ crippled), 1895; captured at Aberdeen June 2nd—19th, 1894 (most abundant about the 12th); June 22nd, 1894, at Penrith; May 25th—June 6th, 1895, at Aberdeen, May 9th—23rd, 1896, at Aberdeen (most abundant about May 23rd) (Varty); June 10th, 1895 (Baily); May, 1893, in Arran, June 17th—21st, 1898, at Rannoch, June 5th, 1897, on the Pentland Hills (Morton); May 18th, 1893, in the New Forest (Richardson); May 13th, 1893, at Instow (Hinchliff); April 26th, 1893, at Forest Row (Dallas-Beeching); June 7th, 1893, at Buckerell (Riding); April 24th, 1893, in Burghclere district (Alderson); May 6th—24th, 1894, in New Forest (P. Reid); June 9th to June 21st, 1894, May 27th — June 1st, 1895, May 16th — June 10th, 1896, near Carlisle (Day); June 3rd, 1894, in Blean Woods (Jones); May 30th, 1894, at Chiasso, in Tessin (Knecht); June 8th — 17th, 1894, in the New Forest (Wells); June 10th, 1895, at Porthcurno (Daws); June 1st, 1895, captured males by assembling at Emsworth (Christy); May 24th, 1895, at Methven Moss (Wylie); bred May 20th—June 4th, 1895, from Langharne, a ♀ attracted a male at 7.30 p.m., the eggs being deposited about 10 p.m. (Jefferys); June 1st—4th, 1895, in North Staffs (Blagg); June 5th, 1895, many males in the Boghall Valley (Evans); June 14th, 1895, at Ayr (Fergusson);

earliest date of capture, spread over many years, May 25th, 1896, and the latest July 15th, 1900, in Reading district; eggs hatched July 14th, 1897, larvæ and pupæ forced in kitchen, and emerged at Christmas of the same year; eggs hatched August 1st, 1899, fed up by October, then hybernated, pupated March 27th, 1900, and emerged May 14th, 1900, and following days (Barnes); May 25th, 1896, June 10th, 1900, at Great Ayton, June 7th, 1897, at Middleton, June 3rd, 1900, at Strensall (Lofthouse); May 16th, 1896, in Epping Forest, June 6th, 1897, on Denny Bog (Tremayne); June 13th, 1897, at Arrochar (Dalglish); June 7th, 1896, June 9th, 1898, at Worcester (Rea); June 29th—July 8th, 1896, in New Forest (Nash); larvæ and pupæ, April 18th, 1897, on Penmaenmawr, imagines bred June 1st—8th, May 28th, 1898, at Rannoch (G. O. Day); earliest imago in 1897, on June 9th at Corsemalzie, others on the 17th caught in the evening at Loch Chesnay, occurred from June 8th—July 1st, 1898, at Corsemalzie (Gordon); May 31st, 1897, on mountains at Windermere (Freeman); June 18th—25th, 1897, on the Norfolk Broads, generally distributed (Bacot); June 14th, 1897, at Abbott's Wood, May 31st, 1897, at Harlesden (Montgomery); June 6th, 1897, and following days, flying in swarms over the heath, also June 7th, 1898, in hundreds at Oxton, imagines emerged naturally in frame out of doors, June 1st—3rd, 1899, &c. (Studd); May 28th, 1898, males and a ♀ on Beaulieu Heath, May 23rd, 1899, at Folkestone (Lane); May 30th, 1898, in the New Forest (B. Adkin); June 8th—16th, 1898, at Tyrone (Greer); June 11th, 1898, at Reigate (Turner); June 8th—14th, 1898, in New Forest (Edelsten); June 5th—11th, 1898, at Rhinefields (Wells); June 7th, 1898, June 11th—19th, 1899, abundant at Galashiels (Haggart); June 11th, 1899, at Shoreham, June 18th, 1899, at Wicken (Carr); June 6th, 1901, at Bournemouth (Butler); May 27th, 1901, at Strensall (S. Walker); June 1st—20th, 1901, common from Douglas to Santon, &c. (Clarke).

LOCALITIES.—Universally distributed in Ireland from Innishowen to Donegal, to Westmeath and southwards to Killarney, and from Howth to co. Galway in the west (Kane); common all over the north of Scotland except in the Shetlands (Reid); abundant on all hillsides and moors in the south-west of Scotland (Dalglish); also very abundant in the east of Scotland. ABERDEEN: Pitcaple, Aberdeen (Reid), Monymusk (Mutch), Braemar (Tugwell), Castleton (Traill). ANGLESEA: general (Arkle). ANTRIM: Glenarm, near Larne (Greer). ARGYLL: all hillsides and moors (Dalglish), Loch Riddon (Christy), Kilberry (Cottingham), Kilmartin (Vaughan), Duntroon (Briggs), Ballachulish, Spaen Bridge (Keays), Glen Lean (Long). AYR: all hillsides and moors (Dalglish), Ayr, &c. (Fergusson). BERKS: Reading, Streatley, Burghfield, Bulmershe, Wokingham (Holland), Finchhampstead (Barnes). BUCKS: Aylesbury (Bayne). BUTESHIRE: all hillsides and moors (Dalglish), I. of Arran (Watson), I. of Bute (Dalglish), Lamlash (McKay). CAMBS: generally distributed and common (Balding), Wicken (Tutt), Cambridge (Clark), Burwell Fen (Farren), Reach (Burrows). CARMARTHEN: Langharne (Jefferys). CARNARVON: Conway valley, Trefriu, Carnarvon (Bland), Penmaenmawr (G. O. Day), Criccieth, Snowdon district (Perkins). CHESHIRE: abundant on heaths, mosses and waste lands (Ellis), coast sandhills (Porritt), Delamere Forest (Arkle), Wallasey (Cooke), Broxton (G. O. Day). CORK: Mallow, very abundant (Newland), Skibbereen, not common (Wolfe), Glandore, Ummera Woods, Timoleague (Donovan). CORNWALL: Trevalga, the Lizard (Riding), Portscatho (Fenn), Whitsand Bay (Briggs), Newlyn, Penzance, Land's End (Burrows), Porthcurno, very abundant (Daws), Scilly Isles (Crewe). CUMBERLAND: Carlisle, abundant, Houghton Moss (Cartmel), Kirkbride (Miller), Keswick (Buckton), Gelt, Brampton, Faugh Moss, Hayton Moss (Routledge), Rockcliffe Moss (Stephens), Keswick, Watendlath

(Beadle), Durdar, Salkeld, Orton, Todhills, Kingmoor, &c. (F. H. Day), Penrith (Varty). DERBY: on the moors (Fuller), Matlock (Hope), Dovedale (Brown), Staveley (Wright). DEVON: Plymouth (Reading), Barnstaple, Braunton Burrows (Mathew), Tor Cross (Fenn), Dartmouth (Bartlett), Paignton (Colthrup), Alphington (D'Orville), Instow (Hinchliff), Buckerell (Riding), Sidmouth (Majendie), Ilfracombe (Battley), Lundy Island (Chase), East Budleigh (Noel), Morthoe (Image), Barnstaple, Oxton, Exeter, Dartmoor (Studd), Torquay (Sich), Lynmouth (Briggs), Newton Abbot (Holdaway). DONEGAL: Lough Swilly — Rathmullan (Walker). DORSET: Dorchester, Weymouth (Bingham), Portland (Partridge), Moreton (Bloomfield), Swanage (Hall). DUMBARTON: all hillsides and moors — Kilpatrick Hills, Luss, Arrochar, Glen Falloch (Dalglish). DUMFRIES: Moffat (Somerville), Dumfries (Thorburn). DURHAM: common — Hartlepool (Robson), Castle Eden. Stockton (Rudd), Upper Teesdale (Gardner). ESSEX: Epping (Doubleday), Leigh (Robbins), Colchester dist. (Harwood), Southend, Benfleet, Eastwood (Whittle), Brentwood, Danbury (Raynor), Loughton, Theydon (Garland), Rainham, Wanstead, &c. (Burrows), High Beach (Bower). FERMANAGH: Enniskillen (Partridge). FORFAR: Clova (Barclay), Kirriemuir (White). GALWAY: Clonbrock (Dillon), Connemara (Birchall), near Crangwell (Lawless). GLAMORGAN: Swansea, Sketty (Robertson). GLOUCESTER: generally distributed — Cirencester (Harman), Hardwicke (Nash). Painswick, Haresfield, Newnham (Lifton), Bristol (Bartlett), Bristol dist., Edge Hill, Painswick Hill, Shortwood (Watkins), Durdham Downs, Dursley (Griffiths). HADDINGTON: Innerwick (Morton). HANTS: Isle of Wight — Shanklin (Ince), New Forest (Robbins), Bisterne, near Ringwood (*Substitute*, p. 28), Southampton (Moberly), Heckfield (Holland), Burghclere (Alderson), Liss (Marindin), Pamber (Clarke), Lyndhurst (Simes), Brockenhurst (James), Shawford (Hewett), Ringwood (Fowler), Fleet (Russell), Bournemouth (Raynor), Emsworth (Christy), Basingstoke (Holdaway), Woolmer Forest (Robinson). HEREFORD: Leominster (Hutchinson), Tarrington (Wood) HERTS: Haileybury (Bowyer), Hertford (Stephens), Barton Hills, near Hitchin (Cottam), Oakleigh Park, Barnet (Williams). INVERNESS: Corrimony (Barclay), Inverness (Eastwood), Outer Hebrides—Skye, Isle of Lewis, abundant (McArthur). ISLE OF MAN: coast from Douglas Head to Growdle and from Douglas to Santon, common on mountains—Onchan, Port Soderick, and in the Curraghs of Sulby, Ballaugh, and Jurby (Clarke), Douglas (Porritt). KENT: generally common—Borstal, Wouldham, Cuxton, Chattenden, Deal, Folkestone, &c. (Tutt), Burham Downs, Snowledge (Chaney), Chatham (Tyrer), Tunbridge Wells (Dallas-Beeching), Wye (Theobald), Dover (Stockwell), Blean Woods, Canterbury (Jones), Shoreham (Carr), Ashford (Heitland), Shooter's Hill (Stephens), Darenth, Abbey Wood, Herne (Fenn), Lyminge (Hills). KERRY: Sneem, Derrynone (Lawless), Killarney — Pass of Dunloe (Rea). KINCARDINE (Esson). LANARK: all hillsides and moors (Dalglish), Carluke (Morton), Douglas (Mackonochie), Pentlands (Evans). LANCASHIRE: abundant on heaths, mosses and waste lands—Wallasey, &c. (Ellis), Chat Moss (Chappell), Whitsand Bay (Brockholes), St. Anne's-on-Sea (Baxter), Ulverstone (Baynes), Preston (Leach), Southport (Porritt), Stalybridge Brushes (White), LINCOLN: abundant (Gascoyne), Hartsholme (Carr), Mablethorpe (Raynor), Linwood, Scotter (Musham). LONDONDERRY: Derry (Campbell). MAYO: Loch Killary (Chapman). MERIONETH: Barmouth (Imms), Tan y Bwlch (Arkle), Farchynys (Partridge). MIDDLESEX: Mill Hill (South), Old Oak Common (Godwin), Harrow (Melvill), Kingsbury (Bond), Harlesden (Montgomery), Barnet (Williams), Edgware (Heath), Acton (Mera). MIDLOTHIAN: Balerno (Northcote and Wilson), Pentland Hills (Morton). MONMOUTH: Wye Valley (Vaughan). MONTGOMERY: Machynlleth (Alington), Newtown (Tetley). MORAY: Altyre (Norman), Forres (Longstaff). NAIRN: Ardclach (Thomson). NORFOLK: King's Lynn (Atmore), Yarmouth (Lockyer), Norwich, Hemsby, Herringfleet (Pitman), Aylsham (Freeman), Beccles, Aldeby (Winter), Grimstone (Balding), Burgh Castle (Thouless), Bewsey (Glenny). NORTHUMBERLAND: common — Needless Hall moor, Meldon, Morpeth (Finlay), Shull (Backhouse), Bambro' (Brady), Twizell (Robson), Amble (Rhagg), Hexham, Gilsland (Nicholson). NOTTS: Sherwood Forest district, formerly (Leivers). OXON: Caversham, Whitchurch (Barnes). PEEBLES: Pentlands (Evans). PEMBROKE: Pembroke (Barrett), Castlemartin (Hodge). PERTH: Rannoch Moors (White), Perth (Nicholson), Pitlochrie (James), Callander (Evans), Trossachs (Dalglish), Methven Moss (Wylie). RENFREW: all hillsides and moors—Mearns, etc. (Dalglish), Port Glasgow, Kilmalcolm (Dunsmore). ROSS: Contin (White), Outer Hebrides (McArthur). ROXBURGH: Hawick (Guthrie), Galashiels (Haggart), Melrose (Beveridge). SHROPSHIRE: Church Stretton (Bradburne). SOMERSET: Clevedon, common (Mason), Weston-super-Mare (Whittaker), Wotton-under-Edge (Perkins), Taunton, Quantock Hills (St. John), Bath (Greer), Yatton, Brockley, Leigh (Bartlett), Leigh Woods (Griffiths), Minehead—Exmoor (Kaye). STAFFS: generally abundant, Madeley (Daltry), Bewdley (Tyrer), Cannock Chase, Burnt Wood (Freer), Leek (Hill), Dovedale (Brown). STIRLING: all hillsides and moors (Dalglish), Fintry (Eggleton). SUFFOLK: somewhat common (Bloomfield), Rushmere Heath (Pyett), Ipswich (Mera), Lowestoft (Montgomery). SURREY: Reigate (Dennis), Croydon (Livett), Box Hill, Caterham (Bower), Oxshott (Helps), Oxted (Sheldon), Shirley (Turner), Wimbledon (Stephens), Camberley (Watson). SUSSEX: generally distributed on open heaths and downs—Lewes (Nicholson), all the heather districts around Brighton (Merrifield), Ashdown Forest (Dallas-Beeching), St. Leonards (Robinson), Abbott's Wood (Hawes), Hollingbury Combe, Brighton (Image), Southdown Hill, near Goodwood (Newman), Hastings (Bloomfield), Groombridge (Blaber). SUTHERLAND: Strathmore, Melness (Mackay), Lochinver, near Assynt (Beveridge). TYRONE: common in the mountains—Dungannon, Tyrone (Greer). WARWICK: not uncommon, Sutton, etc. (Wainwright), Birmingham (Campbell). WATERFORD: Portlaw, very common (Flemyng). WESTMEATH: Mullingar (Middleton). WESTMORLAND: Windermere (Moss), Ambleside (Buckton). WIGTOWN: all the moors—Corsemalzie, Loch Chesnay, Loch Eldrig (Gordon). WILTS: Warminster (Bartlett), Salisbury Plain (Bland). WORCESTER: common throughout the county—Wyre Forest, Worcester, Hartlebury, Bramford, etc. (Rea). YORKS: Scarborough (Rowntree), Cottingham, Hull (Wilkinson), Hatfield Chace (Roebuck), Baildon Moor, Bradford (Carter), Whitby (Lockyer), Skipwith Common (Ash), Thorne Waste, Askham Bog (Prest), Barnsley (Harrison), Beamsley Moors (Taylor), Huddersfield (Varley), Keighley (Calvert), Leeds (Birchall), Pontefract (Hartley), Richmond (Sang), Selby (Foster), Sheffield (Doncaster), Wakefield (Talbot), Weeton (Pickles), Strensall (S. Walker), Guisbro', Castleton, Great Ayton, Middleton, Runswick (Lofthouse), Wilsden (Butterfield), Langwith Common near York (Anderson), Nidderdale, Pateley (Storey), Birstwith (F. T. Walker), Riccall Common, Sandburn, Thorne Moor, near Doncaster (Hewett), Penistone Moors near Barnsley (Whittaker).

DISTRIBUTION.—AMURLAND: Blagowestchensk, common (Staudinger). AUSTRO-HUNGARY: Bukovina, common (Hormuzaki), Pressburg (Rozsay), Bohemia, common (Nickerl), Galicia, not rare (Garbowski), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Brünn (Müller), Tyrol, not common (Hinterwaldner), Taufers, Innsbruck (Weiler), Hermannstadt (Czekelius), Epiries, common (Husz), Chemnitz (Pabst), Hungary—Kocsocz (Vángel), Gölnitz (Hudák), Fiume, common, Glockner (Mann), Upper Carinthia—Salzburg (Nickerl), Lavantthal (Hofner), Upper Styria—S. Lambrecht (Kodermann), Freistadt, Linz, Neuschl, Neutitschein, Rosenau, Vienna (Fritsch), Ischl (Hormuzaki), Carinthia—Portschach (Wagner), Brenner district, near Matrei (Galvagni). BELGIUM: generally distributed and very common—Namur, etc. (Lambillion), Virton, very common (Bray). BULGARIA: Sofia (Bachmetjew). CHANNEL ISLANDS: Jersey (Thorburn), Portelet in Jersey (Kaye). DENMARK: very common everywhere (Bang-Haas). FINLAND: southern part (Reuter). FRANCE: throughout (Berce), Riviera, not near the coast, but in the mountains—Grasse, at 1200ft. elevation, etc. (Chapman), Aube (Jourdheuille), Douai (Foucart), Auvergne (Sand), Saone-et-Loire (Constant), Eure-et-Loir (Guénée), Haute-Garonne, common everywhere to 2000m. elevation (Caradja), Puy-de-Dôme (Guillemot), dept. Var (Cantener), Morbihan (Griffith), Doubs (Bruand), Loire-Inférieure (Bonjour), Seine-Inférieure, rather common (Viret), St. Quentin (Dubus), Sarthe (Desportes), Pont-de-l'Arche, etc., abundant (Dupont), Caussols (Bromilow). GERMANY: generally distributed and common (Heinemann), north-west Germany, almost everywhere (Jordan), Rhine Palatinate (Bertram), Würtemburg (Seyffler), Giessen (Dickore), Lower Elbe district (Zimmermann), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle (Stange), Munich, common (Kranz), Rudolstadt (Meurer), Mecklenburg (Schmidt), Bremen (Dahl), Saxon Upper Lusatia, common (Schütze), Dresden, very common (Steinert), Thuringia, everywhere common (Krieghoff), Gotha, Lauchaer, etc. (Knapp), Prussia—Königsberg, &c., everywhere common (Schmidt), Silesia, very common (Wocke), Upper Lusatia, very common (Moeschler), Nassau, common (Rössler), Ratisbon (Schmid), Dessau, common (Richter), Alsace (Peyerimhoff), Wernigorode (Fischer), Pomerania, exceedingly abundant (Hering), Brunswick, common (Heinemann), Hanover, very common (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), Waldeck (Speyer), Lübeck (Paul), Oberharz (Hoffmann), Braunfels-an-der-Lahn, near Wetzlar (Sich). ITALY: throughout, unless absent from Sardinia, not common (Curò), Lombardy, very common (Turati), Modena (Fiori), Roman Campagna, not common (Calberla), Piedmont—Torre Pellice, Villar, Bobbie (Tutt). NETHERLANDS: distributed and not rare (Snellen), Breda (Heylaerts). ROUMANIA: everywhere common (Caradja). RUSSIA: Baltic Provinces (Sintenis), very abundant, the Hasik turf moor, Tursa-Gesinde, &c. (Nolcken), Moscow district (Albrecht), Wolmar (Lutzau), Volga district, Kasan, Baschkiria, common (Eversmann), St. Petersburg (Erschoff). SCANDINAVIA: generally common to 62° N. lat. (Aurivillius), southern and central Norway, common (Siebke), rare in southern Sweden (Reuter). SPAIN: Andalusia (Rambur), Teruel (Zapater), Galicia (Macho-Velado), Barcelona district, Monserrat, Vich, Roda (Cuní y Martorell), Catalonia—Pyrenees (Martorell y Peña), Bilbao, not common (Seebold). SWITZERLAND: Everywhere (Frey), St. Gallen (Täschler), Gadmenthal, to 5000 ft. (Ràtzer), Grisons (Killias), Weissenburg (Huguenin), Zurich district, common (Rühl), Chur, Splugen, Val Vedro (Forbes), Brienzer Grat (Jordan), Berne (Benteli), Tessin—Chiasso (Knecht), Valais, rare, tree region, La Croix de Martigny, Fully, Mt. Ravoire, Mt.-Chemin, Sion, Sierre, Brigue, Schallberg, &c. (Favre and Wullschlegel).

Subfam.: COSMOTRICHINÆ.
Tribe: COSMOTRICHIDI.

The Palæarctic Cosmotrichids belong to the tribe *Cosmotrichidi*, but Aurivillius treats the whole tribe as a genus under the name *Cosmotriche*, although he recognises, even on imaginal characters, that the species fall into two very distinct groups, which he diagnoses as follows:

a. The outer margin of the forewing not forming a curve with the margin; ♀ antenna shortly pectinated—*potatoria*, Linn., *albomaculata*, Brem.

β. The hind angle of the forewings so broadly rounded off that the outer margin and the hind margin form one with the other an uniform curve. ♀ antenna pectinated - *laeta*, Walk.

This subdivision is supported most strongly by the larval characters, the larva of *laeta** reminding one a little of that of *Dendrolimus pini*, and being very unlike that of *C. potatoria*, more different, in fact, than is that of *pyriformis*, Moore, which is, in the larval and imaginal states, also evidently generically distinct from *Cosmotriche (potatoria)*. We would suggest for section B of *Cosmotriche*, Auriv., the name *Routledgia*, with *laeta*, Walk., as type. It is quite clear that many of the species included by Kirby in his genus *Philudoria* (*Cat.*, pp. 820-822) are not only not congeneric with either *Cosmotriche* or *Routledgia*, but belong to distinct tribal groups. These, however, must be worked out elsewhere. The diagnosis which Aurivillius gives of the tribe *Cosmotrichidi* reads as follows:

IMAGO: Palpi slender and very long, reaching far beyond the forehead, projecting almost straight, the third joint long, cylindrical. Eyes slightly hairy, or nearly naked *(laeta)*. The forehead weakly convex, not protuberant. Legs of medium length; femora and tibiæ, especially in the ♂, with very dense long hairs; the front tarsi on the outer side hairy almost to the tip, the middle ones only slightly, the hind ones not hairy; front tibiæ unarmed, the tibial spine in the ♂ very large, reaching to the tip, in the ♀ very small, knob-like; middle and hind tibiæ with long terminal spurs; the first joint of the hind tarsi as long as the others together. The outer margin of the wings and the moderately long fringes more or less crenate, sometimes only very slightly. Wing-form: the forewings more or less *(laeta)* broad, with straight costa, more or less arched before the apex, strongly arched outer margin, and straight *(potatoria, albomaculata)* or arched hind margin; the apex rather sharp, almost right-angled; the hind angle more or less rounded; hindwings with more or less strongly arched costa and outer margin. Neuration:

*The larva here referred to, in British Museum collection, attached to this series, and connected with a male from Dharmsala, possibly may not belong to *laeta*, Walk., at all, so that this statement as to larval characters must not be relied upon too strongly. Another Dharmsalan species, *pyriformis*, Moore, has a larva which is quite Cosmotrichid in appearance.

median cell of both pairs of wings closed; the transverse nervure of forewing broken about in the middle, that of the hindwing before the middle. Forewings with 12 nervures; nervure 2 near the base, 3 and 4 free, starting from the hind margin, 5 from the hinder angle of the median cell, 6 and 7 with short stalk, 8 free, from the front angle, 9 and 10 with a stalk, which is much shorter than the free part of the nervures; 2—8 running into outer margin, 9 into apex, 10—12 into costa. Hindwings with 8 nervures; 4 and 5 from one point, or united in a short stalk *(laeta)*, 8 is at its base strongly bent, and only unites beyond the middle of the cell, by a long, oblique, transverse nervure, with nervure 7; the resultant basal cell is broad, nearly as large as the median cell, and sends out 4—5 nervules, of which the outermost is longest, straightest, and nearly parallel with the free part of nervure 8; 1*b*—6 run into the hind margin, 7 into apex, 8 into costa. ♂ antennæ long, reaching at least to middle of costa of forewings, straight, with long pectinations, which become shorter towards the base. ♀ antenna built as in the ♂, but with i short *(potatoria, albomaculata)* or medium-length *(laeta)* pectinations. ♂. Abdomen with broad tuft of hairs on the tip. ♀. Abdomen at end somewhat pointed, without anal tuft. LARVA: Very characteristic and easily distinguished from all other Lasiocampids. It is more or less densely clothed all over with soft hair; the 2nd and 11th segments have on the back a longer tuft of hair, and the 4th-10th *(potatoria, albomaculata)* or 3rd-10th *(laeta)* on each side of the back a longitudinal row of 3-4 *(potatoria, albomaculata)* or 5 small, short, dark tufts of hair. On the sides stand on each segment (from 2-10) three silky streaks quite as in larva of *Chilena*. Pupates in a long cocoon. PUPA: Smooth, glossy, with some very fine bristles on blunt anal end.

Aurivillius' diagnosis shows clearly the differences existing between the *Palaearctic (Cosmotriche)* and certain Indian *(Routledgia*)* species, but he does not deal with the Australian nor African species as enumerated by Kirby (*Cat.*, pp. 821-822). Until these species are thoroughly worked out, it is idle to suggest the true distribution of the group. *Cosmotriche*, as represented by *potatoria* and *albomaculata*, extends from the extreme west of Europe to the extreme east of Asia. *Routledgia* is, perhaps, typical of certain of the specialised Indian genera, the species catalogued by Kirby from this district being—*laeta*, Walk. (Silhet), *decisa*, Walk. (N. India), *pyriformis*, Moore (Masuri), *divisa*, Moore (Ceylon), *signata*, Moore, and *lineata*, Moore (Darjiling), to which must be added *castanea*, Hamps., and *isocymae*, Hamps. (India), all of which are evidently not congeneric, and probably not even to be placed in the same tribe. The Australian species catalogued are—*albigutta*, Walk. (Tasmania), *australasiae*, Fabr. (Australia), *nana*, Walk. (Tasmania), and *intemerata*, Walk. (Australia). The African species noted are—*directa*, Walk. (Sierra Leone), ? *minima*, Plötz (West Africa), ? *aluco*, Fabr. (Cape Colony), *reducta*, Walk. (S. Africa), and *niris*, Druce (Lower Niger), whilst one species, *paupercula*, Walk., is recorded from Bogota. The subfamily as a whole, therefore, is widely distributed, extending in few species over the Palæarctic region, but being much better developed in the Indo-Malayan and Australian region, extending also, if the characters on which the authorities have grouped the species be sound, into southern and western Africa. The Cosmotrichids appear distinctly allied to the Eutrichids *(sensu strict.)* on egg characters, whilst, on the somewhat generalised

*We are not quite clear that we have not here two tribes: (1) *Cosmotrichidi* (typified by *Cosmotriche—potatoria, albomaculata*, and an unnamed genus—*pyriformis*, Walker). (2) *Routledgiidi* (typified by *Routledgia—laeta*). *Laeta* is very distinct, both sexes being extremely specialised. The ♂ has less strongly pectinated antennæ, and the ♀ more strongly pectinated antennæ than have the respective sexes of *Cosmotriche*. The ♀s (from Kiukiang) in the British Museum collection have an anal tuft to abdomen.

characters exhibited by *C. potatoria* in the larval stage, Bacot makes many interesting observations. He says that the larva of this species presents general characters that are common to many widely-separated species, *e.g.*, (1) the oblique stripes and tendency to develop a hump on the 8th abdominal, (2) the fact that there are no secondary hairs in the 1st instar, although they become a marked feature of the 2nd, together with the fact that their bases are surrounded by black on the ground colour of the larva, but not on the yellow of the oblique stripes and subdorsal bands, and (3) that there are black dorsal spots in the 2nd stage. All these point unquestionably, in his mind, to a relationship with *Dimorpha (versicolora)*, and through this species (or rather through its ancestral base) with the Sphingids. The growth of secondary hairs, some short, and others long, the general shape of the larva, the coloration and pattern of the thoracic segments (cream- or white-coloured diamond-shaped spots) are characters held in common with the larva of *Lasiocampa quercûs* (in which species diamond-shaped whitish spots form a chain right down the back), the larva of var. *viburni* occasionally showing the same peculiarity. The characters that ally the larva of *C. potatoria* with that of *Eutricha quercifolia* are too apparent to need pointing out. The great development of the prothoracic lateral tubercles, so like those in the larvæ of the Liparids, suggest, an alliance therewith, but this resemblance is most probably due to convergence.

There are but few Cosmotrichid gynandromorphs recorded besides those of *C. potatoria* described (*posteà*). There is one of the allied *C. albomaculata*, described and figured by Wiskott (*Festschr. Ver. Schles. Ins.*, 1897, p. 120, pl. iii., fig. 9), which he notes as follows:

♂ left, ♀ right. In marking, colouring, and form of the wings, perfectly halved; wings of right side 21mm., of left 17mm. in expanse; left antenna male, right female; right legs darker than left; body with distinct line of division, left side slender and thin, right thick and bulged, posterior end with anal tuft. From the Amur.—In the Wiskott collection.

Genus: Cosmotriche, Hübner.

Synonymy.—Genus: *Cosmotriche*, Hb., "Verz.," p. 190 (? 1822); Auriv., "Iris," vii., pp. 160, 161, 163 (1894); Dyar, "Can. Ent.," xxx., pp. 4-6 (1898); Tutt, "Proc. Sth. London Ent. Soc.," 1898, pp. 1-3 *et seq.* (1898); "Brit. Lep.," ii., p. 451 (1900); Staud., "Cat.," 3rd ed., p. 122 (1901). *Phalaena (-Bombyx)*, Linn., "Syst. Nat.," xth ed., p. 498 (1758); xiith ed., p. 813 (1767); Poda. "Ins. Mus. Graec.," p. 84 (1761); Müll., "Fn. Frid.," p. 40 (1764); "Zool. Dan Prod.," p. 117 (1776); Esp., "Schmett. Eur.," iii., p. 75 (1783); Vill., "Linn. Ent.," ii., p. 123 (1789); Bkh., "Sys. Besch.," iii., p. 97 (1790). *Phalaena*, Hufn., "Berl. Mag.," ii., p. 398 (1766); Meyer, "Fuess. Mag.," i., p. 270 (1778). *Bombyx*, Fab., "Sys. Ent.," p. 564 (1775); "Spec. Ins.," ii., p. 176 (1781); "Mant. Ins.," ii., p. 112 (1787); "Ent. Sys.," iii., 1, p. 425 (1793); [Schiff.,] "Schmett. Wien.," p. 56 (1775); Esp., "Schmett. Eur.," iii., pl. xi., figs. 1-5 (1782); Hb., "Larv. Lep.," iii., Bomb. ii., Verae R. b. (? 1800); "Eur. Schmett.," ii., fig. 183 (? 1800); text p. 146 (? 1805); Ill., "Sys. Verz. Wien," n. Ausg., 1., p. 108 (1801); Schrk., "Fauna Boica," ii., 1, p. 273 (1801); Haw., "Lep. Brit.," 1, p. 84 (1803); Leach, "Edin. Ency.," ix., p. 132 (1815): Godt., "Lép. Eur.," iv., p. 92 (1822); Snell., "De Vlind.," p. 183 (1867); Staud., "Rom. Mém.," vi., p. 316 (1892). *Lasiocampa*, Schrk., "Fn. Boica," ii., 2, p. 154 (1802); Oken, "Lehrb. Naturg.," i., p. 707 (1815); Bdv., "Eur. Lep. Ind. Meth.," p. 48 (1829); "Icon. Chen.," pl. vi., fig. 2 (*circ.* 1840); Dup., "Icon. des Chen.," ii., pl. v., fig. 1 (*circ.* 1840); Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 69 (1871); Berce, "Faun. Franç.," ii., p. 196 (1868); Nolck., "Lep. Fn. Est.," 1, p. 129 (1868); Curò, "Bull. Soc. Ent. Ital.," viii., p. 151 (1876); Frey, "Lep. Schw.," p. 97 (1880);

Kirby, "Eur. Butts. and Moths," p. 129 (1880); Lampa, "Ent. Tids.," p. 42 (1885); Jordan, "Schmett. N.-W. Deutsch.," p. 96 (1886); Auriv., "Nord. Fjär.," p. 64 (1889); Rühl, "Soc. Ent.," v., p. 178 (1891); Carad., "Iris," viii., p. 93 (1895); Reutti, "Lep. Bad.," 2nd ed., p. 58 (1898). *Bombix*, Latr., "Hist. Nat.," xiv., p. 178 (1805). *Bombyx (-Lasiocampa)*, Latr., "Gen. Crust. et Ins.," iv., p. 219 (1809). *Gastropacha*, Ochs., "Die Schmett.," iii., p. 256 (1810); Evers., "Faun. Volg. Ural.," p. 153 (1844); H.-Sch., "Sys. Bearb.," ii., p. 104 (1846); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 26 (1851); Speyer, "Geog. Verb.," i., p. 407 (1858); ii., p. 287 (1862); Bang-Haas, "Nat. Tids.," (3), ix., p. 411 (1874). *Odonestis*, Germ., "Bomb. Spec.," p. 49 (1812); Curt., "Brit. Ent.," expl. pl. vii (1824); Stphs., "Ill. Haust.," ii., p. 51 (1828); "List. Br. An. Br. Mus.," p. 48 (1850); Wood, "Ind. Ent.," p. 23, fig. 52 (1839); Bdv., "Gen. et Ind. Meth.," p. 71 (1840); Humph. and Westd., "Br. Moths," p. 56 (? 1843); Dup., "Cat. Méth.," p. 74 (1844); Walk., "Cat. Lep. B. M.," vi., p. 1409 (1855); Sta., "Man.," i., p. 157 (1857); Ramb., "Cat. Lép. And.," p. 348 (1866); Newm., "Brit. Moths," p. 45 (1869); Wallgrn., "Skand. Het.," ii., pp. 105, 106 (1869); Oberth., "Etudes," v., p. 38 (1880); Buck., "Larvæ," iii., p. 60 (1889); Meyr., "Handbook," p. 323 (1895); Tutt, "Brit. Moths," p. 60 (1896); Barr., "Lep. Brit.," iii., p. 37, pl. xciv (1896). *Odonesis*, Samou., "Ent. Compend.," p. 247 (1819); Kirby and Spence, "Introd. Ent.," iii., pp. 175, 177, 221 (1826). *Euthrix*, Meig., "Eur. Schmett.," ii., p. 195 (1830); Grote, "Illus. Zeits. für Ent.," iii., p. 71 (1898). *Bombyx (-Odonestis)*, Led., "Verh. z.-b. Wien," ii., Abh., p. 75 (1853). *Cosmotricha*, H.-Sch., "Ausser. Schmett.," p. 9 (1856). *Gastropacha (-Odonestis)*, Hein., "Schmett. Deutsch.," p. 204 (1859). *Philudoria*, Kirby, "Cat. Lep.," p. 820 (1892). *Philhydoria*, Kirby, "Handbook Lep.," iv., pp. 114-115 (1897).

The type of *Cosmotriche* is *potatoria*. This species was included in Schrank's genus *Lasiocampa* (*Fauna Boica*, ii., Abth. 2., pp. 153-155), it was also one of the species included in Latreille's *Lasiocampa*, but was expressly excluded by Germar (*Sys. Gloss. Prod.*, ii., p. 49) from *Lasiocampa*, and placed with a mark of doubt in *Odonestis*, a genus erected for *pruni*, Germar noting concerning *potatoria* "potius ad sequens (*Gastropacha*, Ochs.) referendæ," so that it is quite out of the question to consider this species as a possible type of *Odonestis*, to the exclusion of *pruni*, as has already been done by some authors. Germar's action, therefore, appears to have still left *potatoria* a possible type of *Lasiocampa*, but Hübner separated it from the species with which it had been previously allied, and included it in Coitus 1 (*Cosmotrichae*) of his Family A of the Eutrichid stirps, with *lobulina* and *lunigera*. He diagnoses the Coitus as follows:

> *Cosmotrichae:* Forewings with white central markings and oblique dark stripes—*Cosmotriche potatoria*, *C. lobulina*, *C. lunigera*.

As we have already pointed out (*anteà*, vol. ii., p. 451), *lobulina* and *lunigera* (really the same species) are not permissible types of this genus, not having "oblique dark stripes," and thus disagreeing with the generic diagnosis. Aurivillius says (*Iris*, vii., p. 102) that "it is much to be regretted that none of the authors who have hitherto separated this genus from the rest has taken the trouble to read Germar's original description, Germar including only *pruni* with certainty in his genus *Odonestis* and adding '? *potatoria*', so that it is impossible to use *Odonestis* for any genus in which *pruni* is not included. Since, in my opinion, *potatoria* and *pruni* are not at all related, another generic name must be applied to *potatoria*. Hübner erected for *potatoria* and *lunigera* the genus *Cosmotriche*; these two species are, indeed, more nearly related than *potatoria* and *pruni*, but still generically distinct, and since Hübner's description fits *potatoria* exactly, but *lunigera* only in part, and Rambur, in 1866, erected the genus *Selenephera* for *lunigera*, whilst *potatoria* did not receive another name until Kirby called it *Philudoria* in 1892, it appears to me correct to retain the name *Cosmotriche* for *potatoria*, a course followed by Herrich-Schäffer (*Samml. Aussereur. Schmett.*, p. 9) in 1856. Meyrick, evidently ignorant of Aurivillius' excellent paper (*Iris*, vii), describes (*Handbook*, &c., p. 323) the genus under the name *Odonestis* as follows:

Palpi rather long. Forewings: 6 and 7 connate or stalked, 9 to apex. Hindwings: 6 from angle, 7 from beyond middle of cell, 8 connected with 7 near origin by oblique bar, two or three pseudoneuria present.

The egg is characteristically Eutrichid, and one cannot but be struck with the remarkable similarity in the arrangement of the markings of the eggs of *Cosmotriche* (*potatoria*) and *Eutricha* (*quercifolia*); the former certainly lacks the distinctness and definiteness of coloration presented by the latter, but the characteristic markings of the eggs of both species are identical. Bacot says: "The pattern of the Cosmotrichid (*potatoria*) egg, although superficially like that of *Eutricha* (*quercifolia*), is simpler, and more regular, the pale bands having consolidated until the egg might be described as greenish-white, with darker spots and streaks; it is also more strongly pitted than that of *E. quercifolia* the pittings being smaller, deeper, and not outlined in points as is the egg of the latter species."

The newly-hatched larva of *C. potatoria* is similar in some respects to that of *L.* var. *callunae*, but the colour and pattern are differently arranged. The characters, however, in which these resemblances are to be traced appear to be very generalised ones, *e.g.*, the black subdorsal patches of the larva of *L.* var. *callunae* are present, but in a modified form, and the meso- and metathorax are black on the dorsal and subdorsal areas, forming a striking background for the pale yellow diamond-shaped patch, and the subdorsal white spots (Bacot, July 11th, 1897). We have already noted that in the 2nd instar the larva of *C. potatoria* has lost all traces of dorsal tubercles, but has, on either side of the dorsal line, in addition to other markings, a row of round black spots of very similar appearance, and in about the same position as those of the larva of *Dimorpha versicolora* in the same stage (Bacot). Comparing the larva of *C. potatoria* with that of *Dendrolimus pini* (both in 2nd instar), one does not notice so strong a development of secondary hairs in the latter as in the former, and the colour does not spread from the bases in so marked a manner, so that there is not the same suggestion of shagreen tubercles as there is in *C. potatoria*. A close comparison of these two larvæ shows that the colour scheme is fundamentally the same, but it is strongly developed in *C. potatoria* and only faintly traceable in *D. pini*, the latter evidently developing towards an unicolorous form, although there are still one or two strongly-contrasted markings; in *C. potatoria* the dorsal area is practically bright yellow with a series of large oval central blotches, dull bluish in colour, one on each segment from the 1st-8th abdominal; these are joined to each other and form a chain, the junction being made by two black spots placed slightly apart and just showing the yellow between them. The black *D. versicolora* spots are situated in the position of the outer edge of these bluish patches; the pattern described nearly fills up the dorsal abdominal area, but there is a broad yellow subdorsal band, and below this the yellow and bluish occupy about equal proportions, the blue chiefly above, and the yellow beneath, but much broken up by being arranged in double oblique stripes. I suspect this bluish was the ancestral tint of the ground colour, and that it has been much encroached upon by the spreading of the yellow (Bacot). Cases of urtication resulting from handling the fullgrown larva of this species are comparativly rare, although South notes (*Ent.*, xviii., p. 5) that, in handling the larva, the tips of his fingers have been thickly felted, and that he has frequently felt a slight itching between his fingers, the hairs not affecting the thicker skin towards the finger-tips.

The pupa is of typical obtect form, noticeable (in *M. rubi*) by the brighter coloration of the movable incisions of the abdomen, as well as of the legs, antennæ, and mouth-parts. The prothorax and mesothorax are large, but the metathorax and 1st abdominal segments are very narrow; the skin is black, finely pitted, and except on the 8th and 9th abdominals, where there are some fine black points, is wanting in the covering of bristly hairs which is characteristic of the Eutrichids *(sens. strict.)*, and especially noticeable in *Gastropacha ilicifolia* and *Eutricha quercifolia*, and hence we find none of the collection of hairs, dust, &c., on the Cosmotrichid pupa, a feature most marked in *Eutricha (quercifolia)* and *Gastropacha (ilicifolia)*; the rounded cremastral area is, however, covered with short golden-brown bristles.

The cocoon reminds one something of that of *Malacosoma*, probably because of its yellow coloration, spindle shape, and thin parchment-like appearance, but is otherwise, in general shape and form, that of an Eutrichid, although almost entirely lacking the thick mass of felted hairs woven into the walls of such cocoons as those of *Gastropacha (ilicifolia)* and *Eutricha (quercifolia)*.

Cosmotriche potatoria, Linné.

Synonymy.—Species: *Potatoria*, Linn., "Sys. Nat.," xth ed., p. 498 (1758); xiith ed., p. 813 (1767); Poda, "Ins. Mus. Græc.," p. 84 (1761); Müll., "Fn. Frid.," p. 40 (1764); "Zool. Dan. Prod.," p. 117 (1776); Hufn, "Berl. Mag.," ii., p. 398 (1766); Fab., "Sys. Ent.," p. 564 (1775); "Spec. Ins.," ii., p. 176 (1781); "Mant. Ins.," ii., p. 112 (1787); "Ent. Syst.," iii., 1, p. 425 (1793); [Schiff.,] "Schmett. Wien," p. 56 (1775); Meyer, "Fuess. Mag.," i., p. 270 (1778); Esp., "Schmett. Eur.," iii., pl. xi., figs. 1-5 (1782); p. 75 (1783); Vill., "Linn. Ent.," ii., p. 123 (1789); Bkh., "Sys. Besch.," p. 97 (1790); "Rhein. Mag.," p. 364 (1793); Hb., "Larvæ Lep.," iii., Bomb. ii., Veræ R. b. (? 1800); "Eur. Schmett.," ii., fig. 183 (? 1800); text p. 146 (? 1805); "Verz.," p. 188 (? 1822); Ill., "Syst. Verz. Wien.," n. Ausg., 1, p. 108 (1801); Schrk., "Fauna Boica," ii., 2, p. 154 (1802); Latr., "Hist. Nat.," xiv., p. 178 (1805); "Gen. Crust. et Ins.," iv., p. 219 (1809); Ochs., "Die Schmett.," iii., p. 256 (1810); Germ., "Bomb. Spec.," p. 49 (1812); Leach, "Edinb. Ency.," ix., p. 132 (1815); Oken, "Lehrb. Zool.," p. 707 (1815); Samou., "Ent. Compend.," p. 247, pl. xii., fig. 3 (1819); Godt., "Lép. Eur.," iv., p. 92 (1822); Curt., "Brit. Ent.," i., expl. pl. vii (1824); Stephs., "Ill. Haust.," ii., p. 51 (1828); "List Br. An. B. Mus.," p. 48 (1850); Bdv., "Eur. Lep. Ind. Meth.," p. 48 (1829); "Icon. Chen.," pl. vi., fig. 2 (*circ.* 1840); "Gen. et Ind. Meth.," p. 71 (1840); Meig., "Eur. Schmett.," ii., pp. 191, 195, pl. lxxviii., fig. 1 (1830); Wood, "Ind. Ent.," p. 23, fig. 52 (1839); Dup., "Icon. des Chen.," ii., pl. v., fig. 1 (*circ.* 1840); "Cat. Méth.," p. 74 (1844); Humph. and Westd., "Brit. Moths," p. 56 (? 1843); Evers., "Faun. Volg.-Ural.," p. 153 (1844); H.-Sch., "Sys. Bearb.," ii., p. 104 (1846); "Ausser. Schmett.," p. 9 (1856); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 26 (1851); Led., "Ver. z.-b. Wien," ii., Abh., p. 75 (1853); Sta., "Man.," i., p. 157 (1857); Spey., "Geog. Verb.," i., p. 407 (1858); ii., p. 287 (1862); Hein., "Schmett. Deutsch.," p. 204

(1859); Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 69 (1871); 3rd ed., p. 122 (1901); Ramb., "Cat. Lép. And.," p. 348 (1866); Snell., "De Vlind.," p. 183 (1867); Nolck., "Lep. Fn. Estl.," i., p. 129 (1867); Berce, "Faun. Franç.," ii., p. 196 (1868); Newm., "Brit. Moths," p. 45 (1869); Wallgrn., "Skand. Het.," ii., pp. 105—106 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 411 (1874); Curò, "Bull. Soc. Ent. Ital.," viii., p. 151 (1876); Oberth., "Etudes," v., p. 38 (1880); Frey, "Lep. Schweiz," p. 97 (1880); Kirby, "Eur. Butts. and Moths," p. 129 (1880); "Cat.," p. 826 (1892); "Handbook," iv., p. 115 (1897); Lampa, "Ent. Tids.," vi., p. 42 (1885); Jordan, "Schmett. N.-W. Deutsch.," p. 96 (1886); Auriv., "Nord. Fjär.," p. 64 (1889); "Iris," vii., p. 163 (1894); Buckl., "Larvæ, &c.," iii., p. 60 (1889); Rühl, "Soc. Ent.," v., p. 128 (1891); Carad., "Iris," viii., p. 93 (1895); Meyr., "Handbk.," p. 323 (1895); Barr., "Brit. Lep.," iii., p. 37, pl. xciv (1896); Tutt, "Brit. Moths," p. 60 (1896); "Proc. Sth. Lond. Ent. Soc.," 1898, pp. 1 *et seq.* (1898); Dyar, "Can. Ent.," xxx., p. 6 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 71 (1898); Reutti, "Lep. Bad.," 2nd ed., p. 58 (1898). *Potatorius*, Schrk., "Faun. Boica," ii., Abth. 1, p. 273 (1801); Haw., "Lep. Brit.," pt. 1, p. 84 (1803).

Original description. — *Potatoria. P. Bombyx* elinguis, alis reversis flavis: striga fulva repanda punctis duobus albis. Goed., *Ins.*, i., t. 12; List., *Goed.*, f. 82; Rai, *Ins.*, 142, *a*.3; Alb., *Ins.*, t. 17; Merian, *Eur.*, 2, p. 27, t. 16; Roes., *Ins.*, 1, phal. 2, t. 2; Wilk., *Pap.*, 27, t. 3, b. 2. Habitat in Gramine Europæ australioris. Larva caudata, cristata, pilosa, lateribus albo maculatis (Linné, *Syst. Naturae*, xth ed., p. 498). To this Linné further adds: "Alæ striga anteriore ferruginea, obliqua; posteriore repanda. Puncta 2 alba approximata: altero minore" (*Sys. Nat.*, xiith ed., pp. 813—814).

Sexual dimorphism. — There is a very marked distinction between the sexes of this species; the males being smaller, usually more deeply coloured; the abdomen of the female is also particularly heavy when filled with eggs. The antennæ of the male are strongly pectinated, those of the female almost simple. Chapman describes them as: ♂. Antennæ 13mm. long, about 60 joints, carrying long plumules (about 2·7mm. long at middle of antenna); these droop down so that those of either side are nearly parallel, as in all the Lachneid section; the dorsum is scaled, the dorsa of the plumules are bare, their inner surface clothed with long hairs, placed so as to form about 80 transverse rows of 8 or 10 in a row, the outer ones meeting those of the next plumule; each plumule terminates in a bulbous extremity, carrying one large conical bristle and three or more smaller ones; these vary in different portions of the antenna; on one side of the antenna the bulbs are shorter and rounder, and carry shorter and thicker spikes than on the other. ♀. The antenna is shorter than that of the ♂, being only 10mm. in length, and consists of about 55 joints; it has a similar irregularly-scaled dorsum, and two plumules to each segment; the plumules are only about 0·5mm. long, faintly clubbed, and each carries one thick and one slender terminal spike of much the same size and aspect as in the ♂; the basal half carries, perhaps, a score of hairs, similar to those of the ♂, but rather more slender and weak; the terminal half has only very minute, straight, appressed bristles.

Gynandromorphism.—It would appear to be quite evident that many of the gynandromorphous specimens mentioned by Schultz (*Illus. Wochensch. für Ent.*, 1., p. 383; ii., p. 414) are mere colour aberrations, in which the normal brownish tint of the male is more or less developed in the ♀, or the ordinary yellow colour of the female is seen in the male, really a not uncommon local form of aberration. The only really gynandromorphous example described appears to be the following:

α. I have just had emerge from pupa a very curious specimen of *Odonestis potatoria*. The right antenna is that of a male, whilst every other portion of the insect is exactly the same as in an ordinary female (Wright, *Entom.*, xvi., p. 188).

The following examples recorded by Schultz appear to us to be not distinctly gynandromorphic. There are an endless number of similar ♀ specimens of dark (so-called male) coloration, and of ♂ specimens of light (so-called female) coloration, in various collections:

β.—♀ of ♂ colouring (Blandford, *Ent.*, xviii., p. 128).
γ-δ.—2 ♀s of ♂ colouring (Mathew, *Ent.*, xiv., p. 68; Wellman, *l.c.*, p. 227).
ε-ξ.—♀ with ♂, and ♂ with ♀ colouring (Bellier de la Chavignerie, *Bull. Soc. Ent. Fr.*, 1887, p. 183).
η.—♀ with ♂ colouring, Wicken (Christy and Meldola, *Proc. Essex Field Club*, iii., p. lxxxiii).
θ.—♂ with the pale clay-coloured ♀ tint. In coll. Bernard, Dantzic (Schultz, *Illus. Wochenschr. für Ent.*, ii., p. 414).
ι.—♂ with ♀ colouring, similar to θ. In coll. Gleissner, Berlin (*loc. cit.*).

VARIATION.—This species is exceedingly variable, and some of the forms are most interesting, as bearing on the question of sexually dimorphic coloration, for, although normally, as we have already stated, the sexes are distinctively coloured, yet, in some places, the males frequently occur with the pale yellow coloration, usually supposed to distinguish the female, whilst, in others, the females approach the darker brown coloration normally distinctive of the male. This tendency is generally only observable in an occasional aberration that will occur among a comparatively large number of specimens, but here and there it almost becomes racial, *e.g.*, dark females occur in unusually large proportion at Angmering, and pale yellow males in the fen districts of the eastern counties of England. On the other hand, Caradja positively states (*Iris*, viii., p. 113) that, in northern Europe, the males are often light yellow and the females dark brown, suggesting that this inversion of colour in the sexes takes place racially and side by side in certain districts, a result which we much doubt, and he heightens this suggestion by stating that the extreme forms might well be arranged as ab. *inversa*. Our own experience forbids this association, and points to an entirely different effective cause in producing unusually pale males in some localities, and unusually dark females in others. Still, pale ♂s and dark ♀s are sometimes reported from the same district. Thus, Johnson notes, "at Armagh, a ♂ in which the upper wings were coloured as in the ♀, and a ♀ with the coloration of the male." Crass observes, "several light males and dark females bred from Blyth," and Wilson, "a ♂ coloured like the ♀, and a ♀ coloured like the ♂, at Richmond, Yorks," but this association is not usual, and there are many localities which produce dark-coloured females without producing light males, *e.g.*, Dollman says: "At Angmering the males vary from light chocolate to purplish-brown (like *Eutricha quercifolia*); the females, from plain pale fawn to chocolate-brown and amber; from two years' breeding from larvæ, from Angmering, only three females have been bred which have no trace of male coloration." Gordon notes: "At Corsemalzie, the females bred vary a great deal, some are light, others very dark; the hindwings of two of them are nearly as dark as those of the ♂ s." Adkin says that, in Sutherlandshire, the coloration of the females is intermediate between the tints considered normal for the two sexes, whilst such intermediate females are noted as occasionally occurring at St. Leonard's (Hollis) and elsewhere. Lovett states (*Ent.*, xiv., p. 17) that he bred a ♀ from Croydon that nearly approached the colouring of the male, the wings being of a very dark shade, and the general markings resembling the usual decided character of those of the male insect. Mrs. Mathew (*l.c.*, p. 68) bred a ♀ from Brittany having all the colouring and markings of the male, and Wellman records (*l.c.*, p. 227) a specimen from Sheffield with the wings of male coloration, but with the antennæ and body of the ♀, although the body is not quite so large as that of an ordinary ♀. Christy exhibited (*Proc. Essex Field Club*, iii., p. lxxxiii) a female, bred from a Wicken larva, the colouring of which, in many respects, approached that of a male. Ullyett notes ♀ s from Folkestone, of the colour of the males, but less red; Barrett, females from Pembroke, in 1876, of a rich dark chocolate-brown, whilst those bred in 1877 were not so dark, but resembled the well-marked forms found in the Norfolk and Cambridge fens. Weir notes a ♀ from Lady Cross of the red colour of the ♂, with very little of the yellow usually characteristic of the sex; Fenn observes the occurrence of a ♀ with ♂ coloration at Deal in 1891; Gregson, from the Liverpool district, describes (*Entom.*, iv., p. 12) a large ♀ with the head and front of thorax dark black-brown, and the whole insect rich ochreous-brown; Whittle bred a long series from the Southend district in 1897, which showed much colour variation in the ♀ s, among others one with slightly flushed forewings, and another with male coloration; Johnson records a ♀, bred July 6th, 1894, at Brighton, as dark as the ♂ s; Robson a ♀ clouded and marked with reddish-brown, exactly like the males, at Hartlepool; Selys notes females with male coloration as occurring in Belgium; and Ochsenheimer (*Die Schmett.*, iii., p. 258) observes that the ♀ is pale yellow, but sometimes ochreous-brown, and at other times of the same colour as the male. This dark ♀ form is Berce's var. *A*, of which he says: "♀, colour of wings nearly the same tone as that of the male." On the other side, Bowyer states (*Ent.*, xiii., p. 310) that he has a ♂ with the light colour of the ♀, from Haileybury; Porritt notes (*Ent.*, xiv., p. 17) that males of the pale yellow colour of the ♀ are of rather frequent occurrence in Wicken Fen, and that the majority of ♀ s bred from larvæ found there are of a much paler and duller yellow than in the ordinary type of the species." Of interesting aberrations in Webb's collection we note: 1. ♂, yellow with all the ordinary purplish markings of fore- and hindwings pale slaty-grey. 2. ♂ s. Two other males almost unicolorous pale buff. 3. ♀, yellow with suffused dark grey outer areas to all four wings. 4. Pale and dark ochreous ♀ s uniformly suffused, the former looking quite dirty grey, the latter, brown. 5. ♀, with no transverse lines. 6. ♀ s, very small and almost exactly like males in shape. Quedenfeldt notes (*Berl. Ent. Zeits.*, xliv., p. 14) some thirty males bred from Finkenkrug, near Berlin, with a sprinkling of yellow colour, which look very similar to the Amurland specimens. Nolcken states that, in the

Baltic provinces, he has never observed any ♀ with the outer half of hindwings so dark as that figured by Hübner (*Eur. Schmett.*, fig. 183). Gregson further notes (*Ent.*, iv., p. 12) a ♀, of a light yellow colour within the oblique apical streak, but rich ochreous-brown (continued through the hindwings) outside; also three light whitish-buff ♀s from Whittlesea Mere. Glenny records, from the Wisbech district, males varying from ordinary dark to the normal colour of ♀s, also ♂s with decided greenish shading, and ♀s of a very light shade of buff with scarcely any markings. In our own collection, the specimens show a wide range of variation, the males appearing to give almost every intermediate stage between pure yellow and deep red-brown. On the whole, however, they break up into five fairly distinct groups:

(1) Yellow fore- and hindwings, with (or without) faint oblique line from costa to inner margin, and equally weak subterminal line; double discoidal spot, silvery; faint transverse shade across hindwings=*potatoria*, Linn.

(2) Orange-yellow, with reddish or buff shading at base of costa, forming a roughly triangular blotch, the oblique line and subterminal line of same shade; the hindwings buff with rather darker transverse line=ab. *proxima*, n. ab.

(3) The reddish-buff occupying the costal area and the outer area beyond subterminal line; the oblique and subterminal lines dark reddish; the hindwings uniform reddish-buff, with rather darker median line=ab. *intermedia*, n. ab.

(4) Forewings deep red-brown or chocolate-brown, except an oblong yellowish basal area having its base along the thorax, one side along the inner margin, and the side opposite the base formed by the lower portion of the oblique line near base of wing; a second small patch of yellow runs from the lower discoidal to oblique line, and extends slightly across latter towards subterminal; the hindwings uniformly red-brown=ab. *diminuta*, n. ab.

(5) The forewings almost uniform red-brown or chocolate-brown, with a purplish gloss (as in *Eutricha quercifolia)*, the oblique line still darker; the subterminal almost lost in ground colour, the lower discoidal distinct, with the base of the inner margin scarcely paler than the ground colour; the hindwings unicolorous, purplish red-brown=ab. *extrema*, n. ab.

All these forms occurred at Wicken during the first week of August, 1892, in the proportions of 4 (no. 1), 10 (no. 2), 27 (no. 3), 17 (no. 4), 2 (no. 5) out of 60 brought away. The finest extreme forms of no. 5 that we have seen came from the Frome district in 1886 (St. John), another almost as good is from Birmingham, whilst from Claty Dene in Fifeshire is a form with the purplish-red tint of no. 5 but with a pale base; nos. 4 and 5 appear to be the typical Folkestone forms, the Deal forms appear to be chiefly nos. 3 and 4, and the Strood forms nos. 2 and 3. A peculiar small race (starved) from Bournemouth inclines to nos. 2 and 3. Linné's original description distinctly shows either that he only knew the female or that he knew the male that approaches the female in coloration, so that it becomes necessary to maintain the yellow form, in both sexes, as the literary type. The following is the simplest tabulation of the forms known to us, that we can suggest, that will cover both sexes:

(1) *α*. Pale ochreous or whitish-ochreous, tinged with grey, with normal transverse lines. ♂ and ♀=ab. *berolinensis*, Heyne (local, Germany and England).

β. Pale greyish- or whitish-ochreous, unicolorous, *i.e.*, with obsolete transverse lines. ♂ and ♀=ab. *obsoleta-berolinensis*, n. ab.

(2) *α*. Yellow, with normal transverse lines. ♂ and ♀=*potatoria*, Linn.

β. Yellow, with obsolete transverse lines. ♂ and ♀=ab. *obsoleta-potatoria*, n. ab.

(3) *α*. Deep yellow or orange-yellow, with normal transverse lines. ♂ and ♀=ab. *lutescens*, n. ab.

β. Deep yellow or orange-yellow, with obsolete transverse lines. ♂ and ♀=ab. *obsoleta-lutescens*, n. ab.

(4) *a*. The yellow ground colour, suffused with reddish-buff or -brown at base of costa, the transverse lines of same shade; buff hindwings with darker transverse line. ♂ and ♀=ab. *proxima*, n. ab.

β. The yellow ground colour, suffused with reddish-buff or -brown in the costal and hind marginal areas, with normal transverse lines, and reddish-buff hindwings with darker transverse shade. ♂ and ♀=ab. *intermedia*, n. ab.

(5) *a*. Reddish-brown or reddish-chocolate, with yellow basal inner-marginal patch, a yellow discoidal streak, normal transverse markings; hindwings reddish-brown. ♂ and ♀=ab. *diminuta*, n. ab.

β. Deep red-brown, or chocolate-brown, with a purplish gloss, the inner-marginal basal area scarcely paler than rest of wing; transverse lines darker; hindwings purplish red-brown. ♂ and ♀=ab. *extrema*, n. ab. (the ♀=ab. *inversa*, Caradja).

γ. As in ab. *extrema*, but with transverse lines obsolete=ab. *obsoleta-extrema*, n. ab.

The forms that have hitherto been described appear to be limited to the following :

α. ab. *inversa*, Caradja, "Iris," vol. viii., p. 113 footnote (1895).—In northern Europe, in parts of northern Germany and Denmark, the species varies so that the males are often light yellow, the females dark brown. The most extreme specimens of this form, in which the ♂ has the ♀ colour, and *vice versâ*, might well be arranged as ab. *inversa* (Caradja).

Caradja's name, *inversa*, is based on two distinct colour forms of the species—a pale ♂ and a dark ♀—which have apparently no connection whatever, either in origin or appearance. His male *inversa* might cover the ♂ s of our forms *berolinensis*, *potatoria*, and *lutescens*, whilst his female *inversa* would possibly cover the ♀ s of our forms—*intermedia*, *diminuta*, and *extrema*. The question, therefore, arises, for which of these sections his name should be retained. Since he states that his name should be used for "the most extreme specimens in which the ♂ has the ♀ colour" (assumed to be pale), and "the most extreme specimens in which the ♀ has the ♂ colour" (assumed to be dark), it would appear that *inversa*, Caradja, must be retained either for ab. *berolinensis* ♂, or our ab. *extrema* ♀. The selection of the ♂ would make the name synonymous with *berolinensis*, Heyne, so that perhaps it had better be kept for the darker females, although its application is difficult.

β. ab. *berolinensis*, Heyne, "Soc. Ent.," xiv., p. 3 (1899).—As is well known, the ground colour, both in the ♂ and ♀ of *potatoria*, varies not inconsiderably. In the former it is dark brown, lighter brown, or brown mingled with lighter, more yellowish, shades. In *berolinensis* it is pale yellow. The parts which are darkest in the type, *i.e.*, the basal half of the costa of the forewings, the oblique stripe, and the marginal markings of the forewings, and the stripe-like shading of the hindwings, are more or less distinctly shaded with grey-yellow (grey). This grey-yellow (grey) tinge may be so strongly expressed, that the pale yellow ground colour is covered almost all over with it. This form is apparently the rarest. Usually the said tinge is weak, often only indicated. Full yellow dashes appear outwards from the pale, yellowish-white, central lunule, and at the base, to the inner margin. The hindwings and the underside agree in pattern with the type; only the ground colour, inclusive of the fringes, is pale yellow. The ground colour of the ♀ is pale yellow, the markings as dark as in the type, and therefore stand out much more prominently than in the type, the ground colour being much paler. The underside also is very much paler than in *potatoria*, often almost white-yellow. The body in all parts is yellow in the ♂, pale or white-yellow in the ♀; only in a few especially strongly grey-yellow (or grey) tinged ♂s, is the grey-yellow (grey) tint found also in the hairs of the palpi, collar, thorax, abdomen, and legs.

Heyne then adds: "In 1898 I received some ♂ s of the above-described aberration from Berlin collectors. I believe there were 2 or 3 ♂ s from Rüdersdorf or Bernau, and from Finkenkrug one has already long been known. As I have recently received again a number of the same form—10 yellow ♂ s, 2 grey-yellow ♀ s, and 3 pale yellow ♀ s—which were found in the larval state at Straussberg, I no longer hesitate to introduce this form as an interesting local variety under the name of *berolinensis*, for, although *potatoria* everywhere varies somewhat, yet I have never before come across such a definite yellow form as this, which, especially in the ♂, is widely enough removed from the type to deserve a special name. The finder and breeder of the above-mentioned little lot informs me, that he has obtained about 100 typical males to one yellow one, and that other collectors have had even smaller results. The larvæ were collected young, and were, in breeding, kept in the open, and one had not, therefore, to do with artificial production." These notes suggest that the occurrence of ab. *berolinensis* is practically identical in Germany and England, where yellow males (including *berolinensis*, *potatoria* and *lutescens*) are locally not rare, occurring, however, in very small proportions in special localities with the type form. On the other hand, as supplementing Heyne's note, Belling records (*Berl. Ent. Zeits.*, xlv., Sitz. p. 43) that a Berlin collector breeds ab. *berolinensis* from larvæ that came originally from Rehfelde, near Straussberg. The breeder (Herr Szczodrowski) considers the pallid coloration to be due to the hothouse treatment used for forcing, and not to any peculiarities of natural environment, a strange conclusion considering that the yellow ♂ aberrations are widely distributed under quite natural conditions, and where one suspects that excessive heat certainly can play no part. One may here note that the yellow ♂ s (forms not detailed) have been recorded in Britain from—Darenth (Newman), Armagh, July 2nd, 1887 (Johnson), Norfolk Broads (Abbott), Haileybury (Bowyer), Wicken, frequently (Tutt and others), Blyth (Crass), King's Lynn district (Atmore), Epping (Bayne), and Wisbech (Glenny). From Berlin (see *suprà*) many of a whitish ochre-yellow colour are recorded, some with delicate grey tint, the ♀ s lighter and of a more delicate yellow than usual (a remark that quite contradicts Caradja's statement that in Denmark and northern Germany the pale males are accompanied by dark ♀ s) (Schulz, *Berl. Ent. Zeits.*, xliv., p. 14).

γ. var. *askoldensis*, Oberth., "Etudes d'Entomologie," vol. v., p. 38 (1880); Graes., "Berl. Ent. Zeits.," xxxii., p. 126 (1888); Leech, "Proc. Zool. Soc. Lond.," 1888, p. 628 (1888); Staud., "Mém. Lép.," vi., p. 316 (1892); "Cat.," 3rd ed., p. 122 (1901); Auriv., "Iris," vii., p. 163 (1894).—Beaucoup plus grande, et les deux sexes d'un brun roux bien plus foncé que le type d'Europe*. [L' *Odonestis albomaculata*, Bremer, paraît être de même couleur que la variété *askoldensis*; mais si l'on juge par les figures de Bremer (*Lep. Ost-Sibiriens*, pl. iv., fig. 6, ♂; pl. iii., fig. 20, ♀) et par sa description (*loc. cit.*, pp. 42, 43), l' *Odonestis albomaculata* serait une espèce distincte de *potatoria*. Malheureusement les figures de l'ouvrage de

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* Barrett's note (*Lep. Brit.*, iii., p. 42) is quite incomprehensible. He writes: "The pale variety of the ♂ already described, has been received from Japan, and has been named *askoldensis*, whilst the dark, rich, chocolate-coloured form of the ♂, precisely as obtained in Pembrokeshire, but with a still more extreme variety of ♀—rich chocolate-red with the two white spots expanded into handsome silvery-white blotches—is named *albomaculata*." Certainly we should not translate Oberthür's "d'un brun roux bien plus foncé que le type d'Europe," as "the pale variety of the male," nor do we think that Mr. Barrett has taken *Cosmotriche albomaculata* in Pembrokeshire.

Bremer sont très grossières, et la plupart du temps ne donnent que bien à peu près l'idée du papillon qu'elles sont censées représenter.] (Oberthür). *Loc.*: Island of Askold (Oberthür); ? Olga Bay in Russian Tartary (Fletcher).

Leech says (*Proc. Zool. Soc. London*, 1888, p. 628) that he has specimens of *askoldensis* from Japan that "agree exactly with typical *potatoria**, and others which are most certainly identical with *O. albomaculata*, whilst between these two forms are aberrations, including a dark one near the var. *askoldensis* of Oberthür, which cannot be satisfactorily referred to either form, and which serve as connecting links and prove the identity of *O. potatoria* and *O. albomaculata*. Loc.: Yokohama (Pryer), Hakone, Gensan (Leech), Corea (Herz)." Bacot says: "The British Museum collection has a good series of both sexes of *albomaculata*, which appears to be a good species. The ♀s differ widely from those of *potatoria*, the ♂s being less markedly different. On the other hand the single example of *askoldensis* in tbe British Museum collection differs chiefly in size and has probably no better right to be considered a separate species, than have most of the Japanese species that only differ from their European relatives in size and tint, *e.g.*, than *cerridifolia* has to be considered specifically distinct from *quercifolia*." After most careful examination of Leech's specimens, we disagree entirely with his conclusions and agree with those of Bacot. As a matter of fact, *C. albomaculata* is very distinctly specialised, the males of a dark red-brown colour, intensely deeply pigmented, with large median spots (which show, however, considerable variation in size), and large, highly-coloured, chiefly red-brown, females, with large white median spots and a very white external marginal edging to the outer line.

Egg-laying.—The egg-laying is somewhat variable—the eggs when extruded are covered with a gummy substance, by means of which they adhere to stems of grass, etc., and to each other (Bacot); I have several times observed females oviposit on the leaves of sallow and on the dead leaves of *Rubus fruticosus* in clusters of four or five (rarely more) at Ringwood (Fowler); eggs attached to stems of grass (Montgomery); found on a blade of grass, August 18th, 1888, at Kingsmill, from which young larvæ hatched on the 21st (Watkins); ova deposited round and round a *Juncus* stem at Arrochar, undoubtedly a protection to represent a diseased or swollen *Juncus* stem (Dalglish); eggs on the underside of leaves of dwarf sallow and hazel, laid singly or in small clusters, and once in a compact little ring round a twig; the ♀ seems almost always to deposit her eggs on anything rather than the natural foodplant, although a small batch was once found on a stem of grass†; possibly her weight prevents her getting a firm hold of the latter, and so she chooses something more substantial, as there is always longish grass to be found close to the bush selected (Edwards); three eggs placed close together on a stem of dead-nettle at Henny, Essex, July 22nd, 1900; these hatched August

* Examination of Leech's specimens shows that he had mixed up at least one specimen of *potatoria* from Japan, with *albomaculata*, under the name of *askoldensis*; he then appears to have concluded from the mixed material that *albomaculata*=*askoldensis*=*potatoria*, a conclusion to which we are not at all able to subscribe.

† This note would suggest "grass" as being "the" natural foodplant. For list of food-plants see *posteà*, p. 175.

2nd, 1900. On August 3rd, 1901, a cluster of ova was found on the underside of a leaf of *Clematis vitalba;* on August 6th another batch on a dead leaf of a wild hop plant, and on August 7th on the upperside of a sallow leaf, all in the Sudbury district, whilst a batch of ova deposited on July 16th, 1901, hatched on July 31st (Ransom). Phillips observed a ♀ ovipositing about 9.30 p.m., on July 22nd, 1901, at Homerton Broad; she had already deposited a few eggs on a rush stem, and then laid a total of 188 in a box on the way home. Griffiths found eggs in September, 1888, laid on a wooden fence, at Portishead, near the ground; Hewett notes eggs laid July 16th, 1891, at York, Corbett on July 29th, 1900, at Doncaster; Image says that he has a record of eggs hatching at Brighton on August 28th, 1862, and Holdaway on August 2nd, 1898, at Basingstoke.

OVUM.—The egg is oval in shape, the length: breadth: height:: 5 : 4 : 3, flattened at top and bottom, the two ends rounded, the micropyle visible, as a minute dot at one end, to the naked eye. The colour greenish- or pinkish-white with a depression on both the upper and lower surfaces. These depressions of a dark greyish hue, each surrounded at some distance by a pink or purple zone of the same shape as the outline of the egg. The egg is of a beautiful white colour, with a faint pinkish tinge, and exhibiting distinct opalescent characters. It is covered with a very well-marked but exceedingly close polygonal reticulation, above which is a much coarser reticulation. The micropylar area is of a deep orange colour, and forms a circular patch at one end. The cells forming the micropylar area are of exactly the same character as those covering the rest of the surface, and the micropyle proper bears a close resemblance to a sea-urchin with the tentacles retracted. This latter, however, would be practically indistinguishable were it not for the fact that the coloured ring in the centre of which it is placed makes an excellent guide as to its position. The empty eggshell is of a beautiful milk-white tint, with no darker rings or shading [Eggs received from Bacot, July 8th, 1896, and description made under a two-thirds lens on the same date].

VARIATION OF EGGS.—Buckler says that there is variation in the outline of the eggs, some being rounder than others. Bacot notes slight differences between northern eggs (from York) and southern eggs (from Mucking and Reading), the York ones having a larger pale area, smaller spots, and narrower streaks of dark colour than those from Reading and Mucking, whilst the eggs from the last-named place are rather larger than those from York and Reading. The eggs of another batch from Tenby were so different in appearance from those obtained from other localities that it was difficult, until the larvæ hatched, to believe that they really were eggs of *C. potatoria.* Two of these sets of eggs are thus described:

1.—OVA (from Mucking): Length 1·9mm.—2mm.; width 1·6mm.; thickness 1·2mm.-1·3mm.; surface shiny, varnished in appearance; rather strongly pitted compared with the egg of *Eutricha quercifolia (posteà);* the surface cell-reticulation small, and sharp around the micropyle, more definitely a network on the remainder of the surface; colour pale grey-green with a broad zone of porcelain-white slightly tinged with green on upper and lower halves; a broad band of the same colour round the edges and over the ends, terminating as a dark spot at the micropyle (Bacot, July 29th, 1900).

2.—Ova (from Tenby): Colour of a delicate pale grey-green, with translucent dark spot at micropyle, and another on upper and lower sides, which are often depressed centrally; length 1·8mm.—1·9mm., width 1·6mm. There is no trace whatever of the usual longitudinal bands in the greater number of eggs in this batch, one or two eggs only showing indistinct traces thereof. The eggs are considerably less in bulk than are those forming a batch sent by Edelsten, and obtained about the same time in the Norfolk Broads; many of these latter measured 2·3mm. in length, and 1·8mm. in width (Bacot, August 12th, 1900).

Buckler describes the egg as:

Rather large, roundish-ovate, some being of a rounder shape than others, having a small, rather shallow, circular depression above, and a deeper one beneath, the surface smooth, the colour opaque shining white, like porcelain; the depressions above and below are light greyish-green, and also the zones, which, at some distance, surround each depression, and a smallish depressed round spot of the same colour midway between the two zones (*Larvae*,&c., iii., p. 60).

Habits of larva.—The larvæ leave the egg in August, and immediately eat about half the eggshell (Ransom), they are very active and strong when hatched, and do not appear to suffer at all by wandering about in search of food for a day or two (Edwards); they hybernate small (4th instar) commencing in October or early November, feed up rapidly the following April to June when they usually pupate. As an exception to this general rule Syme notes ("*Scot. Nat.*," ii., p. 176) that the larvæ hybernate fullfed in Bute, like those of *M. rubi*, but Dalglish says that in the Clyde district they hybernate when about halfgrown, as in the south. Chitty notes finding a fullgrown larva on August 13th, 1891, at Deal, which spun up directly after capture, the imago emerging the second week in September, evidently a simple case of delay for a month in the larval stage. Decie notes a larva taken May 21st, 1894, at Bockleton when it appeared to be halfgrown, but instead of spinning-up at the usual time, it fed up, scarcely increasing at all in size throughout the summer and autumn and winter and was quite healthy in January, 1885, whilst Colthrup records a larva from Chichester that hybernated small in the winter of 1898-9, fed on slowly through the summer and autumn of 1899, hybernated again through the winter of 1899—1900, but died at the end of April, 1900, owing to food not being supplied when it became active after hybernation. Crass says that the larvæ are sluggish but fond of sun, he noticed also that they rubbed their heads in the drops of water with which their food had been sprinkled; and Bostock says that they were especially abundant on a warm rainy day in Derbyshire; Bensel and Belling note (*Berl. Ent. Zeits.*, xliv., p. 14) that larvæ are easily reared if the larvæ and their food are copiously sprinkled with water which they love to drink, a habit quite usual with them in nature. Curtis writes: "The name of 'drinker' caterpillar was given to this insect more than a century back by Goedart, from his imagining that it is subject to thirst and that when it drinks it takes breath, lifting the head up to swallow the water more easily." This note appears to be sceptical in tone, but Hoffmann and Keller write: "Although the name indicates it, yet it is little known that the larva drinks water with great greediness." Hall notes (*Brit. Nat.*, i., p. 76) that he finds most larvæ on warm damp evenings, at Sheffield, when the herbage is saturated with moisture the larvæ revelling in it, and eagerly drinking the drops of water on the grass. He further suggests that success in rearing the species largely depends on their having sufficient water sprinkled over their food. Pickett says that the almost full-grown larvæ are exceedingly common at St. Margaret's Bay and Martin Mill, where they frequently rest on bramble-stalks; Nicholson observes that the larvæ were in profusion on June 4th, 1899, between Blyth and Hartley, that few were noticed in the daytime, although hot and bright, but that about 8.30 p.m. they began to ascend the stems of grass in large numbers. Phillips observes that the larvæ are to be found most abundantly in early morning, usually actively feeding about 7.30 a.m. Other notes read: Young larvæ rarely found in autumn in the Kingsmill district, although common in spring (Watkins); swarm from beginning of April until first week in June at Salisbury (Ridley); larvæ, June 9th, 1867, at Eltham (A. H. Jones); on heather May 27th, cocoons, June 30th, at Altadiawan (Kane); April 4th—May 27th, 1871, at Wanstead, April 27th—May 11th, 1887, at Brentwood, June 18th, 1900, at Wicken, cocoons on June 9th, 1890, at Lockerley, June 24th, 1892, at Rainham (Burrows); May 6th, 1871, at Lee, May 20th, 1872, at Darenth, May 25th, 1873, at Lee, May 21st, 1877, at Darenth, May 3rd, 1890, on Dartford Heath, May 13th, 1894, May 17th, 1896, at Mottingham, May 28th, 1896, at Stone (Bower); March 19th, 1881, at Eastham Wood, Cheshire (Brown); May 14th, 1882, at Birmingham (Bath); May 13th, 1888, at Highgate, June 2nd, 1899, at Arundel (Williams); May 15th, 1890, at Whitwell, May 6th, 1896, at Wallasey, larvæ very large for time of year at Heswall, September 10th, 1896 (Freeman); June 11th, 1890, at Bristol, May 24th, 1892, at Dursley, June 16th, 1892, spun up June 25th, at Brockley, June 3rd, 1895, and May 26th, 1896, at Dursley (Bartlett); June 14th—16th, 1890, at Tancarville (Leech); May 27th, 1891, May 18th, 1897, near Emsworth (Christy); larvæ, June 18th—26th, 1892, in great abundance at dusk at Folkestone (James); September 12th, 1892, September 20th, 1895, at Newnham (Lifton); April 11th, 1893, at Kingsdown, April 18th, 1893, at Southend, April 3rd, 1894, at Sandown, May 11th, 1894, at Pett (Prout); May 19th, 1893, at Colwell Bay, May 21st, 1895, at Perivale (Sich); March 3rd—April 1st, 1894, larvæ abundant at Connemara (Allen); plentiful at Skipwith, March 24th, 1896 (Ash); fullfed at Wisbech on reeds, May 28th, 1896 (Glenny); April and May, 1896, round Aberfoyle (Evans); May 29th, 1896, fullfed at Lymington, June 5th, 1897, fullfed at Yarmouth (Kaye); larvæ fed up until November 13th, 1896, before hybernating, at Llanstephan (Newland); April 17th, 1897, at Formby (Cotton); May 28th, 1897, at Brighton, May 21st — 29th, 1901, at Marhamchurch (Image); fullfed larvæ at Alnmouth, June 8th, 1897, hybernating larvæ between Blyth and Hartley, September 3rd, 1898, fullfed ones in profusion in same locality, June 4th, 1899 (Nicholson); at Painswick, larvæ 46mm. long by March 13th, 1899 (Watkins); larvæ nearly fullfed, May 13th—17th, 1899, on the slopes of Essex Castle, Alderney (Marquand); June 3rd, 1900, at Chattenden (Ovenden); June 4th, 1900, at Askham Bog (Lofthouse); June 28th, 1901, at Askham Bog (Walker).

LARVA.—*First instar* (just hatched): The body cylindrical, tapering from prothorax to anus; legs and prolegs very long. Head, shiny, black, rounded in outline, thinly sprinkled with pale golden and white hairs; 5 of the ocelli in the form of a crescent, the

6th separate, all shiny black, and therefore inconspicuous. The prothorax is wider than mesothorax (each successive segment becoming smaller) and bears, dorsally, two, very large, dark grey tubercles (i + ii), which carry many minute shiny black points, each of which gives off a red-brown hair; a still larger lateral tubercle on either side, bearing radiating hairs, some of which extend over face; each of these also carries two large pale hairs; mesothorax and metathorax with four similar tubercles, i and ii on either side; these are purplish-black in colour, and smaller than those of prothorax; the dorsum of the thoracic segments marked with yellow, which forms a large conspicuous blotch on metathorax; there is also a small pale yellowish subdorsal spot on meso- and metathorax. Abdominal segments gradually taper towards anus; all tubercles large and bear numerous hairs, i much larger than ii; abdominal segments 1—7 have i and ii purplish-black in colour, almost united transversely, each bearing a number of bright-brown hairs; tubercle i is large, raised, hemispherical, bearing many shiny black points, from each of which arises one long red-brown hair; ii similar to i, but smaller and placed on the orange space, and almost directly behind i in position; the purplish-black skin forms a sort of mediodorsal line; on either side of i is a small yellow patch, and these yellow patches are separated longitudinally by bright orange patches (in which ii is situated), so that these look like orange subdorsal lines; a black oblique streak on each segment, bordered on either side with yellow, meets each of these yellow patches, and runs laterally across each segment*; tubercles i are much swollen on the 8th and 9th abdominals, on these segments forming a hump, whilst on the anal segment they are flatter and occupy almost all the upper area; on the 8th, ii bears only 1 hair; the 8th abdominal segment has, and the 9th has not, the bright orange dorsal spot in which ii is placed. Laterally the spiracles are practically hidden beneath the long hairs from the supraspiracular (iii) tubercles; there is a slightly tumid subspiracular longitudinal flange, situated just above the legs and extending from the head to the 9th abdominal, yellowish in colour, more distinct on thoracic than abdominal segments; the lateral tubercles iii, iv, and v are similar in appearance to the dorsal, purplish-grey with black points, but iv and v give out white hairs; these white hairs curve ventrally, and almost meet the surface on which the larva rests; the hairs are mostly minutely spined. The true legs are black, with a black terminal hook, thickly ringed with pale hairs at joints; the prolegs pale amber in colour, with dark points bearing long pale hairs, the terminal joint (foot) bearing red-brown hooks, almost transparent, an oblique whitish ring separating this joint from the amber-coloured pedicel (Tutt. Described July 16th, 1896). *First instar* (about to moult). The larva tapers considerably from thorax to anus, both laterally and dorsally; the effect of the dorsal tapering is heightened by the body being more raised in

* Bacot notes: "Either side bears 7 oblique double stripes, *i.e.*, black medially, with a yellow margin on each side. These slope from head to anus (as in the larva of *Dimorpha*, and opposed to those of the larva of *Smerinthus*, in which they slope from anus to head); the larval subsegments, too, are very distinctly marked like those of Sphingid larvæ" (*i.l.*, July 14th, 1896).

front, and lying closer to resting-surface at anus. The segmental incisions are not well marked, but the five subsegments of each abdominal segment are very clearly defined whilst those of the thoracic segments are less clearly marked, although there seems to be the same number. The tubercles form raised warts (bearing many hairs) dark-coloured and chitinous; on the thoracic segments they are especially large and strongly developed, notably iii and vii on the prothorax, i and vii on the meso- and metathorax, and i on the 8th abdominal. The dorsal tubercles (i and ii) are set at the corners of an oblong, i on the 2nd subsegment, ii on the 4th subsegment, on the meso- and metathorax as well as on the abdominal segments; i is from two to three times as large as ii, iii about equal to ii is on the third subsegment. The spiracles are small, and each appears to be directly below iii, but at some little distance; really it is placed near the junction of the second and third subsegments, which are not noticeably divided hereabouts. Tubercles iv and v form a somewhat elongated wart about the same size as iii, situated on the third subsegment, slightly beneath, but further back than, the spiracle; a small, single-haired, (primitive) tubercle (? vi) is present below and anterior to spiracle; vii is marginal, and consists, on the abdominal segments, of two large warts side by side; on the thoracic and 8th abdominal segments there is only one very large wart present; much elongated on the latter, and doubtless formed of the two present on the other segments, united; on the thoracic segments it is large and circular, and probably consists of only one of those present on the other segments. A large prespiracular wart (slightly larger than iii), at the same level as the spiracle, is present, whilst beneath this prespiracular in vertical line, are three primitive, simple, single-haired tubercles as in the larva of *Eutricha quercifolia*, etc.; ii on the 8th abdominal is a large, single-haired, primitive tubercle, not a wart. On one larva there is a single-haired tubercle on the 2nd subsegment of the abdominal segments just below iii (Bacot. August 23rd, 1900). *Second instar.* The dorsal tubercles have flattened and spread, secondary hairs are abundant on the dorsal area, their bases are surrounded by black, and remind one of the shagreen tubercles of *Dimorpha versicolora*, and the spreading of the black colour from the bases of the hairs, in the position of the dorsal tubercles, form black spots that remind one of the dorsal spots of the larva of this species; the subdorsal line is strengthened on abdominal segments 1—7 by a bright yellow triangular blotch, the apex of which points downwards and joins one series of the oblique stripes; the subspiracular tubercles are large, and the hairs grow downward in the manner of those of the larva of *Eutricha quercifolia;* the thoracic segments are rather larger than the abdominal; the meso- and metathorax have a velvety black dorsal area, in the centre of which (partly on meso- and partly on metathorax) is a cream-coloured, roughly diamond-shaped mark, and, as in previous stage, there is a small, diamond-shaped white- (previously cream-) coloured spot on the subdorsal area of the meso- and metathorax (compare with larvæ of *Dendrolimus pini* and *Lasiocampa quercûs);* on the mesothorax is a mediodorsal tuft, placed at apex of diamond-shaped cream-coloured mark; a slight tuft is present on the 8th abdominal arising from the anterior trapezoidals, which are now very close together and situated on a slight hump, the tubercles themselves only slightly traceable (Bacot. July 29th, 1896). (*Third instar:* not described.) *Fourth instar* (hybernating stage): About 25mm. in length, much darker and more richly coloured than previously; the white lateral tufts present in 3rd instar on thoracic and 1st abdominal segments are now continued on all abdominal segments as far as the 8th; hairs thicker, and more abundant; the larva tapers somewhat from 5th abdominal to anus viewed dorsally, viewed laterally the tapering is more pronounced, the meso- and metathorax being the tallest segments; head large, very hairy, slightly trapezoidal, very slightly if at all notched on crown, mottled (as in 3rd instar), much darker; the subdorsal ("ear") tubercles on prothorax still pronounced; the dorsal tuft on mesothorax stronger, and, in addition, there is a row of small tufts down either side of back, three pairs to each abdominal segment; the first pair much stronger than the following pairs; on the 8th abdominal, which is raised and rather stronger than the 7th, there is a strong, black, central dorsal tuft; the mediodorsal line or band consists of scattered yellow dots and specks; the subdorsal band, formed in a similar manner, is much stronger; the prothoracic scutellum is not particularly conspicuous; the dorsal tuft on mesothorax is black in front and brown behind; the bright yellow subdorsal spots on meso- and metathorax are still strongly marked; on the 8th abdominal segment, behind the central tuft, there are two smaller ones situate on either side of the mediodorsal area; the oblique stripes are now indistinct in consequence of their breaking up into yellow dots; the diamond-shaped patch on dorsal area of meso- and metathorax has lost its definiteness of outline, also on account of its breaking up into scattered dots; the hairs jutting out from prothorax are from 8mm. to 12mm. in length and arise principally from the "ear" tubercles; ventral area dark grey-brown with a whitish line on either side; prolegs long, with ⊥-shaped foot, an oblique whitish line down each proleg (Bacot. August 30th, 1896). ? *Sixth instar* (possibly had moulted once since hybernation): The 8th abdominal distinctly humped, the tuft of hairs arising from the hump; the dorsal thoracic tuft arises chiefly from the posterior of the mesothorax, but partly from anterior of metathorax; there is also posteriorly on either side of the dorsum of the 3rd—7th abdominal segments, a small black tuft; the "ear-tubercles" still very large (Bacot. April, 1897). The ovaries in the ♀ larva are yellow, the testes in the ♂ larva also yellow (Bessels). Fenn describes the fullgrown larva as: "Head large, rounded, dull greyish-brown streaked with ochreous; mouth black. Body hairy, cylindrical; small, black, short, dorsal tufts on each segment, surrounded by long reddish-brown hairs; mesothorax and 8th abdominal segment each with a larger and longer tuft, that on the 8th abdominal blackish and pointing backwards; sides with long reddish-brown hairs and tufts of short whitish hairs below the spiracles; ground colour dull blue-black; a broad subdorsal band composed of numerous yellow spots, and with yellow markings above the lateral white tufts;

a dorsal band of minute yellow dots almost concealed by the long reddish hairs. Venter blackish, with two bands, composed of black dots, and with tufts of whitish hairs at the incisions." Buckler gives (*Larvae*, &c., iii., pl. l., figs. 3, 3*a*, 3*b*) first class figures of the young larva (fig. 3) before hybernation, and two others (figs. 3*a*, 3*b*), one of a duller, the other of a brighter, tinted form, of the adult larva.

PUPATION.—The cocoon is usually spun from 6 ins.—12 ins. above the ground, on a grass or reed culm, or some similar object. The larva first spins a whitish silken covering to the culm, surrounding it, and then attaches the loose baggy cocoon to this so that the primary silk coating of the culm extends above and below the bottom of the cocoon. It often happens that, if the culm contracts, the little silken tube surrounding it slips up and down carrying the cocoon with it. At Deal the cocoons are principally fastened to the stiff tough stalks of *Sparganium*, on Wicken Fen to reeds, and at Higham to tall *Triticum* stems, but are here also occasionally found on the low stems of the bushes forming the hedges. Butterfield says that the cocoons are found on reeds in drains, and also in heathy places at Wilsden; Tetley notes the cocoons on stems of common rush at Dinas Mawddwy; Lambillion says that the larva makes its cocoon on stones, trees and grasses in the Namur district; Atmore that the cocoons and larvæ are found by ditch-sides at King's Lynn, the former attached to *Arundo phragmites* as well as grasses; Dalglish notes that the larvæ spin up on *Juncus* in Argyllshire, and Crass that, between Blyth and Old Hartley, although a few cocoons are placed conspicuously, most are made in the thickest tussocks and situated low down. Usually on stems of reed on the banks of streams near Emsworth, once on the stem of a small bush in Wicken Fen, once also on a fence in Hants (Christy); the larvæ always spin up on reed culms growing among grass at Clacton (James); on stems of dead grass, &c., at Skipwith (Ash); cocoons on grass stems always near the ground at Guildford (Grover); a cocoon in Wicken Fen spun on the flat upper surface of a flag leaf (Rothschild); at Folkestone on grass stems near the roots which they strongly resemble in colour (Pickett).

COCOON.—Composed of pale yellowish silk; $1\frac{1}{2}$ inches long, $\frac{3}{8}$ inches wide at broadest part; almost pointed at lower end, rounded at upper, and loosely spun. The imago forces its way out by making a quite rounded aperture at the upper end. There are sundry brown patches on the outside of the cocoon, and these appear to be bunches of the dark larval hairs. The cocoon has somewhat the texture of thin paper, and is smoother inside (Tutt). Cocoons vary from 1·5 ins.—2 ins. in length, from slightly over ·38 ins. —·56 ins. in depth (dorso-ventral diameter), and ·37 ins.—·44 ins. in width (lateral diameter). The greatest diameter of the cocoon is usually at about one-third from the apex (or head end), whilst it tapers much more gradually to the opposite end; there is some variation in shape dependent upon position, and the cocoons spun by ♀ larvæ exhibit the tapering of the long anal portion less markedly than do those spun by ♂ larvæ, and are generally stouter in comparison with their length. The silk, papery in texture, varies from a rather bright yellow to a dull whitish-yellow tint. The larval hairs are very numerous, lightly attached to the surface, the very fine ones especially thick at the ends and along the groove that runs parallel and near to the line of attachment to the grass culm or other object on which the cocoon is spun, this groove being, in some cocoons, very sharply and clearly marked. The interior of the cocoon is paler than the exterior, and is also less papery in texture, there being a thin internal coating of fine shiny silk (Bacot). The emerging imago stains the exit with a thick brownish fluid, but the great mass of this material is discharged into the pupa-case. Dalglish notes: "Cocoon sott, closely woven, similar to a piece of thin tough parchment, greenish-white in nature when fresh, very thin at bottom."

Pupa.—The pupa is of a black-brown colour, the segmental incisions between 4-5, 5-6, 6-7 abdominal segments, the legs, antennæ, and mouthparts being of a bright red-brown. *Dorsally*: prothorax black, large; prothoracic spiracle deeply set in the incision between the prothorax and mesothorax and almost in contact with the antennæ, and having a raised black rim; the mesothorax, black, large, and swollen dorsally; the metathorax small, much reduced medially, broader at the sides where it gives off hindwings; the first abdominal segment narrow with a median depression; the second, third and fourth gradually increasing in size, fixed, although the intersegmental membranes are recognisable; movable incisions exist between 4-5, 5-6, 6-7; the skin of the segments is black and finely pitted, that of the intersegmental membranes reddish-brown and with the appearance of silk; the 8th and 9th abdominal segments with fine, black, bristly points, the cremastral area covered with fine short golden-brown bristles; the cremaster rounded. *Laterally*: the pupa is swollen at the metathorax and on the wings in the neighbourhood of the 3rd and 4th abdominals; the wings black with raised nervures; spiracles on the 2nd—8th abdominals, each consisting of an elliptical opening with a raised black rim, situated in a shallow depression. *Ventrally*: Mouth-parts situated ventrally, black; lunular glazed-eye red-brown, extending from near the base of antenna to the first pair of legs; the labial palpi and maxillæ placed between the first pair of legs; the second pair of legs ending between the tips of antennæ; the antennæ (♂) distinctly segmented but without showing the distinct pectinations of the imago; the claws of the third pair of legs extend just below the apices of the wings; the anal area rounded; the sexual organs set very far back on the 9th abdominal segment (Tutt. July 19th, 1896). ♂ pupa ·875in. in length, ·3in. in diameter; ♀ pupa 1in. in length, ·375in. in diameter*. Pupa-skin thin and delicate, very dark brown in colour, almost black on thorax, paler on the venter of abdominal segments; the anus is very blunt and evenly rounded off; the ♀ pupæ are more obese, and taper less towards the ends than do the ♂ pupæ; surface smooth, shiny in places; the only hairs to be detected are very minute, bright brown in colour, situated on the anal segment or

* These measurements are made from empty pupa-cases; a pupa, in which an unemerged ♂ had died, measures, at full stretch, 1·1in. in length, ·3in. in diameter (Bacot).

dorsum of the hinder abdominals; the anal and genital organs clearly, but not deeply, marked. The spiracles are large and well-marked, that on the 2nd abdominal just showing clear of hind-wings; a moderate-sized slip of the hindwings is exposed, and can be traced to the end of the 3rd abdominal; the forewings extend to nearly the end of the 4th abdominal, the tips of the 3rd pair of legs concealed beneath them. The antenna-cases are very different from those of pupa of *Eutricha quercifolia*, being at least twice as long, extending as far as tip of 2nd pair of legs (about end of 3rd abdominal), whilst in *E. quercifolia* they only reach to about the end of the metathorax; they are not sharply elbowed, as is often the case in this family; they taper gradually, and the transverse pectination markings are clear. The metathorax is short (a mere slip), the mesothorax large, the prothorax only about one-half the length of the mesothorax. The dorsal headpiece is of nearly equal length, but much less in width; the raised ridge on the dorsal headpiece has a backward extension, which is continued more or less prominently, as a mediodorsal ridge down the pro- and mesothorax. The mouth- and faceparts are very clear; the labrum is central, whilst beneath the labium medially are the labial palpi, and externally to these the maxillæ; on either side of the labium is a small rounded boss, the mandible, and beneath the labial palpi, which are very thin and transparent, are two small triangular prolongations, probably the 1st femora. The glazed eye is very distinct, whilst between it and the labrum and labium is a rather large, bean-shaped piece. There is a great amount of difference between the ♂ and ♀ pupal antennæ, not only in width, but also in length, those of the ♂ extending beyond the 2nd pair of legs, and forming the lowest point of angle between the wing-cases, whilst in the ♀ they do not extend so far as the 2nd pair of legs, these latter forming the point of the angle between the wings. In the pupæ of both sexes of *Eutricha quercifolia* the tips of the antenna-cases only reach as low as the apex of the angle made by the meeting of the 1st pair of legs, about the level of the junction of the 1st and 2nd abdominal segments (Bacot). Poulton describes and figures (*External Morph. Lep. Pupa*, p. 208, pl. xxi., figs. 11—13) the terminal abdominal segments of the pupa of *Cosmotriche potatoria*. He notes as follows:

(1). Fig. 11 × $5\frac{1}{4}$. ♀. The *last three segments of a ♀ pupa* seen from a ventral and posterior aspect are figured. The anterior generative organ is very distinct and surrounded by lips; it is placed on the posterior part of the 8th abdominal. The posterior opening is probably represented by the median line immediately behind the anterior opening, but there is another mark placed more posteriorly which may indicate its presence. The posterior end of the pupa is seen to be rounded.

(2). Fig. 12 × $7\frac{1}{2}$. ♂. The *last three segments of a ♂ pupa* seen from a ventral and posterior aspect, but more posteriorly than in the last figure. Hence the division of the 10th abdominal into a ventral or anal (x) and dorsal (x') part is clearly indicated. The latter is entirely without a terminal spine, but is covered dorsally by minute hooks. The anus is nearly terminal.

(3). Fig. 13 × 50. ♂. The *median ventral area of the 9th and anterior part of the 10th abdominal segments of the same (♂) pupa*, showing the male organ and its relation to the segments. The surface-sculpture is indicated. The male organ is seen to be somewhat a symmetrical, it is surrounded by a thickened margin rather than by the two lateral lips, which are distinct in most male pupæ (compare fig. 2). The relation to the limits of the 9th and 10th abdominal segments is carefully figured.

DEHISCENCE.—Pupal dehiscence takes place by means of a slit along the thoracic mediodorsal line extending as far back as the end of the mesothorax, as far forward as the raised point on the dorsal headpiece, and laterally along the ridges originating at this point as far as the glazed eye, passing along the antenna to some little distance beyond the junction of the pro- and meso-thorax, and extending also between the pro- and mesothorax. This leaves the prothorax apparently unattached, but it does not fall out, being apparently held in position by some of the interior membranes (Bacot).

FOODPLANTS.—Almost omnivorous but especially affects grasses and rushes (Chapman), striped riband grass (Butler), *Dactylis glomerata* (Daltry), seeds of *Juncus* and grasses (Dalglish), heather (Kane), grass, bilberry (G. O. Day), bramble (Lane), *Triticum repens* (Brown), *Arundo phragmites* (Kerry), *Digraphis arundinacea* (Christy), *Luzula* (Rössler), *Bromus*, *Alopecurus agrestis* (Trimoulet), whortle-berry (Fuchs *teste* Rössler), *Holcus lanatus*, *Carex* (Lambillion), *Trifolium* and grasses (Rühl), *Leontodon taraxacum*, &c. (Heylaerts), *Bromus sterilis*, *Alopecurus pratensis*, *Phragmites communis*, *Carex paniculata*, *C. riparia*, *C. caespitosa* (Paux).

PARASITES.*—*Pimpla instigator*, Fab. (Bairstow), *Pimpla graminellae*†, Schr. (Fitch), *Rhogas geniculator*, Nees, this species attacks larva and emerges from it while resting on a twig apparently preparing for 4th moult‡ (Bignell), [*Rhogas circumscriptus*, Nees (Bignell)], *Polysphincta varipes*, Gr. (Billups), *Exorista vulgaris*, Fallén (Porritt). A cocoon of *C. potatoria* found on dead twig of yew on downs near Chichester about Aug. 5th, 1867, contained a pupa of the moth filled with pupæ of *Nemoraea (Tachina) puparum*, which emerged between August 5th–12th (Jeffery).

HABITS AND HABITAT.—The males fly actively by night and come freely to light from about 9.30 p.m. to 11.0 p.m., and possibly later, and one rarely sees them at all during the day. Dalglish, however, unexpectedly notes that, in western Scotland, the males sometimes fly in bright sunshine and that he has seen them battling in a heavy shower of rain. Hewett observed a pair, *in cop.*, on the evening of July 25th, 1900, the moths remaining united until the early part of the next evening, at York. The female commences to fly as soon as it is really dusk, the mode of flight being particularly heavy, and one frequently hears her buzzing among the sedges,

* *Rhogas reticulator*, Nees, has been recorded in error as having been bred from the larva of *C. potatoria* (Bignell).

† Bignell has a note that Fenn bred 23 examples of this species from *C. potatoria (in litt.)*.

‡ Bignell notes: Bred from young larvæ of *C. potatoria*, June 25th, 1880, all the transformations taking place within the skin of its host before the 4th moult. The larva of *C. potatoria* prepares for this moult by the usual method of covering the twig on which it is resting with silk, and from that spot it never moves; the parasitic larva within then consumes the caterpillar, which gradually shrinks in length, and, in about 3 weeks, *R. geniculator* emerges from a hole cut out of the upper side of the 11th and 12th segments; it does not appear to make a cocoon within the larva, but takes advantage of the larval skin of *potatoria* for its protection (*in litt.*).

reeds, and grasses, before one sees her. She is also occasionally recorded as coming to light. When the female first emerges, she suspends herself from the cocoon, and remains there whilst wing-expansion takes place (Dalglish). Grover states that the favourite time of emergence from the pupa is from 8 a.m.–10 a.m., whilst Battley notes a ♀ that emerged in the morning, but wing-expansion did not take place until evening. Rühl observes that the habit of the ♀s is to fly at dusk in the Zürich district, and Lathy observes that an attempt to assemble with a bred ♀, taken out on July 15th and 16th, both, however, cold damp nights, only attracted a single ♂, which appeared about 9.40 p.m., no others being seen. Coverdale reports that, by the ditches on the Deal sandhills in mid-July 1883, he observed ♀s commonly, at rest on grass, side by side with larvæ yet feeding; whilst Musham notes the occurrence of two ♀s on sugared posts in Wicken Fen in July, 1900, on two different evenings, but is uncertain whether these were attracted or not by the sugar. The species is much more abundant in some years than others—very abundant in 1879 at Maldon (Fitch), at Wicken in 1891 (Tutt), at Colchester exceedingly common till the advent of the recent series of dry seasons, since which it has become rare, suggesting a wet or damp environment as advantageous to its successful development (Harwood). The habitats of the species are very various; in Ireland it is widely spread and common on many moorlands, chiefly on the hills, rather than on the flat bogs of the plain (Kane), and in Scotland also it prefers the moorlands. The larvæ abound in the long grass growing on the inside of all hedges around Chattenden Woods in quite dry situations; it is also abundant all over Wicken Fen, by the sides of the ditches that cross the sandhills at Deal, and in the marshy ground around Sandwich; it is exceedingly abundant on the sandhills between Troon and Ayr, the larvæ in thousands, feeding on the bent-grass (Dunsmore); on the sandhills between Blyth and Old Hartley, very plentiful, the larvæ here also feeding on the bent-grass (Crass); on the sandhills and by hedgesides at Hartlepool (Robson); on the moors of Argyllshire, from near the sea to 450 feet elevation (Christy); at the foot of hedges and on borders of ditches in Suffolk and Essex, some years very abundant (Ransom); on hedge-banks at Worcester (Hancock); on grassy hedge-banks in the Lewes district (Nicholson); on rough grass along the hedge bottoms, at Middlesborough (Lofthouse); by hedgerows and on roadside banks at Perivale (Montgomery); on grass banks at the foot of hedges at Boxworth (Thornhill); among coarse grass under thick hedges in the Gloucester district (Merrin); in lanes and on grassy hedge-banks about Carlisle (Day); prefers hedgerows at Wirrall (G. O. Day); in the lanes near Huntington, and by hedgesides near Naburn (Hewett); everywhere by roadsides in the Brighton district (Merrifield); on grassy hedge-banks at Angmering (Dollman); by roadsides, in rough ditches, and on open commons at Skipwith (Ash); prefers the sunny sloping banks by a roadside rather than fields in Notts (Daws); on grasses growing in ditches in the Leicester district (Bouskell); prefers ditches at Weymouth (Forsyth); ditches and hedges at Rossall (Moss); ditches and hedgesides at Cricklewood, &c. (Phillips); in ditches and osier-beds, overgrown with long grasses at Hitchin (Cottam); in every field, although specially abundant in reed-beds and at ditchsides in the Southend and Benfleet districts (Whittle); in reed-beds at Wisbech (Glenny); larvæ abundant in mowing hayfields in the Calne district (Eddrup); in meadows at Ryde (Kaye); on the banks of streams among the ribbon-grass at Emsworth (Christy); in damp rushy spots all round Aberfoyle and the Lake of Menteith (Evans); lanes and grassy banks preferred in Berks and Oxon (Clarke); quite indifferently a hedgerow and woodside species in Middlesex and Norfolk (Lockyer); on railway banks at Southgate, ditchsides bordering woods at Highgate, roadside ditches at Southend, roadside hedgebanks at Arundel (Williams); on grassy hedgebanks about Rochester and Chatham (Chaney); on a grassy roadside at Corsemalzie (Gordon); on the chalk downs near Chichester (Jeffery); on the foreshore at Lymington (Kaye): on coarse grass on hedgebanks, or under bushes close to seashore at Sandown (Prout); hedgerows, thickets, copses, and banks at Dover (Stockwell): hedgerows and sides of dykes throughout Nottinghamshire (Leivers); almost confined to coast districts in Northumberland (Richardson); by the rank overgrown edges of woods in the Zürich district (Rühl); by hedgerows, roadsides, and dry wastes in the Namur district (Lambillion); yet very common in damp places in Belgium (de Selys); not rare along the banks of the Garonne, &c. (Caradja); specially abundant in damp places in the Netherlands (Snellen).

Time of appearance.—The imagines occur from late June (mid-June in 1893) until late August, most abundant in July and early August. Fritsch gives dates for the Vienna district from June 16th to July 24th; from July 15th to end of month in Belgium (Lambillion); July 21st—August 6th, good average dates for the Rochester and Chatham district (Chaney); imagines, July 4th onwards at Wilsden (Butterfield); larvæ, from May 16th–June 24th in different years from 1848–1858, imagines bred in these years from June 29th—July 16th in Brighton district (Merrifield); July 17th—25th, 1855, July 15th—August 1st, 1870, July 19th, 1871, July 10th, 1872, July 22nd, 1873, and larvæ, July 9th, 1867, at Marlow, imagines, July 22nd—August 3rd, 1863, July 21st—August 4th, 1864, at Chertsey, July 17th, 1855, July 27th, 1857, at Notting Hill (Clarke); August 1st, 1856, at Bisterne (*Subs.*, p. 29); larvæ, May 6th—19th, 1860, at Lee and Lewisham, a long series bred from July 2nd—27th, 1860, imagines captured August 12th—18th, 1860, at Lee, larvæ from February 28th—May 30th, 1861, at Lee, imagines bred July 5th—25th, 1861, larvæ, June 16th, 1863, at Portscatho, larvæ, April 20th—23rd, at Lee and Abbey Wood; imagines, July 14th, 1866, at Eltham, larvæ, May 18th, 1867, at Bromley, May 23rd, 1874, at Lee, and May 13th, 1875, at Balcombe, imagines on July 29th, 1875, at light, at Lee, on August 14th, 1879, and July 13th—28th, at Erith, larvæ, June 2nd, 1885, at Lee, and imagines August 1st, 1885, at Grove Park, imagines, July 6th, 1889 and July 15th, 1890, at Dartford, July 26th—August 1st, imagines common at Deal and Sandwich, also July 7th—27th, 1891, and August 6th—20th, 1892, imago on June 29th, 1893, at Bexley, larvæ on April 21st, 1894, at Farningham, and May 16th—29th, commonly at Tor Cross (Fenn); ♀ on wing at Lee, 20th July, 1865, larvæ, June 9th, 1867, at Eltham (Jones); larvæ, April 14th, 1871, June 15th, 1892, the latter pupating June 24th, 1892, imagines, July 22nd, 1886, August 4th, 1887, at Brentwood, August 13th, 1890, at Newlyn, August 10th, 1892, at Rainham, July 23rd, 1900, at Southend (Burrows); June 24th, pupæ from which imagines emerged July, 1871, at Lee, imagines August 9th, 1871, at Tunbridge Wells, July 28th, 1877, at Lee, July 13th, 1896, at Gravesend, cocoons and imagines, the latter flying at dusk (Bower); males taken at light, July 21st, 1871, August 26th, 1891, August 18th, 1892, July 28th, 1893, July 31st, 1894, August 27th, 1894, August 4th, 1896, July 23rd, 1897, August 7th, 1897, August 4th, 1899, at Oxton; dates of breeding specimens at Oxton—♂ June 28th, 1896, ♂ July 9th, 1896, ♂ and ♀ July 16th, ♀ August 11th, 1897, ♀ July 4th, 1898, ♀ August 4th, 1899 (Studd); August 11th, 1875, at Tilehurst, July 30th, 1889, at Warren, August 18th, 1891, at Southcote, August 4th, 1892, at White Knight's Park (Holland); larvæ, May 29th, 1876, at Lewisham, others June 13th, 1876, at Darenth, these commenced to spin up June 21st, 1876, emerged July 12th—13th, 1876; a cocoon on a low branch of a fir-tree at Sultan Pines, near Deal, July 14th, 1877, produced imago July 25th, 1877 (R. Adkin); August 6th, 1876, at Emsworth (Buckler); June 28th, 1879, June 19th, 1880, at Rugby (Solly); larvæ, March 15th, 1881, pupa July 7th, emerged July 13th, 1883, male caught July 14th, 1883, at Ippolytts, larvæ, May 17th, 1881, at Wicken (Durrant); fullfed larvæ, June 9th, 1881, on Strensall Common, larvæ May 5th and June 7th, 1882, near Huntington, larvæ May 6th, 1882, near Haxby, larvæ June 21st, 1882, at Edlington Wood, imagines July 16th, 1885, July 1st, 1886, and July 14th—16th, 1891, at Askham Bog, larvæ June 6th, 1890, near Naburn, larvæ May 12th, 1892, at Strensall, larvæ May 21st, 1892, near Warthill, larvæ May 17th, 1894, spun up June 21st, 1894, at Riccall Common, larvæ, May 26th, 1895, at Spurn Point, imagines began to emerge June 25th, 1895; larvæ April 13th—May 25th, 1896, at Strensall Common, others April 25th, 1896, at Market Weighton, commenced to spin up May 25th, emerged July 10th—14th, 1896, imagines taken June 20th, 1896, at Riccall Common, July 2nd, 1896, several on Askham Bog, also obtained 25 newly spun up cocoons at Melbourne, July 16th, 1899, and larvæ May 20th, 1900, from which imagines emerged July 1st—August 6th, the greater number during the last week of July; larvæ May 11th, 1901, at Bishop-Wilton, imagines emerged June 25th—July 17th (Hewett); July 16th, 1881, at Wickham Market, July 29th, 1891, at Tiverton (Harker); August 9th, 1881, July 11th, 1898, at Hayton Moss (Routledge); July 10th, 1882, July 12th, 1883, July 14th, 1884, July 12th, 1885, July 16th, 1889, July 13th, 1891, July 12th, 1893, July 11th, 1896, July 12th, 1897, July 25th, 1900, July 7th, 1901, at light, at Reading (Butler); imagines caught July 31st, 1883, July 28th, 1899, in Isle of Purbeck (Bankes); July 23rd, 1885, at Bletchingley (Barclay); imagines July 22nd, 1886, July 19th, 1887, August 4th, 1887, August 4th, 1890, at Brentwood; larvæ, June 17th, 1891, at Woodham Ferris, imagines August 23rd, 1895, at Linwood, July 25th and August 13th, 1898, July 26th, 1899, at Hazeleigh, August 1st, 1899, at Needham Market, July 17th, 1900, hovering over grass in ditch, July 20th—22nd, 1900, at light, at Hazeleigh (Raynor);

bred July 24th—31st, 1889, at Portland (Brown); one pupated August 3rd, 1889, and emerged (a small ♂) September 6th, at Sheffield, another larva remained healthy till September 26th, 1889, and then died, although full-grown (Hall); larvæ, May 3rd, 1890, gave imagines, July 13th, 1890; pupa, May 27th, 1891, produced imago, July 25th, 1891, at Newnham (Lifton); July, 1890, at Lyndhurst, one ♂ at light (Simes); bred July 23rd, 1890, from larvæ obtained May 28th; bred July 21st, 1891, from pupæ obtained July 14th, bred June 25th—July 2nd, 1893, June 21st—July 2nd, 1895; July 10th, 1896, June 29th—August 3rd, 1897, all from May larvæ, bred August 2nd, 1898, from June larvæ, June 29th—August 3rd, 1900, all collected in Southend district (Whittle); larvæ, June 11th, 1890, June 16th, 1892, May 25th, 1896, at Bristol, May 24th—June 3rd, 1892, at Dursley, imagines, July 3rd—July 18th, 1892, at Bristol, July 23rd, 1892, at Portishead, June 28th, 1895, at Dursley, July 19th, 1897, at Bristol (Bartlett); bred, from larvæ taken in Leicester district on June 12th, 1891, and following days, throughout August to August 24th, 1892, also larvæ June 16th, 1898 (Dixon); July 6th, 1891, cocoons at Clacton, imagines commenced to emerge July 9th, and following days, July 22nd—26th, 1898, at Wicken (James); bred July 7th, 1891, July 11th, 1894, July 25th, 1899, captured August 5th, 1891, August 5th, 1892, July 17th, 1895, July 21st, 1896, July 21st, 1897, all at Sandown, bred June 20th, 1895, from Southend, bred June 21st, 1893, July 8th, 1894, from Pett, bred July 23rd, 1898, from Stanford-le-Hope, captured July 14th, 1900, at Chalfont Road (Prout); July 18th, 1891, many at light at Wicken (Tutt); July 19th, 1891, at Arrochar, July 11th, 1897, at Glen Mallon (Dalglish); July 30th, 1891, at East Grinstead, July 21st, 1898, at Bacton (McIntyre); imagines at light, August 1st, 1891, at Kingsmill (Watkins); August 7th, 1891, flying in meadow at Ryde (Kaye); imagines, July 18th—August 18th, 1890 and 1891, July 10th, 1892, July 22nd, 1895, June 17th, 1897, July 19th—22nd, 1897, August 5th, 1898, at Whitwell, July 1st, 1899, near Earlstown (Freeman); July 22nd, 1892, at Bristol, ♂ at light, July 22nd, 1896, at Reigate, ♀ slowly flying along hedge at 8.50 p.m. (Prideaux); August 9th, 1892, on moors of Argyll; cocoon, May 26th, 1893, gave imago June 16th, bred others July 11th—August 4th, 1898, from Emsworth (Christy); June 13th, 1893, June 27th—July 1st, 1894, June 11th, 1895, and July 7th—15th, 1895, at Carlisle (Day); larvæ from Perivale produced imagines June 23rd, 1893, imagines taken July 16th—29th, 1894, June 28th—29th, 1895, and July 1st, 1898, a ♀ observed laying eggs on stems of grass on June 29th, 1896; larvæ and pupæ at Eastbourne, June 10th—15th, 1898 (Montgomery); July 15th—24th, 1893, at Wicken (Mitchell); at light, imagines, July 14th and on through this month and August, at Mansfield, imagines emerged July 16th, 22nd, 23rd, 24th, and all dates up to August 18th, 1893, a late one emerged September 4th, 1899, at Mansfield, July 10th to end of August, continuously at Penzance (Daws); larvæ in great abundance at Connemara, March 28th, 1894 (Allen); imagines July 1st—14th, 1894, at Feering, July 1st—7th, 1894, at Wicken, August 5th—10th, 1898, at Horning (P. Reid); July 10th, 1894, June 19th—30th, 1896, at Wisbech (Glenny); July 6th, 1894, at Brighton (Johnson); larvæ on May 23rd, 1895, at Saltburn, pupated May 28th, emerged June 30th, 1895, etc. (Lofthouse); June 27th, 1895, June 13th—21st, 1896, at Malvern, larvæ, May 28th, 1896, gave imagines June 13th—16th, 1896, at Worcester (Rea); June 5th, 1895, June 23rd—27th, 1898, at Carlisle (Wilkinson); from larvæ that commenced to spin June 7th, 1895, imagines were bred as follows: July 4th 1 ♂, July 7th 1 ♂, July 16th 1 ♂ and 1 ♀, July 22nd 1 ♂, July 25th 1 ♀, July 30th 2 ♀s, August 4th 1 ♀, August 11th 1 ♀, August 18th 1 ♂, August 23rd 1 ♀, August 25th 1 ♀ (Varty); July 11th, 1895, July 11th, 1896, ♀s by dusking, at Bungay, bred July 24th—August 5th, 1900, at Burnley (Clutten); larvæ very common at Folkestone at end of May in 1896 and 1897, earliest date of pupation, June 2nd, 1897, latest, July 3rd, 1897, earliest emergence, June 14th, 1896, latest, August 4th, 1897 (Lane); larvæ, collected May 14th, produced imagines June 25th—27th, 1896, in the Linz district (Himsl); larvæ in thousands, May 28th, 1896, at Wisbech, imagines emerged from June 24th, 1896 (Mousley); cocoons, June 27th, 1896, and July 9th, 1898, at both of which dates emergences had already taken place at Dinas Mawddwy (Tetley); June 30th, 1896, at Chelmsford (Miller); larvæ, in April at Blyth, imagines emerged June 20th—July 10th, 1897 (Crass); male caught by dusking, June 14th, 1897, larvæ at Corsemalzie, April 13th, 1898, common, pupated from June 12th, emerged early in July, ♀ captured June 30th, 1898, bred others July 16th—29th, 1898, and June 19th—21st, 1899; saw a larva about one inch long, on August 17th, 1899 (Gordon); larvæ, from April 15th—May 2nd, 1897, at Angmering, first imago emerged June 14th (Dollman); bred from June 24th, 1897, at Boxworth (Thornhill); larvæ, common, May and early June, 1898, at Hitchin, spun up in June, imagines emerged from June 28th on through July (Cottam); larvæ and cocoons, June 18th—25th, 1898, at Wicken, imagines from these July 9th (♀), July 11th (♀), July 19th (2 ♀s, 1 ♂), July 23rd (♀s) (Carr); between Waxham and Horsey, June 26th—30th, (1898) (Cox); electric light, Aigle, July 3rd—4th, 1898 (Lowe); imagines, bred July 15th—20th, 1898, from larvæ found in the north of Middlesex (Burraud); July 27th—August 16th, 1898, at Hayling Island (May); August 12th, 1898, at light, in the Norfolk Broads (Edelsten); July 7th, 1899, at Earlstown, July 8th, both cocoons and imagines at Canal Bank; June 27th, 1900, cocoons only at Canal Bank (Cotton); July 8th, at Wishanger, at light (Newland); July 19th—20th, 1900, at light, at Rugeley (Freer); July 22nd, 1900, at Lichfield (Redmayne), July 6th—13th, 1901, at Addington (Russell); July 22th, 1901, at Somerton Broad (Phillips).

LOCALITIES.—Generally distributed in most suitable localities throughout the British Islands. The whole west of Scotland, common (Chapman), common in the south of Ireland (McArthur), far rarer in Ireland than in England, but found in all 4 provinces occasionally, common locally (Kane). ABERDEEN: Aberdeen, once only (Horne), Murcal Links (Traill). ARGYLL: common (Chapman), Oban, abundant (Evans), Lochgoilhead (Mackieson), Tarbert, L. Riddon (Dalglish). ARMAGH: Armagh, Churchill (Johnson). AYR: Shewalton Moss (Smith), Monkton (Duncan), Kilmarnock (Rose), Troon to Ayr, very abundant (Dunsmore). BEDS: Potton, abundant (Bond-Smith). BERKS: Reading (Butler), Whiteknight's Park, Tilehurst, Southcote (Holland), Sulham Woods (Henderson), Hurst (Broome). BERWICK: Berwick (Bolam). BUCKS: Marlow (Clarke), Eton (Bankes), Chalfont St. Peter (St. John), Buckingham

(Slade), Chalfont Road (Prout). BUTE: Isle of Bute (Chapman). CAMBS: generally common (Farren), abundant throughout the Fen district (Balding), Wicken, swarms in some seasons (Tutt), Wisbech, common (Butterfield), Boxworth (Thornhill), Whittlesea Mere (*teste* Gregson). CARMARTHEN: Llanstephan (Newland), Tenby (Vaughan). CARNARVON: abundant in the Conway valley, Trefriu (Bland), Pwllheli, abundant (Johnson). CHESHIRE: abundant throughout (Ellis), Wallasey, Heswall (Freeman), Wirrall, common, Delamere, rare nr. Knutsford (G. O. Day), Eastham Wood (Brown), Chester, common (Arkle), Ince Marshes (Newstead), Elton Green nr. Ince (Collins), Warburton (Thorpe), Edge nr. Malpas (Wolley-Dod), White Hall nr. Tarporley (Stock), Vicars Cross (Pitcairn-Campbell). CORNWALL: Penzance, Paul, common (Daws), Bude (Image), Portscatho (Fenn), Newlyn (Burrows). CUMBERLAND: east of Carlisle, rare, on the west side near Orton, common, Woodbank (Stephens), Hayton, Hayton Moss, scarce (Routledge), Keswick, very rare (Beadle), Carlisle (F. H. Day), Brampton (Varley), Kirkbride (Miller). DENBIGH: Colwyn Bay, abundant (Whittaker), Ruthin (Ward). DERBY: Long Eaton (Pearson), Derby, common (Payne), Burton-on-Trent (Mason). DEVON: fairly common throughout (McArthur), Oxton, Exeter, Tiverton (Studd), Tor Cross (Fenn), Barnstaple, common (Raddon), Paignton (Bowles), Sidmouth (Majendie), Instow (Hinchliff), Dartmoor, Horrabridge (Still). DONEGAL: Donegal (Campbell). DORSET: generally distributed (Dale), Portland (Brown), Swanage (Kemp), Isle of Purbeck (Bankes), Weymouth (Forsyth). DUMBARTON; Inchmoan, L. Lomond (Ord), Helensburgh, Inveruglas, Luss, Glen Mallon, Glen Falloch, Arrochar (Dalglish), Garelochhead (Henderson). DUMFRIES: Dumfries (Lennon). DURHAM: common throughout county (Robson), Dimsdale, Darlington, Port Clarence (*teste* Hewett), Hartlepool (Gardner), Hartburn (Sachse). ESSEX: generally common — Stanford-le-Hope (Prout), Brentwood, Mucking, Rainham (Burrows), Sudbury district, very common, Middleton, Bulmer, Henny (Ransom), Chelmsford (Miller), Feering Bury (P. Reid), Lambourne (Lane), Benfleet, Prittlewell, Southend (Whittle), Woodham Ferris, Hazeleigh, Herongate, Maldon (Raynor), Woodford (Bishop), Clacton (James), Leigh (Vaughan), Chingford, Walthamstow (Meldola), Harwich (Kerry), Colchester (Harwood), Ilford, Wanstead (Mera), Epping (Rose), Navestock (Claxton). FERMANAGH: Enniskillen (Allen). FLINT: Overton, Rhyl, Cwm (Perkins). GALWAY: Galway, Connemara, Recess, Lenane (Allen), Ahascragh, very abundant (Dillon). GLAMORGAN: Swansea (Robertson). GLOUCESTER: generally common (Griffiths), Bristol district, common, Kingsmill, Painswick (Watkins), Dursley (Bartlett), Litsey (Wainwright), Gloucester district (Merrin), Stonehouse (Nash), Newnham (Lifton). HANTS: fairly common throughout (McArthur), Isle of Wight—Colwell Bay (Sich), Ryde, Yarmouth (Kaye), Sandown (Prout), Shanklin (Helps), Basingstoke, Winchester (Holdaway), Lymington (Colthrup), Hayling Island (May), Lyndhurst, Bisterne (*Subs.*, p. 29), Andover (Rudd), Wishanger, near Churt (Newland), Burghclere (Alderson), Southampton (Moberly), Winchfield (Robertson), Portsmouth (Forsyth), Emsworth (Christy), Lockerley (Burrows), Romsey (Buckell), Ringwood, common (Corbin). HEREFORD: Hereford (Chapman), Leominster (Hutchinson), Tarrington (Wood). HERTS: Hitchin, Ippolytts (Durrant), Hertford (Stephens), near Ware (Image), Bushey Heath (Burraud), Knebworth (Griffith). HUNTS: St. Ives (Norris). INVERNESS: Skye (Wingate). ISLE OF MAN: very common, Lezayre (Clarke), Douglas (Robinson). KENT: Strood, Higham, and Cuxton districts, common, Deal and Sandwich districts, common (Tutt), Chelsfield (Carr), Eltham (Jones), Abbey Wood, Lee, Lewisham, Erith, Bromley, Grove Park, Dartford, Bexley. Farningham (Fenn), Sundridge (Ingpen), Salton Pines, near Deal (Adkin), Eynesford (Colthrup), Rochester, Chatham (Chaney), Springhead (Andrews) Folkestone, abundant (James), Stone, Mottingham, Tunbridge Wells, Gravesend (Bower), Dover (Stockwell), Martin Mill, St. Margaret's Bay (Pickett), Kidbrook, Burnt Ash, near Lee (West). KIRKCUDBRIGHT: Kirkcudbright, Douglas (Robinson). LANARK: locally abundant (Dalglish). LANCS: abundant throughout (Ellis), near Earlstown (Freeman), Liverpool (Walker), Canal Bank, Formby (Cotton), Burnley (Clutten), Bold (Jackson), Rossall, Crosby, St. Anne's (Moss). LEICESTER: widely distributed (Dixon), Leicester, common (Bouskell). LINCOLN: Lincoln, etc., common (Carr), Market Rasen, once only, Legsby (Raynor). LONDONDERRY: Londonderry (Campbell). MERIONETH: near Dinas Mawddwy (Tetley), Barmouth, Llangollen (Arkle). MIDDLESEX: generally common (Godwin), Perivale (Sich), Notting Hill (Clarke), Enfield (Edelsten), Kingsbury, Wembly, Cricklewood, Neasden (Phillips), Tottenham Marshes (Bayne), Enfield Lock, Cross Orchard, Enfield Butts (Bowles), Harrow district, common (Rothschild), Oxhey Lane, Harrow Weald (Brown), Mill Hill (South), Isleworth (Meyers), Hampstead (Watts), Harefield (Wall), Highgate (Williams), Southgate (Lockyer), Kilburn, Willesden, common in 1859 (Wormald), Potter's Bar (Mera), Ealing (Fenton), Twyford (Dawe), Muswell Hill (Buckell). MONMOUTH: Abergavenny (Chapman). NORFOLK: Norwich, very common, Horning, Norfolk Broads (Edelsten), Somerton Broad (Phillips), between Waxham and Horsey (Cox), Whitwell (Freeman), Bacton (McIntyre), King's Lynn (Atmore), Great Yarmouth (Harmer), Ranworth (Wheeler). NORTHAMPTON: Peterboro' (Morley), Oundle, abundant (Whall), Newark (Gascoyne). NORTHUMBERLAND: common throughout the county, and also in Holy Island, St. Mary's Island, etc. (Robson), on coast, never inland—Alnmouth, Warkworth (Nicholson), between Blyth and Old Hartley, abundant (Crass), Newcastle-on-Tyne (Hewitson). NOTTS: generally distributed and abundant (Leivers), Mansfield, common (Daws), Hoveringham, Thurgaton (Whittaker), Long Eaton, Chilwell (Pearson), Nottingham (Wright). OXFORD: Oxford (Eddrup), Warren (Holland), Nettlebed (Henderson), Chinnor (Spiller), Bagley Wood (Steuart). PEMBROKE: Castlemartin (Hodge), Pembroke (Barrett). PERTH: Callander, Aberfoyle, Lake of Monteith (Evans), Rannoch (Birchall). RADNOR: Wye Valley (Vaughan). RENFREW: Renfrew (Dalglish). SHROPSHIRE: generally distributed—Wyre Forest (Wainwright), Wrekin (G. O. Day), near Market Drayton, rare (Woodforde). SLIGO: Markree Castle (Kane). SOMERSET: common (Woodforde), Winscombe, Portishead, Brockley (Bartlett), Clevedon, common (Mason), Castle Cary, common (Macmillan). STAFFS: generally distribnted (Daltry), rare in north of county (Masefield), Rugeley, Cannock Chase, rare (Freer), Lichfield (Redmayne), Betton (Woodforde). STIRLING: Fintry (Eggleton), Rowerdennan (Mackonochie). SUFFOLK: very common (Bloomfield), Sudbury district, very common (Ransom), Waldringfield (James), Wickham Market (Harker), Beccles, Ipswich (Morley), Needham Market (Raynor), Bungay (Clutten), Brantham (Buckell). SURREY: generally distributed (Sheldon), Addington (Russell), Chertsey (Clarke), Redhill, Chobham (Turner), Ripley (Stephens), Frensham (Newland). Guildford, common (Grover), Epsom (Morley), Bletchingley (Barclay), Wimbledon, Riddlesdown (Buckell), Sydenham (Wood), Coulsden (Lake), Croydon (Hall). SUSSEX: very common on the South Downs (McArthur), throughout East Sussex (Jenner), Preston, Patcham, Poynings, Holm Bush, Blatchington, Balcombe, Cuckfield (Merrifield), East Grinstead (McIntyre), Hastings and St. Leonards district (Bloomfield), Brighton (Image), Burgess Hill, Angmering, (Dollman), Lewes (Nicholson), Balcombe (Fenn), Chichester (Colthrup), Arundel (Williams), Bognor (Lloyd), Worthing, Littlehampton (Fletcher), Eastbourne (Blenkarn), Pett (Prout). SUTHERLAND: Bonard Bridge (W. Salvage), between Shin Bridge and Achany (Buxton). TYRONE: Altadiawan, Favour Royal (Kane), Tyrone (Greer). WARWICK: Rugby (Solly), Sutton (Abbott), Birmingham (Bath), Handsworth (Wainwright), Hopwas Wood (Wynn). WATERFORD: Portlaw (Flemyng). WESTMORLAND: Kendal district (Moss). WICKLOW: Wicklow (Barrett). WIGTOWN: common, Corsemalzie (Gordon). WILTS: Salisbury (Ridley), Bremhill, Calne (Eddrup), Warminster (Buckell). WORCESTER: common in the county—Witley, Malvern, Glasshampton, Holt, Tiddesley, Sheriffs Lench, Worcester, &c. (Rea), Yarbley (Wynn), Droitwich (Fountain), Bockleton (Decie), near Worcester (Hancock). YORKS: generally distributed all over county, often abundant (Porritt); Wilsden, abundant (Butterfield), Skipwith (Ash), Saltburn, Middlesborough (Lofthouse), Birstwith (Walker), York (Hewitson). Strensall Common, Riccall Common, Naburn, Askham Bog, Haxby, Huntington, Bempton, Buckton, Flamborough, scarce, Wheldrake, Cottingwith, Melbourne, Towthorpe, Bishop-Wilton, Stamford Bridge, Edlington, near Doncaster, Warthill, Market Weighton, Spurn, common (Hewett), Knaresborough (Blakey), Sheffield (A. Hall), Lowthorpe (Rowntree). Richmond (Willson), Leeds (Moss), Hull (Boult), Whitby (Bold), Doncaster (Corbett), Everingham (Sumner), Brierley Moor, Barnsley (Whittaker).

DISTRIBUTION.—AMURLAND: many places, those from the southern districts=var. *askoldensis* (Staudinger); Wladiwostok, common (Graeser). SIBERIA: Eastern Siberia—Bureja mountains, Ema (Bremer). JAPAN: (Motschulsky). AUSTRO-HUNGARY: Tyrol, not common—Innsbruck, etc. (Hinterwaldner), Pressburg (Rozsay), Bukovina, very local (Hormuzaki), Bohemia, distributed, but never common, Upper Carinthia, Salzburg (Nickerl), Neu Sandec (Klemensiewicz), Stanislawow, Holosko (Werchratski), Galicia (Nowicki), Brunn (Müller), Freistadt, Neutitschein, etc. (Fritsch), Buda-Pest (Speyer), Epiries, common (Husz), Chemnitz (Pabst), Buchenau, near Linz (Himsl). BELGIUM: generally distributed and very common (Lambillion), Virton (Bray). CHANNEL ISLANDS: Guernsey, very rare, Herm (Luff), Jersey (Ansted), Alderney—Essex Castle (Marquand). DENMARK: generally common (Baug-Haas). FINLAND: Abo, Karelia (Lampa). FRANCE: generally distributed and common (Berce), not found in southern France (Chapman), Seine-Inférieure—Pont de l'Arche, Le Havre (Dupont), Dept. du Nord (Paux), Aube (Jourdheuille), Douai (Foucart), Auvergne (Sand), Eure-et-Loir (Guénée), Haute-Garonne (Caradja), Dept. Meuse, Meurthe, Lozère, etc. (Speyer), Puy-de-Dôme (Guillemot), Morbihan (Griffith), Gironde (Trimoulet), Doubs (Bruand), Seine-et-Loire (Constant), St. Quentin (Dubus), Brittany (Mathew), Tancarville (Leech), Hautes-Pyrenees (Leschnault-du-Villard). GERMANY: generally distributed and common—Brunswick, &c. (Heinemann), north-west Germany, most places (Jordan), Thuringia—Gotha, Erfurt (Knapp), Pomerania —Bredow, Julow, nr. Nemitz, Vogelsang (Hering), Silesia, common (Prittwitz), Rhine Palatinate, not rare (Bertram), Wurtemburg (Seyffler), Giessen (Dickore), Lower Elbe dist. (Zimmermann), Waldeck (Speyer), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle, Dessau (Stange), Munich, common (Kranz), Hesse—Upper Hesse, everywhere (Glaser), Rudolstadt (Meurer), Kiel (Burrows), Mecklenburg, very common, Prussia, generally common—Konigsberg (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia, very common (Schutze), Dresden (Steinert), Upper Lusatia, very common (Moeschler), Nassau, almost rare (Rössler), Ratisbon (Schmid), Dessau (Richter), Alsace (Peyerimhoff), Wernigerode, common (Fischer), Hanover (Glitz), Eutin (Dahl), Baden dist., everywhere common (Reutti). ITALY: not common in northern Italy, Tuscany, rare (Curò), Lombardy—Alzate (Turati), Modena (Fiori). NETHERLANDS: everywhere common - Breda, very abundant, &c. (Heylaerts), nr. Zevenhuizen (Lechner). ROUMANIA: very scarce or local – Comanesti (Caradja). RUSSIA: Baltic Provinces, generally distributed (Nolcken), Moscow dist. (Albrecht), Wolmar (Lutzau), Volga dist.—frequent in provinces of Kasan and northern Orenburg (Eversmann), St. Petersburg (Erschoff). SCANDINAVIA: rare in southern Sweden and Norway, northern limit about 60° 30″ (Aurivillius), Christiania, very rare (Siebke), Upland (Lampa). SPAIN: Bilbao, common (Rössler), Teruel, Bolaña, Ateca, common (Zapater). SWITZERLAND: almost everywhere common, but more rarely near Bergün, Trafoi and in the Upper Engadine up to 5000 feet (Frey), Zurich district, common (Rühl), Weissenburg (Huguenin), Valais, rare throughout the Rhone valley (Favre and Wullschlegel), Aigle (Lowe).

IMAGO *.—Palpi projecting. Head and collar of the darker colour of forewings, the thorax and abdomen paler. ♂. 42mm.—58mm. in expanse. Antennæ strongly pectinated. Abdomen somewhat tufted, with long hairs. Anterior wings varying from yellow to rich purplish-brown (*anteà*, p. 162); with three, darker, transverse lines, one near the base, another running obliquely from the apex to near the middle of the inner margin, the third subterminal, and formed of a series of arches, roughly parallel with the outer margin; a silvery-white or ochreous discal or median spot, usually a second smaller, but similar spot between this and the costa. Posterior wings yellowish to dark fuscous-brown, usually with a dark transverse median shade crossing the wing from the apex to the inner margin. ♀. 58mm.—75mm. in expanse. Antennæ less strongly pectinated than in ♂. Abdomen not tufted. Anterior wings yellow of various shades (rarely brown or even heavily-shaded with brown); transverse lines, discal spots, etc., as in the ♂; posterior wings rather darker outside the median shade.

Subfam.: EUTRICHINÆ.

We have already (*anteà*, p. 112) noted the tribal divisions into which we group the Palæarctic members of this subfamily, *viz.*, *Odonestidi* and *Eutrichidi*. There is, in the British fauna, no representative of the first of these, both the British Eutrichids (*sens. strict.*) belonging to the last-named. The most closely allied subfamily to this, represented in the British fauna, is the subfamily *Cosmotrichinae*, which, as we have already seen, possesses but a single British representative, *Cosmotriche potatoria*. The subfamily

* By an oversight, this description was omitted from p. 159 (*anteà*) where it should have preceded the paragraph on "Sexual Dimorphism." In order to complete our account of the species the description is added here.

Eutrichinae is the group A of Ochsenheimer's *Gastropacha (Die Schmett.*, iii., p. 259)—*ilicifolia*, *betulifolia*, *populifolia*, *quercifolia*, *pini* and *pruni*. This he diagnoses as follows :

The antennæ are bi-pectinate, the palpi long and porrected, the wings similarly indented. The forewings in repose are laid roof-wise, and the hindwings project beneath them. The tongue is wanting. The larvæ are flat beneath, arched above, hairy; on the second and third segments with one or two coloured transverse stripes, and a claviform wart on the penultimate; similarly, covered with long hairs in tufts, on the sides. The transformation takes place above the ground in a weak elongate cocoon; dusted from within.

A comparison of the pupæ of *Eutricha quercifolia*, *Cosmotriche potatoria*, *Macrothylacia rubi*, *and Lasiocampa quercûs* has led to the suggestion that we have here a means of checking probable affinities. Bacot notes *(in litt.)*: "The mouthparts of the pupa of *E. quercifolia* approximate much more to those of the pupa of *C. potatoria* than of *M. rubi*. On either side of the labrum is a raised boss, the mandible, whilst between the maxillæ and beneath the labrum is a wedge-shaped slip, and it is in this that a difference between the pupæ of *E. quercifolia* and *C. potatoria* on the one hand, and *M. rubi* on the other, is to be found. In the pupa of *M. rubi* this slip is small, and distinctly divided into an upper and a lower portion, the upper being the labial palpi and the lower, probably, the femora of the 1st pair of legs; in the pupæ of *C. potatoria* and *E. quercifolia* this central wedge-shaped piece is much longer and larger, but is not distinctly divided into an upper and a lower portion, for the central division is only apparent from the tip to about two-thirds up towards the labium. Comparing with a pupa of *M. rubi*, the upper (undivided) portion should represent the labial palpi, and the lower (divided) portion the probable 1st femora. In the pupa of *C. potatoria*, the upper (undivided) portion is exceedingly thin and transparent, but it is much thicker and more opaque in that of *E. quercifolia*. In the pupa of *L. quercûs*, the central wedge-shaped piece, between the maxillæ, although shorter than in *C. potatoria* and *E. quercifolia*, is still much larger than in *M. rubi*, and is seen to be definitely divided into an upper and lower portion." The point wants elucidating further on much wider material, before any useful generalisation can be formulated.

Tribe: Eutrichidi.

Two genera belonging to this tribe are represented in the British fauna—*Eutricha (quercifolia)* and *Gastropacha (ilicifolia)*. The two genera are, in reality, not very closely allied, but, owing to the absence of any other species very nearly related to either in Britain, they have been united by most authors in the same genus. Thus, Meyrick includes them *(Handbook*, p. 324) in his genus *Gastropacha*, which he diagnoses as follows:

Palpi long or moderately long. Forewings: with strong rounded dorsal prominence on apex of *1b*; 6 and 7 stalked, 8 sometimes out of 7, 9 to termen or apex. Hindwings: 4 and 5 sometimes stalked, 6 and 7 approximated at base from angle, 8 connected with cell by long oblique bar or anastomosing with 7 near origin; from 1 to 6 pseudoneuria present.

This diagnosis is, of course, really that of the tribe. Meyrick characterises *quercifolia* and *ilicifolia*, *i.e.*, our genera *Eutricha* and *Gastropacha* thus:

1. Termen dentate; hindwings with 6 pseudoneuria — *quercifolia* (=*Eutricha*).

2. Termen not dentate; hindwings with one or two pseudoneuria—*ilicifolia* (=*Gastropacha*).

This tribe is the restricted *Gastropacha* of Germar (*Bomb. Spec.*, sect. 2, p. 50), and is practically the coitus *Phyllodesmae* of Hübner (*Verz.*, p. 190), details of which may be obtained by reference to vol. ii., pp. 450—451. Meyrick notes it as a small European and Asiatic group. There would appear also to be a very fair extension of *Gastropacha* into North America, if Kirby's references to this genus are accurate. Kirby gives (*Cat.*, p. 824): *G. americana*, Harr. (N. America), *ferruginea*, Pack. (Michigan), *californica*, Pack., and *roseata*, Stretch (California), *alascensis*, Stretch. He also doubtfully adds two Panama species—*modesta*, Druce, and *thyatira*, Druce. Huguenin records (*Mitt. Schw. Ges.*, iv., p. 30) a case of supposed hybridity between *Eutricha quercifolia* and *Gastropacha betulifolia* (*tremulifolia*).

Genus: GASTROPACHA, Ochsenheimer (EPICNAPTERA, Rambur).

SYNONYMY.—Genus: *Gastropacha*, Ochs., "Die Schmett.," iii., p. 240 (1810); Germ., "Bomb. Spec.," p. 51 (1812); Stphs., "Illus. Haust.," ii., p. 53 (1828); Humph. and West., "Br. Moths," p. 61 (1843?); Evers., "Faun. Volg.-Ural.," p. 150 (1844); H.-Sch., "Sys. Bearb.," ii., p. 150 (1846); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 25 (1851); Led., "Verh. z.-b. Wien," ii., abh. p. 74 (1853); Sta., "Man.," i, p. 158 (1857); Spey., "Geog. Verb.," i., p. 405, (1858); ii., p. 287 (1862); Hein., "Schmett. Deutsch.," p. 202 (1859); Ström, "Danm. Sommerf.," p. 84 (1891); Meyr., "Handbook," p. 325 (1895); Barr., "Lep. Brit.," p. 46, pl. 96, fig. 1 (1896); Tutt, "Brit. Lep.," ii., p. 450 (1900). *Phalaena (-Bombyx)*, Linn., "Sys. Nat.," xth ed., p. 497 (1758), xiith ed., p. 813 (1767); "Faun. Suec.," ii., p. 293 (1761); Esp., "Schmett. Eur.," iii., p. 63 (1783); Vill., "Linn. Ent.," ii., p. 121 (1789); Bkh., "Sys. Besch.," iii., p. 69 (1790). *Phalaena*, Retz., "Gen. et Spec.," p. 36 (1783). *Bombyx*, Fab., "Sys. Ent.," p. 562 (1775); "Spec. Ins.," ii., p. 174 (1781); Esp., "Schmett. Eur.," iii., pl. vii., figs. 2-6 (1782); Hb., "Larv. Lep.," iii., Bomb., ii., Veræ S. *b-c*, 1 (*circ.* 1800); "Eur. Schmett.," ii., fig. 190 (*circ.* 1800); p. 148 (?1805); Lasp., "Ill. Mag.," ii., p. 51 (1803); Godt., "Hist. Nat.," iv., p. 84 (1822); Snell., "De Vlind.," i., p. 178 (1867), supp., p. 1142 (1882). *Lasiocampa*, Schrank, "Faun. Boica," ii., Abth. 2, p. 154 (1802); Oken, "Lehrb. Naturg.," i., p. 707 (1815); Bdv., "Eur. Lep. Ind. Meth.," p 47 (1829); "Gen. et Ind. Meth.," p. 61 (1840); Dup., "Cat. Méth.," p. 73 (1844); Bohem., "Vet. Ak. Handl.," 1848, p. 143 (1850); Staud., "Cat.," ed. 1, p. 30 (1861); ed. 2, p. 70 (1871); Nolck., "Lep. Fn. Est.," i., p. 131 (1867); Berce, "Faune Franç.," ii., p. 201 (1868); Newm., "Br. Moths," p. 46 (1869); Curò, "Bull. Soc. Ent. Ital.," viii., p. 152 (1876); Oberth., "Etudes," v., p. 37 (1880); Frey, "Lep. Schw.," p. 98 (1880); Porritt, "Yorks. Lep.," p. 30 (1883); Lampa, "Ent. Tids.," vi., p. 42 (1885); Auriv., "Nord. Fjär.," p. 65 (1889); Rühl, "Soc. Ent.," v., p. 179 (1891); Jord., "Schm. N.-W. Deutsch.," p. 96 (1886); Hofm., "Die Grossschmett.," p. 54 (1887); Tutt, "Brit. Moths," p. 62 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 59 (1898). *Phyllodesma*, Hb., "Verz.," p. 190 (?1822); Kirby, "Cat.," p. 824 (1892); Grote, "Ill. Zeits. für Ent.," iii., p. 71 (1898). *Euthrix*, Meig., "Eur. Schmett.," ii., pp. 191—193, pl. lxxvii., figs. 4 *a-b* (1830). *Epicnaptera*, Ramb., "Cat. Lép. And.," p. 344 (1866); Auriv. "Iris," vii., pp. 166, 168 (1894); Tutt, "Proc. Sth. Lond. Ent. Soc.," 1898, pp. 1 *et seq.* (1898); Dyar, "Can. Ent.," xxx., pp. 4—6 (1898); "Ent. Rec.," xi., p. 142 (1899); Staud., "Cat.," 3rd ed., p. 123 (1901). *Ammatocampa*, Wallgrn., "Skand. Het. Fjär.," ii., p. 113 (1869).

The genus *Gastropacha* is diagnosed (*Die Schmett.*, iii., p. 259) by Ochsenheimer as follows:

This genus falls into several families, each of which has, indeed, its distinguishing characters, but which cannot well be separated, since the most unmistakable transitions from one to another occur. Excepting the superior thickness of the abdomen in the ♀, no general distinctive character is to be found, unless one goes upon larval conditions; therefore I took the generic name from the Greek γαστηρ=venter, and παξος=crassitudo.

Ochsenheimer's genus, as we have before stated, is not only heterotypical but rather more comprehensive than the whole of our superfamily, *Lachneides*. So much is this so, that Ochsenheimer himself divided the genus into 7 sections (*vide, antea*, vol. ii., p. 449), which he called "families" at the time he created it, in 1810. In 1812, Germar restricted this heterotypical genus to the four species—*quercifolia, populifolia, betulifolia* and *ilicifolia*. His description of the genus reads as follows:

Palpi duo porrecti, triarticulati, hirti, subcylindrici, apice obtusi. Lingua nulla. Antennæ filiformes, (maris) pectinatæ—*quercifolia* (*alnifoliam*, Ochs., vix speciem distinctam puto), *populifolia, betulifolia, ilicifolia.*

These four species are themselves heterotypical, *quercifolia* and *populifolia* being congeneric and generically distinct from *betulifolia* and *ilicifolia*, which are also congeneric. But, in 1806, Hübner had (*Tentamen*, p. 1) fixed *quercifolia* as the type of his genus *Eutricha*, which, therefore, was not available as the type of *Gastropacha*, as restricted by Germar, nor, indeed, was *populifolia*, which, if *quercifolia* was referable to *Eutricha*, had to be included in the same genus. This left only the congeneric *betulifolia* and *ilicifolia* possible types of *Gastropacha*, and we consider our conclusion (*antea*, vol. ii., p. 450) to restrict *Gastropacha* to this group the only logical one*. Aurivillius, refusing to acknowledge the authority of Hübner's *Tentamen*, states that (*Iris*, vii., pp. 166—168) *quercifolia* is the type of *Gastropacha*, and, considering *suberifolia* the type of Rambur's *Epicnaptera*, he includes *ilicifolia* and *tremulifolia* (*betulifolia*) therein, and diagnosed the genus as follows:

IMAGO: Palpi much shorter than in *Gastropacha* (*Eutricha*), bristly-haired, their terminal joint scarcely double as long as broad; the "Schienenblatt" of the front tibiæ in the ♂ short, scarcely extending beyond the middle, in the ♀ diminutively small, knob-like; the middle and hind tibiæ with tolerably long terminal spurs. The margin of the wing and the fringes wavy or dentate; the forewing between nervures 1 and 2 deeply hollowed out and without teeth in the concavity. The costa of the hindwings in the basal half projecting and very strongly "ventricose," then deeply hollowed out. Neuration: the transverse nervure of the hindwing in or behind the middle weakly broken, sending out a weak fold that runs back into the cell; 2 of forewing originating very near the base, 2—8 of forewing run into the margin, 9 into the apex, and 10—12 into the costa; 7 of hindwing starts quite near the front angle of the middle cell; the transverse nervure which closes the basal cell is much shorter than in *Gastropacha* (*Eutricha*) and starts from the same point as nervure 7, or out of the base of 7; of the supplementary nervures 1 comes from the base and only 2—3 from the basal cell, but none from the free part of 8. Body densely hairy. Antennæ: ♂ with moderately long pectinations, which become gradually shorter towards base and apex; ♀ with very short pectinations, at base almost serrations. LARVA: The larva differs at once from that of *Gastropacha* (*quercifolia, populifolia*) in the simple (often also shorter) foot-like lateral warts, in the somewhat smaller protuberance on 11th segment, and especially in the quite *naked* "Prachtflecken" of segments 2—3. PUPA: With short hairs, frosted with blue, and with numerous clasping bristles on anal part. Hybernates in a soft, mealy cocoon.

GASTROPACHA ILICIFOLIA, Linné.

SYNONYMY.—Species: *Ilicifolia*, Linn., "Sys. Nat.," xth ed., p. 497 (1758); xiith ed., p. 813 (1767); "Faun. Suec.," 2nd ed., p. 293 (1761); Fb., "Sys. Ent.," p. 562 (1775); "Spec. Ins.," ii., p. 174 (1781); Vill., "Linn. Ent.," ii., p. 121 (1789); Lasp., "Ill. Mag.," ii., p. 51 (1803); Hb., "Eur.

* Prout comes to a different conclusion. He considers that *Gastropacha*, Ochs., Germ., is a synonym of *Eutricha*, Hb., through Curtis' type citation of *quercifolia*, and, therefore, accepts *Epicnaptera*, Ramb., as the correct title for this genus.

Schmett.," text p. 148 with ref. to fig. 190 (? 1805); "Verz.," p. 190 (? 1822); Ochs., "Die Schmett.," iii., p. 240 (1810); Germ., "Bomb. Spec.," p. 51 (1812); Oken, "Lehrb. Naturg.," i., p. 707 (1815); Godt., "Hist. Nat.," iv., p. 84 (1822); Stphs., "Ill. Haust.," ii., p. 53 (1828); "Zool.," ix., p. 3244 (1851); x., p. 3358 (1852); Bdv., "Eur. Lep. Ind. Meth.," p. 47 (1829); "Gen. et Ind. Meth.," p. 47 (1840); Meig., "Eur. Schmett.," ii., p. 193, pl. lxxvii., figs. 4*a*—*b* (1830); Zell., "Isis," 1839, p. 279 (1839); Humph. and Westd., "Brit. Moths," p. 61 (? 1843); Dup., "Cat. Méth.," p. 73 (1844); Evers., "Faun. Volg.-Ural.," p. 150 (1844); H.-Sch., "Sys. Bearb.," ii., p. 103 (1846); Heydrch., "Lep. Eur. Cat. Meth.," ed. 3, p. 25 (1851); Smith, "Zool.," 1851, p. 3178; *loc. cit.*, p. 3212 (1851); Atknsn., *loc. cit.*, p. 3396 (1852); Led., "Verh. z.-b. Wien," ii., Abh. p. 74 (1853); Sta., "Ann.," 1855, 1st ed., p. 7 (1854); 2nd ed., p. 29 (1855); "Ent. Wk. Int.," ii., p. 34 and fig. (1857); "Man.," i., p. 158 (1857); Part., "Ent. Wk. Int.," i., p. 67 (1856); Weav., *loc. cit.*, ii., p. 12 (1857); Bonney, *loc. cit.*, ii., pp. 28, 43—44 (1857); iv., p. 27 (1858); Spey., "Geog. Verb.," i., p. 405 (1858); ii., p. 287 (1862); Hein., "Schmett. Deutsch.," p. 202 (1859); Smith, "Ent. Wk. Int.," vi., p. 163 (1859); Baker, *loc. cit.*, viii., p. 19 (1860); Lickley, *loc. cit.*, p. 51 (1860); Meld., *loc. cit.*, x., p. 85 (1861); Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 70 (1871); 3rd ed., p. 123 (1901); "Rom. Mém.," vi., p. 322 (1892); "Iris," v., p. 353 (1892); Ramb., "Cat. Lép. And.," p. 344 (1866); Nolck., "Lep. Fn. Est.," i., p. 131 (1867); Berce, "Faun. Franç.," ii., p. 201 (1868); Wallgrn., "Skand. Het.," ii., p. 114 (1869); Newm., "Brit. Moths," p. 46 (1869); Curò, "Bull. Soc. Ent. Ital.," viii., p. 152 (1876); Frey, "Lep. Schweiz," p. 98 (1880); Oberth., "Etudes," v., p. 37 (1880); Snell., "De Vlind.," supp. p. 1142 (1882): Freer, "Ent.," xvi., p. 260 (1883); "Ent. Rec.," vi., 238 (1895); Lampa, "Ent. Tids.," vi., p. 42 (1885): Storey, "Yorks. Nat.," 1886, p. 209 (1886); Jordan, "Schmett. N.-W. Deutsch.," p. 96 (1886); Hofm., "Die Grossschmett. Eur.," p. 54 (1887); Buck., "Larvæ Brit. Moths," iii., pl. li., figs. 2—2*a* (1889); Auriv., "Nord. Fjär.," p. 65 (1889); "Iris," vii., p. 167 (1894); Rühl," "Soc. Ent.," v., p. 179 (1891); Kirby, "Cat.," p. 824 (1892); Meyr., "Handbk.," p. 325 (1895); Burnett, "Ent. Rec.," vi., p. 237 (1895); Tutt, "Brit. Moths," p. 62 (1896); "Proc. South Lond. Ent. Soc.," pp. 1—11 (1898); Barr., "Lep. Brit.," iii., p. 46, pl. xcvi., fig. 1 (1896); Dyar, "Can. Ent.," xxx., pp. 4—6 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 71 (1898); Reutti, "Lep. Bad.," 2nd ed., p. 59 (1898). *Foliumsiccum*, Retz., "Gen. Sp. Ins.," p. 36, no. 42 (1783). *Betulifolia*, Esp., "Schmett. Eur.," iii., pl. vii., figs. 2 - 6 (1782); p. 63 (1783); Bkh., "Sys. Besch.," iii., p. 69 (1790); Hb., "Larvæ Lep.," Bomb. ii., Veræ S. *b*-*c*., 1 (*circ.* 1800); "Eur. Schmett.," ii., fig. 190 (*circ.* 1800).

ORIGINAL DESCRIPTION*.—*Ilicifolia. P. Bombyx* elinguis, alis reversis serratis ferrugineis, margine postico albo variegato. De Geer, *Ins.*, i., t. 14, f. 7, 9. Habitat in *Salice* (Linné, *Sys. Naturae*, xth ed., p. 497). In the 12th ed., p. 813, this description is altered to: "*P. (B.)* elinguis, alis reversis, semitectis, serratis griseis, margine postico albo variegato. Margo inter dentes alæ albus est. Antennæ pallidæ."

IMAGO.—31mm.—52mm. Anterior wings, with projecting tooth on inner margin; reddish-brown, shaded with grey medially and towards the outer margin; three transverse blackish lines, the basal bluntly angulated, the second beyond the middle angulated and dentate, the outer, antemarginal line dentate; blackish median lunular mark; nervures dark. Hindwings greyish-fuscous, with two dark transverse shades, paler between these and on the hind margin. Outer margin of wings dentate. Fringes whitish, chequered with dark ferruginous, at the ends of the nervures.

SEXUAL DIMORPHISM.—The extreme measurements of some 40 specimens worked out as follows: Males 31·25mm.—47mm.; females 42mm.—52mm. There is a distinct difference between

*De Geer gave an excellent description of the imago (*Mémoires*, i., p. 233) of this species, in 1752, some years before it was named and described by Linné.

the sexes, somewhat similar to, but less marked than, that exhibited by most of its allies. The male is smaller, the wings shorter, and the body more slender. Chapman notes a distinct sexual difference in the antennæ: ♂. Antennæ with about 42 joints, length 6·5mm.; length of plumules about the middle of antenna 0·6mm., at basal portion (about segment 8 to 10) of upper set 0·48mm., of lower 0·8mm., the difference ceases to be marked about segment 14 or 15—so that the scoop-like arrangement is distinct enough without being exaggerated. The dorsal scaling consists of about two rows to a segment, but is quite irregular; there are scales on the dorsal aspect of the shorter series of plumules. The plumules carry about 26 rows of long hairs, divided as usual into a set on each side, not always quite opposite each other. The plumules are clubbed to a very trifling extent, are sloped off a little at the distal aspect of the end, and on this slope is the baton spike, which is a small, fairly ordinary bristle. This is the structure except towards the apex, where the clubbing is a little greater, the shaft bends distally at its end, making the sloping surface point distally, and the baton is baton-like, very thick and short, with one small accompanying bristle. ♀. Length 6·0mm. composed of about 40 joints; scaling irregular, longest pectinations not twice as long as thickness of shaft, unscaled, upper ones decidedly shorter basally, hairs very much appressed, plumules basally rather conical, apically somewhat clubbed; they each carry a baton, which basally is nearly obsolete, but elsewhere is short, thick and truncated, and a bristle which is well developed on basal plumules but dwindles apically to a minute companion of the baton.

Gynandromorphism.—The following is, so far as we know, the only recorded gynandromorphic example of this species:

a. Left ♂, 17mm.; right ♀, 20mm. In colour the two pairs of wings exhibit no difference, only the left (♂) side is smaller and more rounded towards apex of forewing. The antennæ, in the strength of shaft and character of the teeth, midway between ♂ and ♀; left antenna distinctly shorter (apparently crippled). The principal mark of gynandromorphism is in the formation of the abdomen; it is more ♀ in form with a dividing line of bristles along it, which, on the underside, is curved towards the left, just as the body and anus are towards the male side. In agreement with this the left side has the soft, woolly, erect down characteristic of the ♂, whilst the right (♀) side of the body has the smooth female down; the abdomen is also thicker on the right, and more full or swollen. Bred in Saxony (Wiskott, *Festschrift Ver. Schles. Ins.*, 1897, p. 120).

Variation.—The species appears subject to considerable minor colour variation, and reminds one much in this respect of the variation of *Lachneis lanestris*, the extremes of colour being grey (in central Europe) and red (in Britain). Our British examples are markedly redder than most of those from the Continent, although some are indistinguishable, and the Japanese form (if it be not indeed a distinct species) is also redder than the type. In his *Etudes*, v., p. 37, Oberthür records a ♂ and ♀ taken in April, 1879, in the Island of Askold, which he says are larger and more brightly coloured than European specimens. These, we suspect, are referable to var. *japonica*. It is possible that the var. *sinina* is closely allied to, if not identical with, our British form, in spite of the difference in habitat, but one wants specimens of *sinina* for comparison before one can safely decide. McArthur exhibited at the meeting of the South London Entomological Society, February 13th, 1896, two British examples belonging to the "Fry" collection, which were completely banded, *i.e.*, the area between the lines on either side of the middle of the wing, and enclosing the median lunule, was filled in to form a dark transverse band, ab. *virgata*, n. ab., whilst another specimen had a yellow ground colour, ab. *lutescens*, n. ab. Occasionally one finds pale grey examples with scarcely a trace of red or dark grey in the ground colour=ab. *pallida*, n. ab., but the chief aberrations are included in the following table:

GROUND COLOUR RED.

1. Red, almost unicolorous=ab. *unicolor-rufescens*, n. ab.
2. Red, with grey or purplish-grey outer margin to all wings, small whitish discal area on forewings, and whitish transverse band to hindwings=ab. *rufescens*, n. ab.
3. Red, with grey or purplish-grey outer margin to all wings, a large whitish discal area on forewings, and transverse whitish band across fore- and hindwings=*ilicifolia*, Linn.

GROUND COLOUR GREY.

1. Pale grey, basal two-thirds of forewings tinged with reddish, small whitish discal spot, outer area of all wings grey or purplish-grey, hindwings only with whitish transverse band=ab. *grisea-pallida*, n. ab.
2. Dark grey, basal two-thirds of forewings tinged with reddish, discal area somewhat paler, outer area of all wings dark grey, transverse bands of fore- and hindwings whitish-grey=ab. *grisea*, n. ab.
3. Dark grey, usual dark transverse lines almost obsolete, nervures reddish, dark discal lunule small, outer margins of all wings dark grey; the usual whitish transverse lines obsolete, hindwings dark grey with faint median transverse shade=ab. *grisea-suffusa*, n. ab.

The only described forms of the species appear to be the two following, both from the extreme east of the Palæarctic area:

a. var. *sinina*, Grumm-Grschm., "Hor. Soc. Ent. Ross.," xxv., p. 465 (1891); Kirby, "Cat.," p. 824 (1892); Auriv., "Iris," vii., p. 168 (1894); Staud., "Cat.," 3rd ed., p. 123 (1901).—Varietas pallidior, rosaceo-fulvescens. In montibus ad Sinin reperta.

β. var. *japonica*, Leech, "Proc. Zool. Soc. Lond.," 1888, p. 628 (1888); Kirby, "Cat.," p. 824 (1892); South, "Ent.," xxxi., p. 231 (1898); Staud., "Cat.," 3rd ed., p. 123 (1901).—1 ♂, 2 ♀, coll. Pryer. The Japanese form of *G. ilicifolia* differs from the European type in size and colour. It expands 56mm., and is pale reddish-brown with all the violet-tinged white markings well defined; there is, however, no character by which it can be specifically separated from *G. ilicifolia*, therefore I propose for it the varietal name *japonica*. Yesso (Leech).

South re-diagnoses this race (*Ent.*, xxxi., p. 231) as "pale reddish-brown, with well-defined white markings, which are tinged with violet." The specimens in the Leech collection measure (roughly)—♂. 39·5mm., ♀ 54mm. The examples have the red ground-colour brighter, and the paler parts of the wing more extended, than in the European examples.

OVUM.—(From dead specimens, one of which, however, seems to have preserved both form and markings very completely, though colour cannot, of course, go for much.) The egg is flat, *i.e.*, has three diameters, each different, and also is thinner and narrower at one end. The length is almost 1·5mm., the width 1·1mm. to 1·15mm., and the depth 1·0mm. The top (micropylar end) is larger than the other, whether the egg be viewed from the side or from the edge. Viewed on the side, the edges are convex, and the outline quite "egg"-shaped. It is 0·9mm. across at a distance from the nadir, that, at the same distance from the top, measures 1·0mm. Viewed on edge the sides are seen to be flattened, perhaps on the upper side almost hollowed, consequently the widest part of the egg here (1·0mm.) is only one-fourth from the top; at the nadir it is only 0·8mm. at about the same distance from the end. The egg has a beautiful arrangement of markings, white (porcellanous and opaque) on a darker ground (thinner and more transparent). The details appear to vary a little on different eggs. The top (micropylar end) is white, except a small circular micropylar area. Calling one edge dorsal and one ventral (arbitrarily and for convenience), two white lines leave the top and proceed down each side of the dorsum, and, before quite reaching the end, curve round the side and meet in front. Ventrally, the white top is produced downwards so as to include a transverse pale strip, and about the middle is again a transverse white strip. On each side is a circle, or rather ellipse, of not so pronounced white, forming a sort of centre, round which the white dorsal lines curl concentrically. The micropylar area is about 0·15mm. in diameter, and in this width there are about 12 cells, *i.e.*, roughly 6 circles of hexagonal cells occupy the area, the smallest centrally. The central ones are placed in a rosette of 8, and have a stellate set of lines at the micropyle (result of egg being old and cells parting from each other?). Outside this area no cells can be made out, but there are a number of fine dots that appear to be placed at the angles of a set of (invisible) hexagonal cells, often tolerably regular, and varying in size from 0·02mm. to 0·03mm. in diameter. Under a higher magnification these dots or points appear to be really very fine hair-like points (Chapman). Ochsenheimer says: "The eggs are longish oval in outline, white, marked with brown, above with a black spot." De Geer describes them as being of the form of small elongated bowls, white, with some brown spots; a black point at one of the ends.

Habits of larva.—Stainton repeats Ochsenheimer's observation, that, "at Leipzig, the larvæ and cocoons are brought in hundreds almost every year, for sale, to the market, by the country people who gather bilberries." Freer writes (*Ent.*, xvi., p. 260) that he found three larvæ in 1879 and two in 1883 on Cannock Chase, that they were difficult to find, reposing in the daytime on twigs of heather, preferring dead or old twigs; he suspects that they feed at night, as he never found any feeding or even resting on their foodplant, *Vaccinium myrtillus*. Hering states that, in Stettin, he found the full-grown larvæ resting low down on aspen. De Geer writes (*Mém.*, i., pp. 229 *et seq.*): 'The larvæ are heavy and slow, walking little, the body supple and flaccid as are those of the 'lackey' larvæ. Sometimes the larva takes up a very remarkable attitude, rolling itself into a circle with the legs and venter outside, occasionally the larva only raises the anterior part of the body, and folds it back, resting often more than a quarter of an hour in this position, at other times it will bend the front of the body back so that the head touches the 8th or 9th segment, and, as the larva at the same time maintains its hold by its prolegs, it appears as if the body were bent in two."

Larva.—*Adult* (from blown example). Length 1·6ins., diameter at widest segment (5th abdominal) ·15ins. Superficially the larva reminds one of a dull or rather brownish larva of *Cosmotriche potatoria*. Head: Rounded, only slight tendency to square or trapezoidal outline; colour, dull bluish-grey, dead velvety-looking surface, with thickly-scattered, rather fine, black and pale brown hairs covering it; clypeal triangle orange and black; mouth-parts pale red-brown and black; antenna (rather shrunken) with the base pale brown; ocelli large, black, five in semicircle (? another near base of antenna). Body: The thoracic rather smaller than the abdominal segments, of which the 4th and 5th are largest; subdivisions of segments distinct, the abdominal segments subdivided into 5 subsegments. The skin dull bluish-grey, mottled with velvety-black and some orange-red; on the dorsal area, the latter (mixed with some white) forms two irregular and diffused subdorsal longitudinal bands; these are wider at the junction of the segments, and it is here that the white mottlings are chiefly in evidence; some rather obscure transverse bands of the red mottlings may be discerned near the middle of the abdominal segments, crossing the dorsal area; laterally the red mottling again becomes prominent, forming the predominant ground colour at, and below, the spiracles. The spiracles are brown-grey, with a black rim of rather large size. True legs black. Prolegs velvety-black, with some orange-red on anterior and posterior sides. The ventral area velvety-black, with bright yellow intersegmental bands at the junction of the meso- and metathorax, of the metathorax and 1st abdominal, of the 1st and 2nd abdominals, and so on as far as the incision between the 6th and 7th abdominals, so that, altogether, there are 8 intersegmental yellow bands on the ventral area; there is also a pale (doubtfully-coloured) spot centrally on the anterior of the ventral area of abdominal segments 2 to 7, and two smaller ones on the posterior edge of abdominal segments 1—3 and 8. The ventral and lateral areas are distinctly separated by the long loose hair-tufts arising from the situations of the marginal tubercles vii, and also by dense tufts of short, silky, brilliant, white hairs at the posterior and anterior edges of each segment from the meso-metathoracic incision to that between the 7th and 8th abdominal segments; viewed ventrally these white tufts and yellow intersegmental bands cut up the ventral area into a chain of large black patches, bordered by white at the sides, and yellow in front and behind. [Probably this coloration has a "startling" protective value to the larva when dislodged from its resting-place, as in all probability, under these circumstances, it wriggles vigorously, as do its relatives and other twig-resting larvæ, such as those of the Catocalas, etc.] The ventral area is thickly covered with very small scattered black hairs, too small and fine to be clearly distinguished, unless a lens be used. The lateral hair-tufts are very strong and long, and rise from raised skin areas (tubercular bases), but these (the skin areas) do not form processes as in the larva of *Eutricha quercifolia*. The region of the anterior trapezoidals on the 8th abdominal segment is somewhat raised into a low circular mound, rendered more conspicuous by its dark colour. The dorsal areas of the meso- and metathoracic segments each bears a brilliant, scarlet, oblong, transversely-set spot, and the deep cutting of the subsegment where this spot occurs suggests that the larva, when living, is able to diminish or increase its area, if not to completely hide it, at will. On either side of each scarlet spot is a deep, blue-black velvety-looking dash; behind it at either end is a wedge-shaped white spot, with its apex just touching at the posterior angles of the scarlet spot. The dove-tail-shaped area between the red and white spots is nearly black. The whole scheme forms a dorsal pattern, which is faintly repeated on the abdominal segments, the white and red especially being very diffused and faint, and the black subdorsal patches being altogether wanting on the abdominal segments. The lateral and dorsal areas are covered with numerous fine scattered hairs, with a smaller number of longer black ones, which I think rise exclusively from the tubercular areas. There is a distinct tendency for the hairs to form into transverse ridges as in the larvæ of *Macrothylacia rubi*, *Cosmotriche potatoria*, *Lasiocampa quercûs*, etc. (Bacot). De Geer gives the following description of the (living) larva (*Mém.*, i., p. 229, pl. xiv., figs. 1—9): "2ins. in length, very stout, the diameter of the body almost uniform throughout, except the head and last segment, which are less wide than the rest. The larva is very hairy, the hairs not very long, nor do they hide all the colours of the skin. The dorsum and sides of the body are tan-yellow and dark, approaching brown, along either side, and above the stigmata is a wide dark blue streak, pointed with black. Each segment except the first and last has, on the upper side, towards the posterior edge, two large white spots edged anteriorly with black, on the second and third segments there are, below the white spots, a black one on each side; the yellow of the back is mixed with black and with bluish; the head is grey, approaching black; the venter is of a rich velvety-black; between each pair of segments, except at the junctions of the first three, is a transverse yellow band; the six true legs are corneous and black, but the prolegs are yellowish, particularly on the outside, the semicircle of crochets on the prolegs being brown. On the 11th (penultimate) segment is a rounded eminence well-furnished with scales; all the upper part of the body is furnished with many yellowish and some blackish hairs, which are erect and straight, and come directly from the skin of the larva; the sides of the body have, however, a much greater number of hairs of the same colour, which are bent downwards or towards the resting-position in such a manner that, when the larva walks, the tips of the hairs touch the surface on which the larva is walking, and there are among these hairs some scales which are placed horizontally; the hairs on the sides of the body are placed on the conical, yellow, fleshy tubercles; each segment has two of these fleshy eminences, one on either side; but the first segment (prothorax) has four, and they are more raised than on the others; each carries a tuft of hairs pointing towards the head. Between the segments, towards either side, is a tuft of short whitish hairs, which are bent against the venter of the body; at first sight these hairs appear to be white spots; the sides of the body have many folds and ridges. The larvæ are thus most hairy laterally along the line separating the upper and lower parts of the body, and the hairs arising from these areas are directed downwards." Horton describes the larva of this species, from a specimen taken August 3rd, 1864, near Lynton, North Devon, as follows: "A *Bombyx* larva, apparently fullfed; length 1″ 9‴. Head and body hairy; cream-coloured, dusted with black. Hairs on back dark, short; on sides in long white fascicles (a few dark interspersed) curving downwards. Head pale drab, the black atoms on it in longitudinal bands. On the second segment, a reddish blotch bordered with black atoms; a series of markings something like the ace of clubs down the centre of the back, embracing the dorsal line, formed of thicker black atoms, blackest on the fourth segment, into which run lateral stripes of black atoms, from each black spiracle directed backwards. An indistinct spiracular line of black atoms. Legs reddish with black spots; claspers the colour of the body, with a black stripe on the upper surface, orange underneath. Along the ventral line a chain of black spots, very large and conspicuous from commencement of the claspers to the anal segment, gradually smaller towards the head" [*Ent. Mo. Mag.*, i., p. 121 (1864)]. Hofmann describes the larva (*Raupen Grossschmett. Eur.*, p. 54) as "rusty-coloured with black dorsal stripe, in which appear white spots." Ochsenheimer describes it (*Die Schmett.*, iii., p. 241) as follows: "When full-grown it is very supple, long, extended, with short hairs on the back, and longer on the sides, and with a bunch of hairs on the penultimate segment. I know two varieties which are probably sexual: (1) The one is rust-coloured, with two large white dots on each segment, which are bounded inwards by a black central line that widens out towards them; on the 2nd and 3rd segments stands a red-yellow transverse stripe dotted with black on both sides, whilst above the legs it is grey; the head brownish-grey, with rust-coloured hairs. (2) The second variety has on the dorsum red-yellow spots, interrupted by black transverse lines; the spots are connected by a black median line, and are, on both sides, broadly white-margined; above the legs stands a blue-grey stripe; the head is black-grey." Hering says (*Stett. Ent. Zeitg.*, ii., p. 59) that the larvæ he obtained at Stettin resembled the figure of Hübner, and were yet essentially different in some aspects, but he failed to figure it or describe the differences.

Cocoon.—The cocoon is spun up among the foodplant, almost surrounded by leaves, which are fastened flatly and closely to the outer part of the cocoon. The latter is composed of loose flossy silk, pale greyish or dirty white in colour. The inner part of the cocoon more closely woven, reminding one a little of that of *Cosmotriche potatoria*, the upper end being much more closely spun than the other. The lining of the cocoon is formed of loosely woven dirty whitish (inclining to brown) silk. The cocoon is of a soft yielding texture, in this respect also resembling that of *Cosmotriche potatoria*, and not firm and solid like that of *Lasiocampa quercûs*. The pupa is firmly fixed at the lower end of the cocoon by the cremaster (Tutt). Bacot notes: "The cocoons are composed of pale grey-brown silk, loose and flossy on the outer side, smoother, closer and whiter on the inner side; a few larval hairs are felted in the silk. Of two cocoons examined, the slightly larger one is composed of greyer silk, and the grey dust, that is plentifully sprinkled over both pupæ, is paler and less brown in this than in the somewhat smaller one. This may indicate a difference of sex, although the sexual organs of both pupæ appear to be quite similar." Chapman observes that the cocoon opens by a transverse slit that has been prepared by the larva. Ochsenheimer describes it as "yellowish-white, permeated with a reddish-white dust-like material which also covers the pupa." De Geer says: "The larvæ spin oval cocoons between leaves on July 8th and following days, the cocoons are thick and solid, made of a white silk but after they are completed the larvæ powder them interiorly with a reddish-white material after the manner in which the 'lackey' larvæ powder the basement material of their cocoons with a yellow powder. The powder gives the cocoon of *ilicifolia* a reddish colour and makes it very opaque."

PUPA.—The pupa is very striking; the thoracic segments dorsally and the abdominal segments dorsally and ventrally, being covered with pale ochreous, or grey-brown, loose larval hairs, which can be easily removed with a pin, and which are evidently held in place by the stiff golden-brown hairs* with which these portions of the pupal body are studded. *Ventrally:* The skin is blackish-grey in colour, moderately smooth. Mouth-parts smooth, and apparently ill-developed, dark reddish-brown in colour; maxillæ short, moderately developed, the labial palpi small but fairly noticeable; the antennæ much thickened at base, swollen centrally, and showing pectinations by means of transverse segmentation, they narrow off towards tip, and terminate on the costa of the wing at not quite two-thirds from base to apex; the second pair of legs extends beyond the antennæ, the first pair terminating medio-ventrally in a line with the apices of antennæ; the base of first pair of legs expanded and covering base of second pair; the glazed eye is situated on the outer side of a red-brown shiny rounded knob, extending from the base of the antenna to the base of the wing; the dorsal head-piece is not prominent, is supplied frontally with many stiff red-brown bristles, but is without the loose hairy matter which covers the prothorax; the wings are ample, finely corrugated transversely over the greater part of the wing, but longitudinally on the outer margin. The abdominal segments are of a fine silky texture, segments 5 and 6 with two slight shiny depressions occupying the position of the larval prolegs; no bristles ventrally, except at cremaster; movable incisions between 4–5, 5–6, 6–7. *Laterally:* Bristles on frontal part of dorsal head-piece and on prothorax very conspicuous; wings without bristles, black-grey, of a silky texture, slightly reddish-brown at base, a transverse series of tiny longitudinal depressions parallel with outer margin; prothoracic spiracle (hidden by larval hairs) is situated in the incision between pro- and mesothorax, and its margin is little more than a thickening of the incision membrane; the abdominal spiracles also hidden, but after being cleared are visible on the 2nd, 3rd, 4th, 5th, 6th, 7th, and 8th abdominal segments, each is formed of a double pale-margined convex slit placed at the bottom of a shallow oval depression, with a raised rim made of the chitinous material forming the pupal skin; each spiracle is placed on the anterior part of its seg-

* The pupal hairs are stout, stiff bristles, bending forwards on the head and thorax, and nearly vertical on the abdominal segments, colour bright brown. These bristles aid in retaining the flossy silk and greyish powder which form a large woolly mass on the dorsum of the head, thorax, and abdominal segments 1 and 2; on some other parts the pupa is only dusted, whilst at the junction of the movable incisions and on the dorsal ridges it is thickly powdered, the powder giving the pupa a bloom. The woolly appearance is caused by numerous, very fine, silk threads, similar to those found among the egg-masses of *Tephrosia crepuscularia* and *T. bistortata*, mixed with small oblong crystals (Bacot).

ment, whilst behind it, and continued from the dorsal area, are some stiff red-brown bristles on the prominent part of the segment, which (bristles) end a little ventrally to the spiracles. *Dorsally:* Everything is hidden by the fluffy material (larval hairs, &c.) in which the pupa appears to be almost enveloped. The prothorax covered with long stiff bristles projecting frontally; the prothoracic spiracle more conspicuous than when viewed laterally; the mesothorax not very swollen, plentifully supplied medially also with long, stiff, red-brown bristles which stop short at the base of the wing; the metathorax plentifully supplied with bristles medially, but without bristles laterally; at the base, in contact with the hindwings, the 1st and 2nd abdominals are very slightly depressed; these segments are narrow, plentifully supplied with bristles medially, and above and behind the spiracles; the 3rd, 4th, 5th, and 6th segments are raised posteriorly, and the bristles form a regular ring on the raised margin of these segments extending on either side behind and for a short distance lower than the spiracles; the 7th and following segments are more plentifully supplied medially, but still on the posterior portion of the segment, whilst the anterior portion of these segments (comparatively smooth on abdominal segments 4—6) is somewhat roughened; anal area rounded, with dark recurved hairs* mixed with the shorter brown ones, the whole forming a very serviceable cremaster (Tutt. Described March 10th, 1896, from pupa sent by Voelschow), ♀ pupa. Length 19mm., greatest width 8mm. Has a marked Lachneid outline (taking the pupa of *Malacosoma neustria* as being rather typical) in so far that the greatest diameter is at the 4th abdominal segment; 5th and 6th are each smaller, not so much by tapering as by each being, though itself cylindrical, smaller than its predecessor, and as if capable of telescoping into it; 7th still smaller and tapering notably; 8th more cylindrical, followed by 9 and 10 tapering rapidly into a blunt round extremity, incision 7—8 thus looks very narrow, and the whole of the abdominal segments are slightly curved forward. The tapering forward from the 4th abdominal segment is less marked, especially seen laterally, till the thoracic segments are reached. The pupa is dark brown, surface a little rough, but, like those of many Lachneids, its minute characters are obscured by a felting of larval hairs entangled amongst the bristly hairs with which the pupa itself is freely covered in various aspects. The antenna-, leg- and wing-cases are free from hairs, and have a finely granulated surface. These pupal hairs are short, stiff, straight, little bristles, a group of which, in two divisions, occupies the antenna-basal region. The prothoracic and mesothoracic segments on dorsum are well covered by them, slightly porrected, so that they look as if they had had a good brushing forward, but, being very stiff, had fairly resisted it. It would perhaps be correct to say that the abdominal segments are wholly clothed with hairs. These are, however, only noticeably long at the posterior dorsal margin of each segment, extending less markedly laterally, but still very obvious on the 5th, 6th, 7th, and 8th abdominal segments, and on the 5th there are some very distinct but shorter ones

* The cremastral hooks are absent in the pupa of *E. quercifolia*, being replaced by simple bristle-like hairs. Allowing for the difference in size, the hairs are much coarser and larger in *G. ilicifolia* than in *E. quercifolia* (Bacot).

ventrally. These hairs are rather bright brown, and extend over the terminal area, where, however, they are mixed with darker ones, with recurved ends, which form a cremastral set of hooks that hold to the pupal silk more firmly than is often found in the Lachneids. The dark hooks are especially terminal, and may be 50 or 60 in number, but silk and larval hairs make them nearly impossible to count. The wing-margins, which meet in front for about 2mm., are about half-way down the pupal length, then forward in the middle line are the 2nd tarsi, the 1st tarsi, the maxillæ, and the labial palpi, which are small and short, but well exposed by the narrowness and separation in the middle line of the maxillæ. The oral region is very smoothed down. The labium and its palpi have almost a glazed surface, and are paler than the surrounding parts, indicating a very short ancestry for their being so fully exposed, the labrum is above this and the jaws (mandibles) at each side. In some specimens, on the cheek, at each side of the labrum is a prominent point, which is not the mandible. The glazed eye is small and in the usual position, the antennæ extend downwards between the 2nd legs and the wings all but as far as the ends of the 1st tarsi. The narrow margin of hindwing extends to the hind margin of the 3rd abdominal segment. On the forewing the neuration is not shown and Poulton's line is absent or extremely close to the actual margin. The abdominal segments have some pits along their median and anterior portions (Chapman). Ochsenheimer describes the pupa as "short and thick, blackish-blue, and here and there red-haired." De Geer writes: "The pupa is bluish-black and drab, length nine and a half lines (it is remarkable that larvæ two inches in length transform into pupæ hardly half as long); it is covered with a reddish-white powder, and is remarkable in that the upper part of the corselet and the head are supplied with many small red hairs; similar hairs are seen on the abdominal segments, but they are not so numerous."

Dehiscence.—The pupal dehiscence is by splitting down the dorsal line to end of mesothorax, the separation of the wings from the antennæ and from the metathorax, some loosening of antennal base, and separation of prothorax, so that it may even be carried away and lost.

Foodplants.—Various species of *Salix* (De Geer), *Salix caprea*, *Vaccinium myrtillus* (Ochsenheimer), *Populus tremula* (Moeschler), *Cytisus* (Viertl), birch and *Corylus mandschurica* (Staudinger), *Betula alba* (Teich), *Salix*, *Populus* (Rühl), apple, willow (Stephens).

Parasites.—Weaver notes (*Zool.*, xv., p. 5718) the breeding of a large ichneumon from a pupa of this species. The name of the parasite is not mentioned.

Habits and Habitat.—When at rest the imago sits with its antennæ drawn back, the forewings placed roofwise, the front margin of the hindwings projecting for some distance beyond the front (costal) margin of the forewings, the hind portion of the wings flattened, until the whole insect appears to be excellently protected by its resemblance to a leaf, the grey thoracic crest and margins of the wings looking just like the dust or bloom on the edge of many dead leaves that have wintered. Both sexes remain immovable all day, but become restless at dusk, and the female flies strongly from 8 p.m.—9 p.m. (Tutt). The imagines are very agile, and towards the evening they fly quickly; when they are at rest they place the antennæ by the side of the thorax, and hold the head lowered (De Geer). On May 17th, 1851, Atkinson met with the first authentic British specimen on Cannock Chase, clinging to a dead sprig of heather, apparently but lately emerged from the pupa, and bearing so great a resemblance to a withered leaf, that it would not probably have caught his eye had he not luckily knelt down within a few inches of it to pin a small Tortricid moth (*Zool.*, 1852, p. 3396). The occurrence of this specimen had, however, been mentioned at the meeting of the Entomological Society of London on June 2nd, 1851 (*loc. cit.*, 1851, p. 3178), and exhibited at the meeting of July 7th, 1851 (*loc. cit.*, p. 3212) by Mr. Smith. For a long time previous to this, however, the species had been reputed to be British, having been described by Stephens in 1828 (*Illus. Haust.*, ii., p. 53) and figured by Humphreys and Westwood (*British Moths*, vol. i., pl. xii., fig. 8), although at the time no really British specimen was known. Almost directly after the exhibition of Atkinson's specimen, Stephens recorded (*Zool.*, ix., p. 3244) two larvæ found a few miles from Sheffield by Green, in 1850, one of which pupated, and produced a moth on April 20th, 1851, nearly a month before Atkinson's specimen was taken, and two more larvæ were recorded (*loc. cit.*, p. 3358), as having been taken by Green in 1852; after which a number of specimens were recorded from Cannock Chase, and the moors around Sheffield* and Ripon, Partridge noting among those taken in the former locality, three imagines, captured May, 1857, hanging on undersides of sprigs of heather. Weaver and the brothers Bonney obtained the species at Cannock also in considerable numbers (*teste* Freer, *Ent.*, xvi., p. 260, and *Ent. Rec.*, vi., p. 238), and Freer himself captured the last recorded †Cannock example on May 17th, 1896 (*Ent. Rec.*, viii., p. 86). Rühl records (*Soc. Ent.*, v., p. 179) beating from birch a pair that were *in copulâ*, when he was collecting on the Uto, and that, whilst being boxed, the male suddenly loosed his hold of the ♀ and fell into some faggots beneath, where he was unable to find it. He further notes that the meconium of the ♀ is of a pale silvery colour. Horton's larva, from which the description (*anteà*, p. 193) was made, was taken on August 3rd, 1864, in a wood abounding with bilberry, at Lynton (*E.M.M.*, i., p. 121). Porritt writes (*List Yorkshire Lep.*, p. 30): "The moors near Sheffield and Ripon were formerly well known localities for this scarce species, but it has not been taken there now for some years," and he further notes on the authority of Walsingham that Eedle is supposed to have seen it on the moors at Blubberhouses in 1882. Burnett notes (*Ent. Rec.*, vi., p. 238) that the locality where Bonney used to obtain the larvæ on Cannock Chase in considerable plenty is now greatly changed, part is now a field, the rest a thick covert, and the bilberry, which

* Gregson notes (*Ent. Wk. Int.*, p. 58): "On Sheffield Moor, the locality for *ilicifolia*, Messrs. Brook, Hydes, Thomson, and myself, took many larvæ in September." These captures evidently do not refer to larvæ of *ilicifolia*, in spite of the form of the sentence.

† Freer writes that he "bred two imagines from three larvæ found at Cannock in 1898," and has no doubt that, though the species appears to be dying out there, hard work will still produce it (*in litt.*, Jan. 9th, 1902).

was the food of the larvæ, has had to give way to larch and pine. Some two years after this was written, Freer captured a male on the Chase at some distance from the old locality. Favre notes the species as rare on the arid and bushy moorlands of the lower elevations near Sion in the Valaïs.

TIME OF APPEARANCE.—The time of appearance depends somewhat on the season, but April and May seem to be the chief months for the emergence of this species. De Geer found larvæ in early July, these pupated in due course and imagines emerged the next year from May 23rd onwards after a pupation period extending over ten months; in May in Saxony and Swabia (Ochsenheimer); May in the Zürich district (Rühl); May in Wurtemberg (Hofmann); April and May in Transcaucasia (Romanoff); a ♀ fresh from pupa on the turf moors near Hasik, May 13th, 1866, specimens being rarely found after the middle of June (Nolcken); one male and two females bred in April, 1879, at Askold (Oberthür); end of April in Belgium (Hippert); bred April 20th, 1851, from moors near Sheffield (Green *teste* Stephens); captured May 17th, 1851, on Cannock Chase (Atkinson); two pupæ middle of April, 1856, by Boyle, three imagines May 16th (two) and 20th (one) on Cannock Chase (Partridge); nine ♀s and one ♂ bred March 20th, 1857, and following days, from Cannock Chase (Weaver); bred a ♀ March 25th, 1857, from larva found on Cannock Chase (T. G. Bonney); two bred early April, 1857, from Cannock Chase (E. S. Bonney); three bred April 25th, 1857, from Cannock Chase, one pupa taken April 21st, 1857, in same locality, produced imago next day (F. Bonney); bred a ♂ April 12th, 1858, and three others between then and April 15th, from Cannock Chase (E. S. Bonney); larvæ August 15th, 1859, on Sheffield moors, noted as being like those of *Cosmotriche potatoria*, and an observation that Green and Baker obtained other larvæ (Smith); two ♂s bred 1st week of April, 1860, from two larvæ obtained August, 1859, at Sheffield (Baker); pupa on Ripon moors April 30th, 1860, imago emerged May 9th, 1860 (Lickley); cocoon on Ripon moors, spring of 1861, produced imago May 18th, 1861 (Meldrum), May 17th, 1896, an imago on Cannock Chase (Freer).

LOCALITIES.—DEVON: Lynton (Horton, *E.M.M.*, i., p. 121). [DURHAM*: Castle Eden Dene (Sang *teste* Wheeler).] STAFFORD: Cannock Chase (Weaver). [SURREY: Ascot district† (Edmonds).] YORKS: Ripon Moors (Prest and Meldrum), Sheffield (Baker), moors near Sheffield (Smith), near Ripon (Lickley), ? Blubberhouses (Eedle), once on the Dallowgill Moors, part of the Nidderdale Watershed (Storey).

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* Bankes observes that a specimen of this species was sold with Wheeler's collection labelled as having been "received from Sang and taken in Castle Eden Dene." This he considers a mistake as (1) "The species is not known to have occurred in Co. Durham. (2) There is no entry of the specimen in Sang's diary. (3) If Sang had only taken this one example he would not have sent it away in exchange; if more – where are they? (4) Robson states that "Sang only had one example in his own collection, not taken by himself." On writing to Wheeler the latter informed Bankes that probably some mistake, as to the locality, had occurred, although he did not doubt that he received the specimen from Sang. Bankes says that he has no doubt it came from Cannock Chase, the pinning and setting agreeing with others from this locality.

† Males are said to have been taken at Ascot by Edmonds of Windsor by assembling with foreign-bred females. This wants confirmation badly.

DISTRIBUTION.—Scattered in the Palæarctic region, rare and only observed in the lower regions (Speyer). ASIA: Kentei mts.—Raddefka, Ussuri, Nikolajewsk, Chabarowka (Staudinger), Altai mts. (Speyer), Isle of Askold (Oberthür). AUSTRO-HUNGARY: Tyrol, very rare (Hinterwaldner), Taufers Valley, Innsbruck (Weiler), Bohemia, rare (Nickerl), Chemnitz (Pabst), Bukovina—Czernowitz, very rare (Hormuzaki), Carniola, Bozen, Eppen (Speyer), Fünfkirchen, Transylvania, Galicia (Caradja), Stanislawow (Werchratski). BELGIUM: very rare, Kinkempois, near Liége (Lambillion), Hockai, Hertogenwald, Campine (? Speyer), Spa (Hippert). DENMARK: very rare (Hedemann). FRANCE: not known in south (Constant), very rare, only known from Paris and Châlons (Berce), Auvergne (Sand), dept. Var (Cantener), dept. Doubs (Bruand), Loire-Inférieure—Missilac (Bonjour), Saone-et-Loire—only in forests near Châlons (Constant). GERMANY: distributed but scattered, rare (Heinemann), south-west Germany (Koch), in the Hahnenkamm (Freigericht), Aix, Carlsruhe, Aschuffenburg, Uffenheim (Speyer), north-west Germany — Biedenkopf, Mülhausen, Leipzig, Hameln, Lüneburg (Jordan), Pomerania, near Stettin, very rare (Hering), Spires (Linz), Würtemberg, rare—Stuttgart (Seyffler), Swabia (Ochsenheimer), Loudet in Hardtwald, near Carlsruhe, the Palatinate (Reutti), Lower Elbe dist., not common (Zimmermann), Erfurt, rare (Keferstein), Bavaria, Saxony (Hofmann), Munich, very rare in gardens in the town (Kranz), Rudolstadt, extremely rare (Meurer), Dresden, very rare (Steinert), Thuringia, distributed but very rare—Sondershausen, Coburg, Berlach, near Gotha, etc. (Krieghoff), Hirzberg, etc. (Knapp), Prussia—not very rare, Dantzig, Konigsberg (Schmidt), Silesia—on the Zobten (Prittwitz), Upper Lusatia, rare—Görlitz (Moeschler), Nassau (Rössler), Bavaria, Saxony, Waldenburg mtns., Ratisbor (Hoffmann), Ingolstadt, rare (Schrank). ITALY: northern Italy, rare—Liguria (Curò). NETHERLANDS: not common – Breda, Maastricht (Heylaerts). RUSSIA: southern Russia (Moeschler), Baltic Provinces—on the moorlands of the whole district Groesen, Riga, Kokenhusen, Hasik (Nolcken), Dorpat, etc. (Sintenis), Livonia (Teich), Moscow dist. (Albrecht), Volga dist., very rare (Eversmann), St. Petersburg (Erschoff), Transcaucasia—Borjom (Romanoff), wohl kaum von Sarepta, aber sicher aus dem Ural (Caradja). SPAIN (Hofmann). SCANDINAVIA: rare, northern limit 62° 30′ (Aurivillius), Anneberg in Smoland, Gusum in East Gothland, Horsa in Helsingland, Stockholm, Norway—Christiania, Odalen, Naes Vaerk (Siebke), Sweden, eastern parts, rare, Scania—Helsingland, Norway—southern and central parts, Romsdalen, Finland—southern and eastern parts, Oesterbotten (Lampa). SWITZERLAND: rare (Frey), Bern (Rätzer), Schüpfen (Rothenbach), Oftringen in Aargau (Wullschlegel), Zürich dist. very rare (Rühl), Grisons—Chur, Bergell (Killias), Valais, very rare, in the wooded and dry parts of the lower region—near Sion (Favre and Wullschlegel).

Genus: EUTRICHA, Hübner.

SYNONYMY.—Genus: *Eutricha*, Hb., "Tent.," p. 1 (1806); Dyar, "Can. Ent.," xxx., pp. 4-6 (1898); Tutt, "Proc. Sth. Lond. Ent. Soc.," 1898, pp. 4-5 (1898); "Brit. Lep.," ii., pp. 449, 450, 451 (1900); Grote, "Ill. Zeits. für Ent.," iii., p. 71 (1898); Bacot, "Tutt's Brit. Lep.," ii., p. 439 (1900). *Phalaena-Bombyx*, Linn., "Sys. Nat.," xth ed., p. 497 (1758); xiith ed., p. 812 (1767); "Faun. Suec.," 2nd ed., p. 293 (1761); Poda, "Ins. Mus. Græc.," p. 84, pl. ii., fig. 7 (1761); Müll., "Fn. Frid.," p. 39 (1764); "Zool. Dan. Prod.," p. 117 (1776); Vill., "Linn. Ent.," ii., p. 120 (1789); Bkh., "Sys. Besch.," iii., p. 63 (1790). *Phalaena*, Scop., "Ent. Carn.," p. 193 (1763); Hfn., "Berl. Mag.," ii., pp. 394, 428 (1766); Meyer, "Fuess. Mag.," i., p. 269 (1778); Geoff., "Fourc. Ent. Par.," p. 261 (1785). *Bombyx*, Fab., "Sys Ent.," p. 561 (1775); "Spec. Ins.," ii., p. 173 (1781); "Mant. Ins.," ii., p. 111 (1787); "Ent. Sys.," iii., 1, p. 420 (1793); [Schiff.,] "Schmett. Wien," p. 56 (1775); Esp., "Schmett. Eur.," iii., pl. vi., figs. 3-7., pl. vi *a*, figs. 1-2, p. 56 (1782); Hb., "Larv. Lep.," iii., Bomb. ii., Veræ S. *a—b* (*circ.* 1800); "Eur. Schmett.," figs. 187-188 (*circ.* 1800); text p. 147 (*circ.* 1805); Ill., "Sys. Verz. Wien," n. Ausg., i., p. 103 (1801); Schrk., "Fauna Boica," ii., 1, p. 270 (1801); Haw., "Lep. Brit.," 1, p. 95 (1803); Latr., "Gen. Crust. et Ins.," iv., p. 219 (1809); "Consid. Gén.," p. 362 (1810); Leach, "Edinb. Ency.," ix., p. 132 (1815); Godt., "Hist. Nat.," iv., p. 76 (1822); Snell., "De Vlind.," p. 181 (1867). *Lasiocampa*, Schrk., "Fauna Boica," ii., Abth. 2, p. 154 (1802); Latr., "Gen.," iv., p. 219 (1809); Oken, "Lehrb. Naturg.," i., p. 706 (1815); Bdv., "Eur. Lep. Ind. Meth.," p. 47 (1829); "Icon. Chen.," pl. vi., fig. 1 (*circ.* 1840); "Gen. et Ind. Meth.," p. 72 (1840); Dup., "Cat. Méth.," p. 73 (1844); Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 69 (1871); Berce, "Faun. Franç.," ii., p. 200 (1868); Nolck., "Lep. Fn. Estl.," i., p. 130 (1868); Newm., "Brit. Moths," p. 45 (1869); Cuní y

Mart., "Cat. Lep. Barc.," p. 69 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 144 (1875); Curò, "Bull. Soc. Ent. Ital.," viii., p. 152 (1876); Frey, "Lep. Schw.," p. 98 (1880); Lampa, "Ent. Tids.," vi., p. 42 (1885); Jord., "Schm. N.-W. Deutsch.," p. 96 (1886); Carad., "Iris," viii., p. 93 (1895); Tutt, "Brit. Moths," p. 61 (1896); Auriv., "Nord. Fjär.," p. 65 (1889); Reutti, "Lep. Bad.," 2nd ed., p. 58 (1898). *Bombix*, Scop., "Introd. Hist. Nat.," p. 416 (1777); Latr., "Hist. Nat.," xiv., p. 177 (1805). *Gastropacha*, Ochs., "Die Schmett.," iii., p. 247 (1810); Germ., "Bomb. Spec.," p. 50 (1812); Curt., "Brit. Ent.," i., pl. xxiv *and* expl. (1824); Stephs., "Ill. Haust.," ii., p. 52 (1828); "List Br. An. B. Mus.," p. 48 (1850); Wood, "Ind. Ent.," p. 23, fig. 53 (1839); Humph. and Westd., "Brit. Moths," p. 60 (? 1841); Evers., "Faun. Volg.-Ural.," p. 151 (1844); H.-Sch., "Sys. Bearb.," ii., p. 104 (1846); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 25 (1851); Led., "Verh. z.-b. Wien," ii., Abh. p. 75 (1853); Walk., "List Lep. Ins. B. Mus.," vi., p. 1388 (1855); Sta., "Man., i., p. 157 (1857); Ramb., "Cat. Lép. And.," p. 344 (1866); Spey., "Geog. Verb.," i., p. 403 (1858); ii., p. 287 (1862); Hein., "Schmett. Deutsch.," p. 203 (1859); Wallgrn., "Skand Het.," ii., pp. 108-110 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p 410 (1874); Kirby, "Eur. Butts. and Moths," p. 188 (1880); "Cat.," p. 823 (1892); "Handbk. Lep.," iv., p. 118 (1898); Buckl., "Larvæ, etc.," iii., pl. li., figs. 1-1*b* (1889); Auriv., "Iris," vii., pp. 168-170 (1894); Meyr., "Handbook," p 324 (1895); Barr., "Brit. Lep.," iii., p. 42, pl. xcv (1896); Staud., "Cat.," 3rd ed., p. 123 (1901). *Phyllodesma*, Hb., "Verz.," p. 190 (*circ.* 1822). *Euthrix*, Meig., "Eur. Schmett.," ii., p. 191 (1830).

Eutricha was the generic name given by Hübner to *quercifolia* in the *Tentamen*, p. 1, he having already figured the species as *Bombyx quercifolia* in his *Europäische Schmetterlinge*, figs. 187—188. In spite of this, Ochsenheimer, in 1810, included the species in his heterotypical genus *Gastropacha*, whilst, in 1812, Germar restricted Ochsenheimer's *Gastropacha* to the four species *quercifolia*, *populifolia*, *betulifolia*, and *ilicifolia*, also overlooking Hübner's selection of *quercifolia* as the type of *Eutricha*. *Populifolia*, which is, and always has been, considered congeneric with *quercifolia*, must go therewith to *Eutricha*, and this leaves *betulifolia* and *ilicifolia* possible types of *Gastropacha*, Germ., and these, being congeneric, we have already (*anteà*, ii., p. 450) suggested *ilicifolia* as the type. Aurivillius, rejecting the authority of the *Tentamen*, took (*Iris*, vii., pp. 168—170) an entirely different view, accepting *quercifolia* as the type of *Gastropacha*, and referring *ilicifolia* and *betulifolia* to Rambur's *Epicnaptera*, of which he noted *suberifolia*, Duponchel, as the type. He then describes the genus *Gastropacha* (type *quercifolia*) as follows:

Gastropacha (*quercifolia*, *populifolia*).—Imago: Palpi long, projecting like a beak, with appressed scales; terminal joint long, somewhat pressed together, haired on the margins. Eyes hairy. Forehead simple, with long hairs running out into a point. Legs moderately long; femora and tibiæ with long and dense hairs, tarsi with appressed scales; the first two joints of the front tarsi, however (at least in the ♂), slightly hairy on the outer margin, front tibiæ unarmed, the "Schienenblatt" in the ♂ large and broad, in the ♀ much shorter and narrower, scarcely reaching beyond the middle of the tibia; middle and hind tibiæ with very short terminal spurs concealed in the hairs; the first joint of hind tarsi shorter than the following together. Neuration: Median cell of both wings closed; the transverse nervure of forewing bent, that of hindwing broken before the middle. Forewing with 12 nervures; 2, 3, and 4 almost equidistant, 5 a short distance from 4, 6 and 7 with a short stalk, 8 free from the front edge, 9 and 10 with very long stalks, from the front margin of the median cell. Nervures 2—9 run into the hind margin, 10 into the apex, 11 and 12 into the costa. Hindwings with 8 nervures; 3 free, 4 and 5 with short stalk from hinder angle, 7 not far from 6, near to the front edge of median cell, 8 free from base onwards, much bent and united with the front margin of median cell by a long transverse line. The very large basal cell sends out 4—6 very long and powerful nervures towards the costa, also behind the basal cell a nervule arises from 8. Abdomen hairy, hardly reaching beyond anal angle of hindwings; thorax with scale-like, smoothly appressed scales. Antennæ: ♂ antennæ curved, with moderate pectinations, longer at the base and gradually shorter towards the apex; the outer (hinder) pectinations on the first third of antenna a little longer than the inner. ♀ antennæ quite as in the ♂, their pectinations only a little shorter. LARVA: Considerably flattened, laterally with very strongly developed foot-like protuberances, which are simply conical on segments 1-3, but distinctly "two-flapped" on 4-10; on segments 4, 5, and 10 the front lappet is much smaller than the hind, but on the other segments nearly as large as that. Low down on the sides on the ventral margin stand on all the segments 3-4 broad lateral dashes. The sides are densely clothed with long, soft, simple hairs. The dorsum, on the other hand, has only sparse short hairs, and has on segments 2 and 3 two large "Prachtflecken" ("Splendour-spots") clothed with bristles and stalked scales, and on the 11th segment a blunt protuberance. *Pupa*: Black to black-brown, dusted with whitish, with rounded bristly anal part, resting in a longish soft cocoon, mingled with hairs and mealy dust.

The species that appear to be absolutely congeneric with *quercifolia* are: *Populifolia*, Esp. (Europe), *cerridifolia*, Feldr. (Japan) (so nearly certainly a race of *quercifolia* that we have treated it as such), *angustipennis*, Walk. (China). In all the species, the antennæ do not differ appreciably as regards pectination in the different sexes (♂ and ♀ nearly equal as regards pectination of antennæ) a remarkable character in this superfamily. Frings notes (*Soc. Ent.*, xiii., p. 89) that he found a cocoon with the characters of *E. populifolia* in a locality where he was accustomed to take that species, but bred from it on July 9th a ♂ with the typical form of wings, markings, etc., of *E. quercifolia*, yet with the peculiar clay-yellow colour, mixed with rust-yellow on the hind margin of forewings and costa of hindwings of *E. populifolia*. This he supposed to be a hybrid. Bernoulli details a case of reputed parthenogenesis (*Nouv. Mém. Acad. Berol.*, 1772, pp. 24 *et seq.*) in *E. quercifolia*, on the authority of his friend Basler, who claimed to have witnessed it several years previously; but both Basler himself and also Bernoulli, subsequently experimented with the same species and utterly failed to obtain fertile parthenogetic ova.

EUTRICHA QUERCIFOLIA, Linné.

SYNONYMY.—Species: *Quercifolia*, Linn., "Sys. Nat.," xth ed., p. 497 (1758); xiith ed., p. 812 (1767); "Fauna Suec.," ed. ii., p. 293 (1761); Poda, "Ins. Mus. Græc.," p. 84, pl. ii., fig. 7 (1761); Scop., "Ent. Carn.," p. 193 (1763); Müll., "Fn. Frid.," p. 39 (1764); "Zoöl. Dan. Prod.," p. 117 (1776); Hfn., "Berl. Mag.," ii., pp. 394, 428 (1766); Fab., "Sys. Ent.," p. 561 (1775); "Spec. Ins.," ii., p. 173 (1781); "Mant. Ins.," ii., p. 111 (1787); "Ent. Syst.," iii., 1, p. 420 (1793); [Schiff.,] "Schmett. Wien.," p. 56 (1775); Meyer, "Fuess. Mag.," i., p. 269 (1778); Esp., "Schmett. Eur.," iii., pl. vi., figs. 3-7; pl. vi *a*, figs. 1-2; p. 56 (1782); Geoff., "Fourc. Ent. Paris," p. 261 (1785); Vill., "Linn. Ent.," ii., p. 120 (1789); Bkh., "Sys. Besch.," iii., p. 63 (1790); "Rhein. Mag.," p. 357 (1793); Hb., "Larvæ Lep.," Bomb. ii., Veræ S. *a—b* (*circ.* 1800); "Eur. Schmett.," ii., figs. 187-188 (*circ.* 1800); text p. 147 (*circ.* 1805); "Tent.," p. 1 (1806); "Verz.," p. 190 (*circ.* 1822); Ill., "Syst. Verz. Wien.," n. Ausg., i., p. 103 (1801); Schrk., "Faun. Boica," ii., 2, p. 154 (1802); Latr., "Hist. Nat.," xiv., p. 177 (1805); "Gen. Crust. et Ins.," iv., p. 219 (1809); "Consid. Gén.," p. 362 (1810); Ochs., "Die Schmett.," iii., p. 247 (1810); Germ., "Bomb. Spec.," p. 50 (1812; Leach, "Edinb. Encycl.," ix., p. 132 (1815); Oken, "Lehrb. Naturg.," i., p. 706 (1815); Godt., "Hist. Nat.," iv., p. 76, pl. vii., figs. 1-2 (1822); "Cat. Méth.," p. 73 (1844); Curt, "Brit. Ent.," i., pl. xxiv *and* expl. (1824); Stephs., "Ill. Haust.," ii., p. 52 (1828); "List Br. An. Br. Mus.," p. 48 (1850); Bdv., "Eur. Lep. Ind. Meth.," p. 47 (1829); "Icon. Chenilles," pl. vi., fig. 1 (*circ.* 1840); "Gen. et Ind. Meth.," p. 72 (1840); Meig., "Eur. Schmett.." ii., p. 191 (1830); Wood, "Ind. Ent.," p. 23, fig. 53 (1839); Humphs. & Westd., "Brit. Moths," p. 60 (? 1843); Evers., "Faun. Volg.-Ural.," p. 151 (1844); H.-Sch., "Sys. Bearb.," ii., p. 104 (1846); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 25 (1851); Led., "Verh. z.-b. Wien," ii., Abh., p. 75 (1853); Sta., "Man.," i., p. 157 (1857); Speyer, "Geog. Verb.," i., p. 403 (1858); ii., p. 287 (1862); Hein., "Schmett. Deutsch.," p. 203 (1859); Staud., "Cat.," 1st ed., p. 30 (1861) ; 2nd ed., p. 69 (1871) ; 3rd ed., p. 123 (1901); Ramb., "Cat. Lép. And.," p. 344 (1866); Snell., "De Vlind.," p. 181 (1867); Berce, "Faun. Franç.," p. 200 (1868); Nolck., "Lep. Fn. Est.," i., p. 130 (1868); Wallgrn., "Skand. Het.," ii., pp. 108-110 (1869); Newm., "Brit. Moths," p. 45 (1869); Cuní y Mart., "Cat. Lep. Barc.," p 69 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 144 (1875); Bang-Haas, "Nat. Tids.," (3), ix., p. 410 (1874); Curò, "Bull. Soc. Ent. It.," viii., p. 152 (1876); Frey, "Lep. Schw.," p. 98 (1880); Kirby, "Eur. Butts.," p. 128 (1880); "Cat.," p. 822 (1894); "Handbook Lep.," iv., p. 118 (1897); Lampa, "Ent. Tids.," v., p. 42 (1885); Rühl, "Soc. Ent.," v., p. 179 (1891) ; Jordan, "Schm. N.-W. Deutsch.," p. 96 (1886); Buckler, "Larvæ," etc., iii., pl. li., figs. 1 *1a*, *1b* (1889); Auriv., "Nord. Fjär.," p. 65 (1889); "Iris," vii., pp. 168-170 (1894); Carad., "Iris," viii., p. 93 (1895); Meyr., "Handbook," etc., p. 324 (1895); Tutt, "Brit. Moths," p. 61 (1896); "Proc. Sth. Lond. Ent. Soc.," 1898, pp. 1-11 (1898); Barr., "Brit. Lep.," iii., p. 42, pl. xcv (1896); Dyar, "Can. Ent.," xxx., p. 6 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 71 (1898); Reutti, "Lep. Baden," 2nd ed., p. 58 (1898). *Dentata*, Scop., "Introd. Hist. Nat.," p. 416 (1777). *Quercifolium*, Schrank, "Fauna Boica," ii., 1, p. 270 (1801). *Quercifolius*, Haw., "Lep. Brit.," i., p. 95 (1803).

ORIGINAL DESCRIPTION.—*Quercifolia. P. Bombyx* elinguis, alis reversis dentatis ferrugineis margine postico nigris. Alb., *Ins.*, i., t. 16; Merian, *Eur.*, i., t. 17; Frisch, *Ins.*, 3, t. i., f. 3; Reaum., *Ins.*, 2, t. 23; Roes., *Ins.*, i., phal. 2, t. 41; Wilk., *Pap.*, 27, t. 3, b. 1. Habitat in *Salice*, *Pruno spinosa*, *Pyro*, *Gramine*. Larva subcaudata, pilosa, ferruginea, collaribus cæruleis (Linné, *Syst. Naturae*, xth ed., p. 497). This Linné later modifies to: "Alis reversis semitectis dentatis. . . . Antennæ brevissimæ fuscæ. Palpi porrecti" (*op. cit.*, xiith ed., p. 812).

IMAGO.—48mm.—102mm. Anterior wings deep purplish-brown; the outer margin dentate, the inner wavy; blackish towards the costa, redder towards the inner margin; with three transverse blackish-grey waved lines, one basal and angulated, the second angulated and dentate, the outer dentate; a blackish median lunular mark; the nervures darker than ground colour. Posterior wings similarly coloured to forewings; three ill-developed transverse shades; the outer margin dentate. Head, thorax and abdomen deep red-brown.

SEXUAL DIMORPHISM.—The extreme measurements of some 50 specimens gave: ♂s 48mm.—79mm.; females 73·5mm.—102mm. Except in size, the sexual difference is very small, and even in this particular the large males have often almost as great a wing-expanse as the average-sized females. The latter, however, are usually larger, and altogether more bulky. Réaumur notes that "the male only differs from the female in being smaller, and in the brown colour of the wings having some black wavy lines which are less marked in the wings of the female." Chapman notes of the antennæ: ♂. About 10mm. long, but with a curve that leaves measure doubtful, of some 60 joints; dorsal scaling irregular, but showing each segment. The plumules of the pectination show a specialisation that seems common in the Eutrichids—*viz.*, the lower set of plumules, at least for the basal half of the antenna, are longer than the upper ones, and their portion of the antenna forms a sort of scoop, directed forwards. This is not very pronounced in *E. quercifolia*, but the longer are 1·2mm. long, the shorter opposite them 0·8mm. The longer carry about 50 transverse rows of hairs, three or four on either side, and the half-rows not always quite opposite each other. There is no terminal thickening, but the one side is straight, the other curved over at the end. There are three or four stronger bristles at or near the end, but the strong spike seen in the antenna of *Macrothylacia rubi* or *Cosmotriche potatoria* is represented by a very short baton about one-fourth the length of the bristles and not twice its thickness in length. There is, however, an important primitive character shown, for, instead of the dorsa of the plumules being naked, as is the rule in Lachneids, and as is the case also in this species in the lower set and the further of the upper (or shorter set), the dorsa of 24 joints, at least, nearest the base of the antenna, carry very long dark scales. The scales are pointed at their attachments, to which they narrow very regularly from their not very broad apices, being thus long narrow triangles. They are most abundant at the ends of the plumules, and are but one row towards their base, and appear to be rather fugitive, so that some are obviously missing how many being doubtful. ♀. About 58 segments, length 9mm.—10mm. The character of the pectination approaches that of the ♂ much more than in most Lachneids. The longer pectinations are about 1·3mm., the shorter about 0·65mm. in length. The upper ones are shorter throughout, but not markedly for the distal half of the antennæ. The short plumules carry scales as in the ♂. The hairs of the plumules are much shorter and fewer than in the ♂, but very similarly disposed. The short terminal batons are about half the length of the accompanying bristles.

Gynandromorphism.—The following are the records we are able to find of gynandromorphous examples of this species:

α. ♂ left, ♀ right. Body on right side with ♀, left side with ♂ genitalia. Wings of ♂ side smaller. Antennæ equal in length, the ♂ thicker. Body from above to beneath divided by a sharp line. Head strikingly oblique; ♂ side more arched, the eyes larger. Abdomen on the ♀ side more extended, thinner haired, with more perceptible segments; ♂ side more slender, somewhat bent in, more strongly haired, with anal hairs. Middle line with erect hairs on the sharply-marked suture. On the anus some points visible as "rod" (Rute), on each side thereof a small, rounded, brown, corneous plate as in the ♂. Hind margin broadly truncated as in the ♂. Internally on the ♀ side a twisted "egg-bag" with 18 normal eggs; on the ♂ side 2 testicles connected by a passage. Bred. In the Berlin Museum.—Klug, *Verh.*, p. 368; Klug, *Jahrb.*, p. 235; Burm., p. 340; Rudolphi, p. 55.

β. Left side ♂, right ♀. Size of the wings differs greatly. Left side ♂. In form the wings agree with both sexes; the colour is uniform, but the ♀ side has sharply marked bands. Antennæ equal in length, that of the ♂ thicker. Abdomen with the left side thin and more slender than the right, which is stout and swollen. Terminal end crooked towards the left side. Bred in Offenbach. In Wiskott coll. Breslau (Wiskott, *Festschr. Schles. Ver. Ins.*, 1897, p. 120).

γ. An apparent ♀, containing eggs, but with one ♂ antenna (Dorfmeister, *Mitt. Steiermark*, iv., p. 70).

Variation.—The variation of this species is comparatively great; in colour the British examples vary from a delicate ochreous, with a distinct rosy tinge, to a deep purple, with intermediate forms of ochreous-red, red-brown, and reddish-purple. Besides these, some examples are very richly tinged with a grey bloom, whilst other examples are entirely greyish in tone, and these are usually rather poorly scaled. Knaggs records a curiously pale specimen almost albino. James notes that of 20 bred from Waldringfield, the ♀s varied considerably, one being of quite a greyish tint, another with the colour of the male, whilst two or three others are more or less suffused with the same coloration. Chapman notes that in Constant's collection the specimens labelled *alnifolia*, from central France, are much darker than usual, and the purple bloom is so pronounced that the colour is deep purple-blue rather than red. It occasionally happens that very small specimens (ab. *hoegei*, Heu., especially ♂ s) are occasionally caught and more frequently bred. There appears also to be some difference between the size of specimens bred from various localities, probably, though, induced by artificial conditions of life in confinement, *e.g.*, three New Forest ♂ s vary from 2′.9″—3″, and six from Chelmsford from 2′.3″—2″.6″. D'Aubuisson twice bred small examples as a second brood (Caradja). Warren notes that in 1885 he bred an imago from Wicken, which is almost exactly the same by reason of its colour as that of its smaller but rarer relative, *G. ilicifolia.* Gauckler records (*Illus. Woch. für Ent.*, ii., p. 85) an example in which the hindwings had a semicircular concavity, as if a piece had been taken out of the anal angle of each hindwing (ab. *incompleta*, n. ab.) He further notes (*loc. cit.*, p. 143) very large larvæ of *E. quercifolia* found near Vienna, June 24th, 1896, one of which was 155mm. in length, others equally large were taken in 1889 and 1891, two females bred from which measured 100mm.—120mm. in expanse (ab. *major*, n. ab.) Eversmann describes two forms from the Volgo-Ural district: α. Brunnea seu fusco-cuprea. β. Brunneo-fulva. Staudinger notes seven specimens from Saisan, of medium size, the wings rather light red-brown with yellow fringes, which rather rarely occurs in Germany. On the forewings the dark outer transverse line is almost entirely wanting, while the middle line, and to a large extent the basal, is black and stands out very sharply. Barrett notes (*Lep. Brit.*, p. 44) a very light brown specimen, and another pale buff with the lines and shades grey; other specimens are occasionally suffused with smoky-black. Leech states (*Proc. Zool. Soc. Lond.*, 1888, p. 629) that the Japanese specimens are rich in colour, and most nearly approach the form *alnifolia*, Ochs. He further adds that a specimen which he himself bred from a larva found at Gensan is much paler than either Japanese or European examples in his collection. We have some remarks on this form under the var. *cerridifolia.* The specimens that we have examined may be roughly tabulated as follows:

GROUND COLOUR OCHREOUS.

1. Ochreous (of same tint as *E. populifolia*), without (or with ill-developed) transverse lines = ab. *ulmifolia-obsoleta*, n. ab.
2. Ochreous, with well-developed transverse lines = ab. *ulmifolia*, Heuäck.

GROUND COLOUR YELLOWISH-RED.

1. Yellowish-red (inclining to orange-ochreous), without (or with ill-developed) transverse lines = ab. *meridionalis-obsoleta*, n. ab.
2. Yellowish-red (inclining to orange-ochreous), with moderately-developed transverse lines = ab. *meridionalis*, Horm.
3. Yellowish-red (inclining to orange-ochreous), with very strongly-developed transverse lines = ab. *meridionalis-lineata*, n. ab.

GROUND COLOUR BRIGHT FERRUGINOUS OR ORANGE-RED.

1. Bright ferruginous, without (or with ill-developed) transverse lines = ab. *dalmatina*, Gerh.
2. Bright ferruginous, with fairly defined transverse lines = ab. *dalmatina-typica*, n. ab.
3. Bright ferruginous, with very wide, dark, and strongly-marked transverse lines = ab. *dalmatina-lineata*, n. ab.
4. Bright ferruginous, with the outer marginal area blackish = *quercifolia*, Linn.
5. Bright ferruginous, with well defined transverse lines, blackish costa to forewings and shaded with blackish towards centre of hindwings, inclining to purplish at outer margin of wings = ab. *alnifolia*, Ochs.

GROUND COLOUR DULL FERRUGINOUS.

1. Dull ferruginous, without (or with ill-developed) transverse lines=ab. *suffusa-obsoleta*, n. ab.

2. Dull ferruginous, shaded with grey, especially at base and along costa of forewings (suggesting a greenish tinge*), more purplish on outer area of all wings, often with pale (yellowish or orange) marginal line and cilia; transverse lines well developed=ab. *suffusa*, n. ab.

GROUND COLOUR DEEP PURPLE-BLUE OR PURPLE-BLACK.

1. Deep purple, scaled heavily with black, especially over costal and basal areas of forewings; transverse lines ill-developed; marginal line usually pale (yellowish); thorax and abdomen also very dark=ab. *purpurascens-obsoleta*, n. ab.

2. Deep purple, scaled heavily with black, but with well-developed transverse lines=ab. *purpurascens*, n. ab.

The only described forms of this species appears to be as follows:

α. var. *salicifolia*, Staud., "Iris," v., p. 352 (1892); "Cat.," 3rd ed., p. 123 (1901). —A pair found at the end of July on the river in the Kentei are so different from all my *quercifolia* that I briefly describe them as var. *salicifolia*. The ♂ measures 51mm., the ♀ 60mm.; the specimens are therefore much *smaller* than typical *quercifolia*. They are much *lighter grey-brown*, almost of the colour of *populifolia*; especially is the *outer marginal part* of the forewings *behind* the dark *dentated line* (which in the ♀ stands out very strongly) *light*, towards the *middle* of the *outer margin* almost becoming *violet-grey*. The blackish transverse line (band) in this outer part, often well-developed in typical *quercifolia*, is only so rudimentarily indicated that it is as good as wanting. The *fringes* of the *forewings* are in the *basal part with* the *limbal-line almost yellow, exteriorly blackish*, on the *hindwings* they are entirely *yellowish*. The hindwings have, especially in the ♀, a thick black transverse line behind which in the ♀ stands also a faint second line. On the *underside* their basal half, as far as the dark transverse line *dirty light-grey*, almost without a brown tinge, especially in the ♀, in the light grey-brown *outer part*, the *dark* band-like markings are practically *wanting* (Staudinger).

Staudinger further notes that he has intermediates between the type and the new variety from Saisan, south-western Siberia, as they are smaller and lighter than the type; the form from the Amur, on the contrary, quite agrees with the large European type. In his *Catalog*, 3rd ed., p. 123, he diagnoses the variety as "Minor, dilutior, griseo-brunnea vel ochracea. Dahuria, Mongolia *(trans.)*."

β. ab. *ulmifolia*, Heuäck., "Stett. Ent. Zeit.," xxxiv., p. 244 (1873); Auriv., "Iris," vii., p. 170 (1894); Staud., "Cat.," 3rd ed., p. 123 (1901). *Alnifolia*, Kirby, "Cat.," p. 823, in part (1892). —Multo pallidior, flavescens. ? var. *ulmifolia*, Dahl, *in lit.* Besides the ab. *alnifolia*, O. (obscurior), this species forms an antithetical, extraordinarily light yellowish white-grey aberration, which I have seen in several collections without taking note thereof. At present only one example lies before me, which Herr Blauel of Osterode bred from a larva fed on *Salix*. I believe I see in this form the var. *ulmifolia*, Dahl, mentioned in Heydenreich's *Catalogue*, 1851 (Heuäcker).

Staudinger unites *(Cat.*, 3rd ed., p. 123) this aberration with *dalmatina*, Gerh., and gives as localities: "Sicily, Castile, Dalmatia, Issyk Kul, Amdo, southern Tyrol, etc. *(ab.)*; Saisan, eastern Siberia, etc. *(trans.)*."

γ. var. *meridionalis* (Staud., *in litt.*), Horm., "Verh. z.-b. Ges. Wien," xlvii., p. 331 (1897).—All the specimens from Suceava and its vicinity belong to a particular race, which, according to Staudinger, is identical with his unpublished var. *meridionalis*, which is indigenous to the Mediterranean region and to Asia Minor. The examples in question (♂ and ♀) are light ochre-yellow, quite as in *populifolia*, with a peculiar clear rose-red silky gloss. As Suceava is situated in a steppe district, the occurrence of a Mediterranean race is readily explained (Hormuzaki).

Staudinger notes seven specimens from Saisan, of medium size,

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* Due to a rough black scaling on the orange or reddish ground colour, the black scaling being carried to its extreme in ab. *purpurascens*. Here, however, the purple-black is predominant, with scarcely any tendency to a greenish hue.

rather light red-brown in colour, with yellow fringes, which, he says, is a form that rather rarely occurs in Germany; whilst on the forewings the dark outer transverse line is almost entirely wanting; the middle line, and to a large extent the basal, are black, and stand out very sharply. We have, in our collection, a similar British example (from Cuxton), and suspect it to be not very far from the var. *meridionalis*. Staudinger does not mention this form in the *Cat.*, 3rd ed., p. 123. His localities suggest that he considers it a transition form to var. (et ab.) *ulmifolia*.

δ. var. *dalmatina*, Gerhard, "Berl. Ent. Zeits.," xxvi., p. 128.—From Dalmatia, somewhat lighter than the type, the black dentated line which runs from apex towards inner margin is not visible, the second dentated line only quite faintly indicated, also on the underside the markings are very indistinct (Gerhard).

This is probably but little lighter than the type, presumably light reddish, not yellowish, in colour, as is the ab. *ulmifolia*, to which Staudinger refers it.

ε. var. gen. ii., *hoegei*, Heuäck., "Stett. Ent. Zeit.," xxxiv., p. 244 (1873); Kirby, "Cat.," p. 823 (1892); Auriv., "Iris," vii., p. 170 (1894); Staud., "Cat.," 3rd ed., p. 123 (1901).—Duplo minor. *Quercifolia* has with us, in warm summers, a second brood; in 1868, Herr C. F. Höge of Hamburg bred a large number, which only differ from the parent ♀ in their extraordinarily small size (♂s 36, ♀s 39mm. in expanse) (Heuäcker).

This form is possibly never taken in nature, in Britain, although an occasional specimen is bred from a larva that feeds on in confinement, instead of undergoing its ordinary hybernation. In addition to the small size which always characterises such individuals, Petersdorff notes (*Berl. Ent. Zeits.*, xlv., Sitz. p. 52) that they appear, in Germany, to have a paler ground colour, and less distinct markings than the typical form. Belling exhibited (*loc. cit.*) artificially reared second brood examples that were not only much smaller than usual, but were also covered thickly with plum-blue scales, the lunular spots of the submarginal bands of all the wings being either ill-developed or entirely wanting; in the ♂s the reddish ground colour is especially intense.

ζ. ab. *alnifolia*, Ochs., "Die Schmett.," iii., p. 250 (1810); Germ., "Bomb. Spec.," p. 50 (1812); Staud., "Cat.," 2nd ed., p. 69 (1871); 3rd ed., p. 123 (1901); Kirby, "Cat.," p. 823 (1892); Auriv., "Iris," vii., p. 170 (1894); Spul., "Reutti's Lep. Bad.," 2nd ed., p. 58 (1898).—The ground form is copper-brown; on the head and collar stands a black streak, and the epaulettes are similarly margined. The wings are slightly and smoothly dentated, the forewings dark copper-brown, on the costa, as far as to the middle, black, on the outer margin bluish, on the inner margin rust-brown; the first two transverse lines consist of two cap-shaped uninterrupted black parallel lines, the third of lunular spots with their hollow sides turned inwards. The hindwings are at the costa rust-brown, in the central part blackish, at the outer margin bluish tinged; through the middle runs a double black transverse stripe, and a second single one stands in almost straight position before the outer margin, where it is cut off sharply and runs inwards into the ground colour. The underside is copper-brown, the forewings in the middle shaded with black, with a row of spots of the same colour before the margin. In the middle of the hindwings stands a curved black band, and near the outer margin a not distinctly defined shade of the like colour. I have found this variety in the neighbourhood of Leipzig, and know no transition to the other form in the aspect of the markings, but only in the ground colour, and leave it to others to decide whether it can be erected as a separate species under the name *Gast. alnifolia* (Ochsenheimer). Distribution.—Austro-Hungary: Inn Valley—Innsbruck (Weiler), Eperies, rarer than type (Husz), Gölnitz (Hudák). Belgium: Brussels (Donckier). Germany: Lower Elbe district, everywhere on the moors (Zimmermann), Bremen, where only the variety occurs (Rehberg), Baden district, rare (Spüler). Russia: Wolmar, commoner than the type (Lutzau), Moscow district, very rare (Assmuss). Scandinavia: commoner than the type (Aurivillius). Spain: Bilbao (Seebold).

η. var. *cerridifolia*, Feld., "Wien. Ent. Monats.," vi., p. 35, no. 46 (1862); Kirby, "Cat.," p. 823 (1892); Staud., "Cat.," 3rd ed., p. 123 (1901).—Differt a nostra specimen ex montibus prope Ning-po allatus alis levius dentatis, strigis paginæ superioris obsoletis strigaque paginæ inferioris nigra omnino absente (Felder).

Cerridifolia is a very marked and distinct eastern race, with the ground colour of a bright red-brown tint, and the costal margin of the hindwings of both males and females bright orange. The transverse lines are not particularly strongly marked, and there appears to be a tendency for three transverse shades to be exhibited—one towards the apical area, a second medially, the third on inner margin. Two worn ♀ specimens in the Brit. Museum collection are ochreous in colour. Staudinger diagnoses it (*Cat.*, 3rd ed., p. 123) as: "Al. strigis obsoletioribus, al. post. margine anter. late ochraceo-maculata. Japan, Corea, northern China, Ussuri (cum *trans.*)."

EGGLAYING.—Two eggs laid by a wild ♀ on the underside of an apple leaf, others in confinement laid on gauze in a loose and irregular patch (Burrows). The eggs for the most part placed on their sides, but individual eggs vary in this respect (Bacot); ova deposited on buckthorn, whitethorn, and willow, on underside of leaf, usually two or three eggs on the same leaf, at Worcester (Hancock); three eggs found August 9th, 1899, at Henny, deposited on underside of a sallow leaf, quite at the apical end, and close together (Ransom): the eggs are often laid more or less on each other, four, five, six or more in a small group or heap on a twig (Chapman). The eggs are laid singly on the leaf of *Prunus spinosa*, and hatch in about 14 days (Moncreaff). Brandt and Krancher note (*Psyche*, iii., pp. 363-4) 580 fertile eggs laid by one ♀, and J. A. Clark records the enormous number of 1050 eggs from a single female. Graber observes that the embryo during development is at first without appendages on the abdominal segments, and that when they do appear they develop only on those segments on which they persist in the adult. His paper on the embryology of this species is published in *Denks. Ak. Wien*, lv., pp. 109—162, pl. i-viii.

OVUM.—The egg is long, flattened at top and bottom, and may be almost as satisfactorily described as being brick-shaped, as cylindrical, neither of which terms however, are suitable. Length : breadth : height : : 4 : 3 : 2¾. The egg is very remarkable with its green rings marked so conspicuously on the white ground colour. These green lines pass round the egg longitudinally, forming a central dot and an outer oval ring on both the upper and lower halves of the egg. Another ring runs centrally round the egg, broken, however, at the poles, where there are one or more smaller green points. The shell is minutely pitted, each pit forming the centre of a minute hexagon, the surface being covered with a minute irregular hexagonal reticulation. The micropylar area forms a round green spot at one pole of the egg; it comprises a slight depression, the cells of which are somewhat more regular on the sides of the depression, and end in a stellate structure (the micropyle proper) at the lower point of the depression. The egg is somewhat opalescent, the green markings appearing distinctly beneath the surface reticulation. [The eggs described had been laid in heaps loosely, and were received from Mr. Nevinson. They were deposited June 29th, and described July 7th, under a two-thirds lens.] When first laid dull green, the white markings scarcely defined, the eggs evidently soft and damp (Burrows). In shape a short, rounded oval, about 1·5mm.—1·6mm. in length, 1·3mm. in width, and 1·2mm. in thickness; slightly depressed on upper side, also slightly at micropyle, which appears to be nearer the shoulder than centrally at end of egg; surface smooth, with a slight polygonal pattern outlined in minute raised points; colour dull grey or drab, banded curiously with opaque porcelain-white; there is a ring of this white on the side surrounding the depression, and another similar, roughly oval, ring or band on the opposite or resting side; a transverse stripe across one edge, and two longitudinal stripes along the opposite edge; these continue to the ends and curve round and join without meeting the transverse stripe on the opposite edge; a small ring round the micropyle and its nadir joining the parallel longitudinal bands as they narrow before forming the loop (Bacot, July 29th, 1900). The eggs are described by Réaumur as being like "petites boules, dont la couleur dominante est un bleu tel que celui qui a été un peu trop épargné sur la fayence. Deux bouts opposés sont d'un brun noir, et deux ou trois cercles du même brun paralleles entr'eux, et paralleles à ces bouts, entourent l'œuf, et le rendent un très-joli œuf, qui semble être de fayence." Esper figures the egg (*Schmett. Eur.*, vol. iii., pl. lxxix., fig. 3) both of natural size and magnified.

Habits of larva.—The young larvæ rest on the twigs of the foodplant, spin considerable silk, and seem to prefer to live in little groups of four or five, indicating a gregarious tendency. They crawl backward, wriggle much if disturbed and drop freely by a thread, both the backward-moving habit and the ability to suspend themselves are in evidence until the larvæ have reached the third moult (Bacot); the larvæ feed up very slowly until the end of October, moulting three times, and are then about an inch in length, when they fix themselves to the shoots of their foodplant, close to the ground for hybernation, and commence to feed again in spring as soon as the young leaves expand (Moncreaff); they hybernate so closely attached to stems of blackthorn as to appear like excrescences on the bark which they so exactly resemble as to deceive even the most practised eye (Grapes); winter well along the dry leaves of the foodplant (Mera); whilst Bowles notes that in "the middle of March the larvæ are still sprawling on the naked stems of plum and sallow and looking uncommonly like them too; when touched, they show their orange spots between the segments, which are now conspicuous against the dull dead-brown of their bodies; later on, when full grown and grey, the blue in these spots predominates. Is the shining of them likely to frighten a bird, who thought that that nice piece of rotten wood was good for building a nest? Their protective coloration is marvellous, but when the larva is touched and it shows off these intersegmental glories it becomes most conspicuous." Rühl observes that in the Zürich district, the larva hybernates in the branch forks of the fruit-trees and sloe-bushes. The larvæ appear much given to the habit of biting one another (Griffiths); the larvæ hide during the day, low down on the bushes, lying very close to the stem and so closely assimilating to the colour of the latter as almost to defy detection ; they come up to feed at night and are then easily taken with a lantern, but, in the Cambridgeshire fens, the regular workers get a fair number by day by passing the hand down the stems, and carefully examining any suspicious thickening thereon. Around Winchester the larvæ hide low down and sit immovably on the stem where they are hidden by the grass during the day, but are to be taken freely with a lantern at night (Hewett) ; the larva suns itself in the afternoon on hedges (Burrows) ; hides on main stems of blackthorn at Angmering during the day (Dollman) ; rests by day low down on the stems of foodplant near the ground (Farren); low down on stems close to ground among grass in daytime (James) ; at Winchester prefers blackthorn bushes, on which the larvæ may be found by searching, but at Wicken they are to be found resting on the buckthorn and sallow bushes quite near the ground amongst grass and reeds, and generally seem to prefer small bushes to large ones (Moberly) ; prefers the blackthorn hedges at Hazeleigh (Raynor) ; a favourite haunt for the larvæ is a young quickset hawthorn hedge, little more than a foot high ; this can be pulled open down the middle and the larvæ will be found sitting on the stems (Holland) ; found commonly with a lantern in the middle of May, 1897, when about three-quarters grown, at Titney Green, near Chelmsford (Pickett) ; larva on a beech-trunk, April, 1897 at Loughton, probably a wanderer (Garland) ; the larvæ will feed in the afternoon when they eagerly devour leaves of blackthorn, but also in the evening when they may be readily found in the Wateringbury district by the aid of a lantern (Fremlin) ; they feed vigorously in the middle of the day (Russell) ; rest low down, near the ground, stretched along the stems of bushes usually buckthorn on Wicken Fen (Christy) ; reported as doing damage to apple foliage in 1893 in the orchards at King's Acre, near Hereford (Ormerod) ; Réaumur notes (on the authority of Hire) a full-fed larva, June 20th, 1688, and four others a few days later from bergamot pear and peach-trees, other records relating to dates of larvæ being taken are :—Larvæ still small, April 8th, 1871, at Bexley, larger ones found May 20th and June 17th, 1872, at Darenth, whilst small ones only could be taken, May 12th, 1889, at Greenhithe (Bower) ; larva, June 30th, 1871, a ♂ bred therefrom July 25th, 1871, larvæ from Higham marshes, April 17th, 1875, at Eltham, November 3rd, 1875, on Paul's Cray Common, June 3rd, 1876, at Chattenden, June 1st, 1877, on Wicken Fen (Jones) ; full-grown larvæ were found at Wicken Fen, June 4th-26th, 1880, larvæ, May 29th, June 2nd, 1892, at Abbott's Wood (Porritt) ; larvæ taken August 19th, 1888, before hybernation, at Brentwood, and September 29th, 1897, at Rainham ; and after hybernation on May 25th, 1893, at Benfleet, and May 16th, 1894, at Islip (Burrows) ; larvæ, August 19th, 1888, at Brentwood, April, 1898, at Danbury, April, 1897, at Woodham Walter, September 12th, 1900, at Fulbourne (Raynor) ; June 1st, 1875 full-fed at Reading, May 2nd, 1890 at Hardwick 36 larvæ nearly full-fed, taken from a young whitethorn hedge at Southstoke, Oxon, on May 18th, 1890 (Holland) ; a few larvæ on the buckthorn bushes at Wicken between June 3rd and 16th, 1891, and larvæ were found at the same place until June 16th, 1892, larvæ on open hedge at Emsworth, May 17th, 1894 (Christy) ; June 7th, 1892, August 28th, 1893, at Wicken (Freeman) ;

13 larvæ, May 6th, 7th, 1893, at Wicken, varied in length from 1½-4½ inches (Moberly); full-fed near King's Lynn, May 13th, 1894 (Glenny); June 16th, 1896, in Wicken Fen (W. Hewett); full-fed larvæ at Wicken, June 18th, 1897 (Kaye); larvæ, August 12th, 1897, before hybernation, at Oxton (Studd); larvæ 2 inches long at Margate, May 1st, 1900 (Colthrup); larvæ full-fed at Much Hadham on June 24th, 1900 (Newland); May 29th, 1900, at Kelvedon (P. C. Reid).

LARVA.—*First instar* (*newly-hatched*): Very short and broad, square-ended in appearance; fairly large head, the body tapering from thorax to anus; length about three-sixteenths of an inch; body fairly well raised from surface when crawling; prolegs rather long; the body gives rather the impression of being of a ◠-section than cylindrical. Head large, notably wide, surface dead black, a few fine white and black hairs. The segmental incisions not deeply cut, but the inter-segmental areas distinct. Scutellum not very marked, except the ridge on front of prothorax, bears four large many-haired tubercular warts on its front, and two behind; on the meso- and metathorax the four dorsal tubercular warts arranged as if at four corners of a square; on the abdominal segments arranged as trapezoidals; all are rounded, large, and many-haired. On the 8th abdominal the anterior trapezoidals are very large and placed on a tall fleshy hump or prominence. On the 9th abdominal there are also two raised dorsal tubercular warts. The lateral tubercular warts are—a large supraspiracular, a very large accessory prespiracular, placed very far forward in line with spiracle, a smaller subspiracular placed well below the spiracle, and two large marginal tubercular warts at base of prolegs united to form one large longitudinal wart that forms, by its union with the adjacent warts, the raised flange. The subdorsal prespiracular wart on the prothorax is very large. The colour of the larva is dead black, a deep velvety patch on 2nd and 8th abdominal segments; slightly paler on thoracic than on abdominal segments, especially the intersegmental areas. A large, square, fleshy (red-grey) patch on dorsum of 1st abdominal. *First instar* (*full grown*): Head rounded, division of lobes distinct, small, rather retracted, surface dull, colour black, very hairy. Body: already appears to be of the adult pattern, low and wide at thorax, thickest at pro- and mesothorax, tapering gradually both laterally and dorsally to anal segment; a fleshy cone or horn on 8th abdominal segment which bears both anterior trapezoidals as twin warts at its summit; the lappets already in evidence, but the body is really cylindrical though carried very low; colour is dull black, warts blue-black; two pale yellow spots present on the dorsum of mesothorax, one on either side, and situated between tubercles i, ii and iii; another pair of spots in similar position on metathorax, the remainder of the dorsal area of the metathorax, and the whole (or nearly the whole) of the 1st abdominal segment are pale, dirty white, and structurally weak, to judge by the tubercles, which are smaller than the corresponding ones on other segments, *i.e.*, warts ii on metathorax are smaller than on meso-thorax and both pairs of trapezoidals on 1st abdominal are smaller than on the following abdominal segments; a large part (about three-fourths) of the dorsal and subdorsal area of 2nd abdominal is dusky black, much darker than on the rest of the body area, and here the warts are stronger (to about the same extent as those on paler areas are weak); five poorly marked subsegments are present; the tubercles are represented by many-haired warts; i and ii are set nearly four square on abdominal segments, i slightly the outer on thoracic segments; i is also slightly the larger on thoracic segments, and ii slightly the larger on abdominal segments; iii is about equal to i and is vertically above spiracle, but at some little distance from it; ? iv and v combined form a single wart equal to iii, slightly below and a short distance behind spiracle; a slightly larger supplementary prespiracular, or anterior marginal, tubercular wart (characteristic of the Lachneids) is horizontally in line with spiracle; there are also two well-developed marginal warts, the fleshy bases of which form the lappets; one of two single-haired tubercles placed near each other below spiracle, but further forward on segment, is perhaps vi; in addition, there occurs on the abdominal segments a little group of 3 or 4 single-haired tubercles on posterior margin of segments in same plane as iii, on some segments these form a line or row rather than a group, extending upwards nearly as far as ii; another line or row of three single-haired tubercles occurs below the prespiracular or marginal wart; the warts each give rise to a considerable number of smooth, tapering, generally black, hairs, a few of the lateral ones being white; no skin spicules are present, nor general growth of secondary hairs. Legs shiny-black (August 3rd, 1900). *Second instar:* Head roughly trapezoidal, colour now dead grey, finely mottled with darker; a black transverse band present, just above clypeus; the scutellum not at all distinct, the surface and colouring practically the same as rest of body, neither chitinous nor horny; the body low, flattened, ᗝ-section rather more marked, lies closely to twig or leaf-stalk, the lateral processes already well-developed on thoracic and first two abdominal segments also present on abdominals 3 to 7, not so long, but broader, and double, due to duplicate condition of marginal tubercles. Viewed laterally the larva slopes from mesothorax to anal segment, the outline only broken by the prominent elevation formed by the conjoined bases of the anterior trapezoidals (i) on the 8th abdominal. The intersegmental incisions not very marked, but subsegments moderately distinct. The tubercular warts and primitive setæ almost lost amidst a dense growth of secondary hairs; the lateral thoracic warts are, however, still apparent, particularly the prespiracular of prothorax; towards the posterior portion of each segment are two black, slightly raised, elevations, possibly a modification of a pair of the dorsal tubercles; they are surrounded by a faint orange border stronger on some segments than others, notably the 2nd abdominal segment; in general appearance, these dark raised spots remind one of those on the dorsal area of the larvæ of *Cosmotriche potatoria*, *Dendrolimus pini*, and *Dimorpha versicolora*. The larva is now dull dark grey, somewhat mottled and speckled with darker, the dorsal prominence on the 8th abdominal velvety-black; a black transverse band across the 2nd abdominal segment, broader laterally than dorsally; a black velvety dorsal patch on mesothorax and a small faint one on metathorax, these form a background for the two bright orange spots, one on either side of the median line, on each of these segments; the mediodorsal line is faintly marked on the thoracic and just traceable on the abdominal segments. The narrow 9th abdominal segment has the tubercular areas occupied by velvety-black spots. [It may be noted that the complicated dorsal pattern of the larva of *C. potatoria* is distinctly to be traced, though in a modified form, in that of *D. pini*, but is only very faintly traceable in that of *E. quercifolia*. The orange mesothoracic and metathoracic spots appear to be identical with those seen in larvæ of *C. potatoria* and *Lasiocampa quercûs*, although they are dorsal in *E. quercifolia* and subdorsal in *L. quercûs*.] All hairs—tubercular and secondary—are fine, short and simple. *Third instar :* Length, after second moult, five-eighths of an inch. Larva very similar to second instar but browner; the black dorsal spots (area of tubercles i) have disappeared but the elevated areas are still distinguishable, except on the 9th abdominal; the dark transverse band on 1st and 2nd abdominals much weaker; the general markings and mottlings on the surface of the skin fainter, resulting in a more uniform tint; the markings on meso- and metathorax less conspicuous when the larva is at rest, being hidden by folds of skin, the bright orange spots being the more conspicuous, the black between being almost completely hidden, except when the larva has been disturbed or is crawling; the central portion of the black area on the 3rd thoracic shows traces of blue. *Fourth instar* (Hybernating stage): Length varies from seven-eighths to seventeen-sixteenths of an inch; the white blotches behind the dark transverse markings on mesothorax in some larvæ very strongly marked; on the 2nd to 7th abdominal segments in most larvæ is a double series of oblique white dorsal streaks, approaching each other anteriorly; their ends just within the raised areas of dorsal tubercles i, which tend to become dark again (these were black in second instar, almost lost in third). Lateral processes on the 1st abdominal segment give rise to a more prominent brush of hairs than on the others; the swollen bases of anterior trapezoidals on the 8th abdominal segment distinct though weak compared with size of larva to previous stages and placed well forward on 8th abdominal. The following is a more detailed description of hybernating stage—*Spiracles :* Not conspicuous, a long, narrow oval in shape, almost slit-like in appearance; those on prothorax and 8th abdominal segments are much enlarged; grey in colour, differing little, if at all, from ground colour of larvæ (two larvæ examined, one medium grey and the other very dark, almost black; in both larvæ the colour of spiracles closely matched the ground colour of larva), surrounded by a narrow black border in the centre of which is a very narrow and apparently raised white line; on one of the larvæ examined this white line was wanting on the prothoracic spiracle. *Lateral processes :* On thoracic segments long, fleshy-looking, finger-shaped projections pointing forwards and downwards, bearing a fan-like brush of black hairs and more numerous fine and scattered grey ones; on the abdominal segments the processes are double or twin, and are, in all cases, much shorter than the thoracic ones, excepting the posterior fork of the process on the 1st abdominal, which is fully as long as the thoracic ones, and bears a pencil of long black hairs (as long as thickness of body); the posterior fork of the twin process on the 2nd and 7th abdominal segments is also lengthened, on the 2nd to nearly the same extent as on the 1st, but on the 7th to a much less extent; on the 3rd abdominal the posterior fork of process is very slightly larger than the anterior; on the 4th, 5th, and 6th abdominal segments, both arms of the twin processes are about equal, and they are, as are also those on 3rd and 8th, very much smaller than the others; on the 8th the process is not twin or double, though there is a small process or fleshy lateral wart at a higher level. All the lateral hairs point downwards, and those at either end point backwards and forwards respectively in addition; the processes can be moved at will of larva; when resting, the larva depresses them, and the hairs, in consequence, are curved beneath it, and touch the twig on which it rests; when the larva crawls or is about to shift its position, the processes are slightly raised and the hairs jut outwards from the body; these movements are best observed with regard to the processes on the 1st abdominal segment which bears the long pencil-like tufts of black hairs; on the other segments the movements are not nearly so noticeable. *Ocelli:* Shiny raised buttons forming a curved row of four in front, and an isolated one behind. *Legs:* These are difficult to examine, as they are completely hidden when at rest, and the larva has to be forcibly turned over before a glance can be obtained. The legs are black, shiny, and end, so far as one can see, in a single hook. *Prolegs:* Yellow, with a black oblique stripe at front and back; the foot has a tendency to be ⊥-shaped, and the hooks run round the outer margin. (It is rather difficult to describe the foot of living larvæ, as it greatly alters its shape and appearance according to the surface and position of the object to which it is attached.) *Venter:* The ventral side of lateral processes is very pale grey, almost white, and contrasts strongly with the velvety-black of the ventral surface of thorax; the abdominal segments also have the centre of ventral area black, but the inner side of the prolegs is yellow, and the intersegmental areas are also pale (yellowish). It is difficult, however, to accurately describe the ventral colours, as a larva, when turned over, almost immediately regains its natural position. There can be little doubt, however, that these strongly contrasted—black, white, and yellowish—ventral colours are startling*, and give the larva a formidable appearance if it should by any chance become detached from its resting-position, more especially as it wriggles vigorously if removed from twig or resting-surface. *Larval scales*†: The larva has some deep metallic blue hairs very similar to those of *Dendrolimus pini*; when at rest nothing is to be seen of them, but, if disturbed, the larva arches its thoracic segments; this opens the folds of skin on the meso- and metathorax, exposing the well-known velvety blue-black and orange markings of these segments, and at the same time a rather formidable array of blade-shaped hairs; as the larva sinks back into its resting-position, the skin folds gradually and the hairs are sheathed and the velvety-blue slit-shaped markings hidden from view (Bacot, September 28th, 1897). *Adult*

* Some, if not all, of the larvæ of *Catocala* have pale grey or whitish undersides, with a black blotch or spot on most or all the segments; this, one may suppose, is a parallel development to the contrasted ventral coloration of the larva of *E. quercifolia*, their habits, and consequently their protective needs being so similar; the habit of wriggling if knocked or jarred off the resting-place is still more noticeable in the larvæ of the Catocalids than in that of *E. quercifolia*.

† Packard deals with these scale-like setæ at length (*Ann. Mag. Nat. Hist*, (6), ix., p. 373), and gives illustrations of them.

larva: Head small, rounded and hairy; of the ground colour, dusted with ochreous. Body rounded, hairy, much flattened ventrally; fleshy protuberance on each segment (in a line with the bases of the legs and prolegs), emitting long hairs; the 8th abdominal with a small dorsal hump; incisions and sides wrinkled, the prothorax and anal segment attenuated; the whole of the body covered with moderately long and scattered downy blackish hairs. Ground colour dark grey, dusted with blackish. The incisions between pro- and mesothorax, and meso- and metathorax blue-black; from the metathorax to the 7th abdominal is a series of pairs of whitish, oblique, wedge-shaped, dorsal dashes, each dash succeeded by a dull orange mark; these pale markings most conspicuous on the meso- and metathorax, and 3rd, 4th and 6th abdominal segments; base of hump on 8th abdominal shaded with dull orange. Venter orange, spotted with black and with a series of black spots, one on each segment; the lateral tubercles, viewed from beneath, are paler, and the hairs emitted from them form a fringe to the sides of the larva (Fenn, May 22nd, 1875). Réaumur gives an excellent description of the larva of this species, of which he says: "Sa couleur dominante est un gris de souris, qui tire un peu sur le cendré, qui tient moins de l'ardoise que le gris de souris ordinaire, c'est la couleur du dessus de son corps. Le dessous, le ventre est d'une feuille-morte, mêlé avec des taches d'un brun plus foncé. Elle porte sur le pénultieme anneau une corne assés courte, et de substance charnue. . . . Dans la ligne qui marque le séparation de la partie supérieure, et de la partie inférieure, il part de chaque anneau un appendice charnu, dirigé perpendiculairement à la longueur du corps, et terminé par une pointe mousse. A sa base, cet appendice a moins d'épaisseur que de largeur, son contour est bordé d'assés grands poils roux: de pareils poils partent aussi du corps dans les intervalles des appendices. Les deux appendices les plus proches de la tête, ont quelqu'air de deux oreilles. Les poils du dessus du corps sont courts, on ne les voit bien qu'à la loupe. Elle en a pourtant de plus longs, et qu'elle ne montre qu'en certains temps, qui sont très-propres à la caractériser; c'est principalement, à la jonction du premier anneau avec le second, qu'ils se trouvent; il y en a aussi de ceux dont je veux parler, à la jonction du second anneau avec le troisieme. Quand la chenille courbe sa partie antérieure en bas, les jonctions de ses premiers anneaux, qui sont cachées lorsque la chenille est simplement étendue, sont alors à découvert; elles se sont remarquer par leur couleur, qui est d'un bleu foncé, mais beau. C'est alors aussi que paroissent des poils de même couleur, et de figure singuliere. La partie, par laquelle ils se terminent, ressembleroit très-bien à un fer de pique, si elle étoit aussi plate, mais elle est plus renflée. A la jonction du premier anneau, il y a une frange de pareils poils; elle est cachée quand les anneaux sont autant appliqués l'un contre l'autre, qu'ils peuvent l'être, et elle est à découvert quand les anneaux s'écartent l'un de l'autre. Il y a encore de ces poils singuliers, mais en moindre quantité, à la jonction du second anneau avec le troisieme. Entre les deux anneaux dont je viens de parler, il y a encore d'autres poils d'une structure particuliere, et qui m'ont échappé pendant que j'observois la chenille vivante.

Ceux en forme de pique s'étoient apparemment saisis de toute mon attention. C'est dans la premiere enveloppe de la coque que j'ai trouvé les poils de la second espece, et leur couleur bleue, comme celle des poils en fer de pique, me persuade qu'ils sont aussi placés dans les jonctions du premier anneau avec le second, et du second avec le troisieme. Ces nouveaux poils sont des poils composés; ils sont des especes de poils en plume, ou en duvet, ou, plus exactement, ils sont un paquet de poils, qui a tantôt la forme d'un petit balai, tantôt celle d'une palme. Deux taches blanches de figure triangulaire se sont remarquer sur la partie supérieure du second anneau. On apperçoit de plus sur la partie supérieure de chaque anneau deux tubercules roux, chargés chacun de poils de médiocre grandeur. A la jonction des anneaux, il y a des especes de cordons charnus, qui ne sont pas si distincts à beaucoup près sur les anneaux des autres chenilles. La tête est bleuâtre, et paroîtroit bleue, si elle n'étoit pas garnie de quantité de poils roux. La peau de cette chenille mérite d'être observée à la loupe, elle ne paroît qu'un rézeau. Sa tissure est semblable à celle d'une éponge fine" (*Mémoires*, ii., pp. 287-289).

Variation of larva.—There is considerable variation in the larval coloration, Godart noticing more than three-quarters of a century since that the colour difference was constant on different foodplants, and Poulton has given us the results of certain experiments which point distinctly to the variation being of value in as much as they are capable of adjustment, within certain limits, to the surroundings of the larva, and thus adding considerable value to the protection afforded to the larva by its resemblance to its surroundings. Bacot notes that in the first instar there is little colour variation, but in the second the grey ground-colour varies, some larvæ having white marblings dorsally, which are usually strongest on the mesothorax, just behind the orange spots. Farren states that the larvæ, in nature, are well protected, for not only do they feed by night and rest by day, low down on the stems of the foodplant, but, when at rest—on sallow, whitethorn, blackthorn or buckthorn—so difficult are they to see that a very general way of collecting them, is to feel down the stems for them. They are very variable, and certainly seem to have the power of adapting their colour to the stems of the particular bush on which they feed, *e.g.*, on blackthorn and buckthorn, the stems of which are black and smooth, one finds mostly black larvæ, whilst on sallow and whitethorn, the stems of which are white or mottled grey, the larvæ match the colour; they appear to follow this rule very generally, though not, of course, without exception. Prout says that on the lichen-covered blackthorns at Sandown some of them are very prettily mottled like the lichen-marked form of the larva of *Gonodontis bidentata*, etc. Carr notes that a black larva on buckthorn at Wicken, June 18th, 1898, produced a male on July 17th, whilst an ash-grey larva, on sallow, on June 20th, produced a female on July 16th, 1898, but adds the suspicion that the colour had to do with the environment and not with sex. Merrin says that he has observed the larvæ, in May, resting high up on bramble branches, which their markings closely resemble. Poulton, by surrounding living larvæ during the early stages of growth (the food being the same) with black twigs and lichen-covered twigs respectively, obtained results showing that the larvæ did respond largely to their environment (*vide*, *Proc. Ent. Soc. Lond.*, 1894, p. xvi). Buckler figures (*Larvae*, etc., pl. li., figs. 1-1*a*) the two forms that are usually found in nature. These may be noted as: (1) Dorsal area purple-brown with a slaty-blue V-mark (pointing towards head) on each of the abdominal segments, the lateral areas of the abdominal segments slaty-grey. (2) Dorsal area of varying shades of grey with ill-defined darker grey longitudinal markings on each segment. The thoracic segments dark grey, with two white wedge-shaped markings on the front of meso- and metathorax, the second and fifth abdominal segments dark grey, the first, third, fourth, sixth and seventh, paler and somewhat ochreous, a slight protuberance on the 8th abdominal segment. Réaumur notes the great difference in size as sexual, the very small larvæ producing males, the large ones females.

Comparison of larvæ of Odonestis pruni and Eutricha quercifolia.—When the larvæ of these species are from ·75in. to 1in. in length, they are remarkably alike. The chief differences appear to be: (1) The larvæ of *O. pruni* lie flatter on the resting-surface, the larvæ themselves being thinner and rather more slender than those of *E. quercifolia*. (2) In the larva of *O. pruni* the caudal horn on the 8th abdominal segment is very small, merely a slight hump. (3) The lateral processes are less noticeable in *O. pruni*, the prothoracic segment bearing the most noticeable brush or fan of hairs, this brush does not arise from the lateral processes but from the so-called "ear-tubercle"; in *E. quercifolia* the hairs from the "ear-tubercle" are pointed forwards and downwards and lie almost flat on the skin, in *O. pruni* they are pointed upwards and outwards and stand out conspicuously. (4) In *O. pruni* the dorsal white oblique /\ marks of *E. quercifolia* become round, whitish spots. (5) There is a white area observable just behind the head in *O. pruni* that is not observable in *E. quercifolia*. (6) The orange, black and white markings on the meso- and metathorax of *E. quercifolia* are not nearly so well-developed in *O. pruni*. [Later, the mesothorax of *O. pruni* bears only traces of the black, orange and white markings, while the metathorax has hardly a trace of them; the white area (noted in 5) extends to the head itself, *E. quercifolia* being without a trace of any such marking.] (7) The anal claspers of *O. pruni* are more widely spread and lie flatter than do those of *E. quercifolia*.

Pupation.—The larva usually selects a spot among its foodplant in which to spin its cocoon, frequently rather low down, and generally, in our experience, extremely well hidden, yet Fowler notes that, at Ringwood, and in the New Forest generally, the black cocoons are found on hedgebanks, where they are very conspicuous indeed. Holland says that, in Berks, the cocoons are generally found in the middle of the bush or hedge where the larvæ have fed; Forsyth once found a cocoon spun up under a low wall at Waterlooville, near Portsmouth; and Godwin one spun up on a willow tree on the present site of Addison Road Station; Ransom found a cocoon at Henny on a dead stalk of *Verbascum thapsus*, about 2 or 3 inches from the ground, on a low hedgebank facing south-east; also 2 cocoons spun among the inner branches of a hedge about a foot above the ground.

Lambillion notes that in Belgium the cocoon is usually hidden in cracks of walls or low down in hedges, and Selys that it chooses a place between the branches or the twigs of the trees, whilst Pabst records the unusual occurrence of two larvæ, apparently normally healthy, pupating on the surface of the ground without attempting to spin the normal cocoon, although the reddish-coloured contents of the intestines were discharged, as would have happened had a cocoon been spun: in both instances ♀ moths appeared (*Illus. Zeits. für Ent.*, vol. iii., p. 249); a larva of *Cosmotriche potatoria* that acted similarly is also referred to. Ransom notes that at Sudbury he obtained a fullfed larva on June 20th, 1901, that changed to a pupa on the 27th without spinning a cocoon, and the imago emerged in due course on July 18th. Réaumur observes that the fluid excreted by the larva is whitish. He says: "Before the larva changes to a pupa, it excretes apparently a very great quantity of a whitish fluid (bouillie) from the anus, just as the larva of *Malacosoma neustria* excretes a kind of yellow fluid (bouillie). This dries and becomes a white powder, which attaches itself to the body of the still moist pupa, when it first gets rid of the larval skin, and when the movements that it indulges in at that time make it come in contact with the walls of the cocoon" (*Mém.*, ii., p. 285). There seems to be some little variation in the length of the pupal stage; many authorities give about three weeks. Czekelius gives 20 days. Williams notes a fullfed larva found at Ipswich, June 12th, 1891, spun up June 13th, the imago emerging July 13th, 1891. Ransom observes that a larva pupated June 24th, 1899, and the imago emerged July 13th, 1899, at Sudbury. It may be well here to note that, on emergence from the cocoon (especially if the cocoon be laid horizontally), the imago frequently scratches the outer membrane of the wings while still quite soft, from which scratches exude tiny globules of yellow blood; this does not usually prevent successful expansion, and as the wings harden, the little blood drops become solid and black in colour, and sometimes drop off, carrying, however, a certain number of scales with them; frequently they are immovably fixed to the wing membrane.

Cocoon.—Two cocoons attached to sallow twigs examined; these bear considerable resemblance to those of *Cosmotriche potatoria*. (1) ♀. 2·5 in. long, ·75 in. wide and ·625 in. high (or deep) at bulkiest part. (2) ♀. 2·5 in. long, rather less than ·7 in. wide and slimmer than the other. The cocoon tapers gradually to the ends, which are pointed, the lower exhibiting traces of concavity, the upper being convex. It is composed of stout, greyish-brown silk, with numerous larval hairs felted into it; the general colour is patchy or mottled, varying from pale whitish-grey to dark grey-brown, with some ochreous stains. The inside is sometimes quite whitish-grey owing to the quantity of white powder on it. The cocoon looks opaque and dense, but if held up to the light is seen to be far from opaque, and when opened this looseness of structure is still more apparent; it is woolly externally, a few threads of flossy silk occurring on the outside of the cocoon, but smoother on the inside. (3) A ♂ cocoon is smaller, 2 in. long and ·625 in. wide. (4) ♀. Another cocoon, detached from its supports, 1·625 in. long, ·75 in. wide and ·625 in. high (at bulkiest part) is more oval, less stout in texture. The posterior portion of the cocoon for about ·5 in. is filled with the cast larval skin, the pupa completely filling the remainder, except a small space at the top. From their outward appearance, one would hardly expect the cocoons to contain such large pupæ. The pupæ are marvellously closely packed (Bacot). (5) The cocoon "est fort longue, et souvent pointue à un des bouts à tel point, que si l'autre bout étoit plus applati, elle auroit une figure à peu près conique. La base de la coque est d'une soye grisâtre, mais des poils entrent dans sa composition; son tissu est médiocrement épais et serré; aussi n'est-elle pas dure; mais son intérieur est entiérement poudré d'une espece de farine qui bouche les vuides que les fils laissent entr'eux. Cette poudre blanche s'y trouve en aussi grande et plus grande quantité, que la poudre jaune dans les coques des chenilles appellées livrées" (*Mém.*, ii., p. 284). Burrows notes that the cocoons are sometimes spun very loosely, and that on June 5th, 1893, a fine pupa fell into the umbrella without injury when he was larva-beating. Fenn notes the cocoon as composed of tough grey silk, intermixed with larval hairs, fusiform in shape, flattened on one side, adhering to a stem among the twigs of the bush on which the larva has fed.

PUPA.—♀. Stout, smooth in outline, just 1·5 in. long, ·5 in. wide (from venter to dorsum at 4th abdominal); the ventral area almost straight (lying along the line of the twig to which the cocoon is attached) dorsally it is curved (following the outline of the cocoon) except that, being shorter, the curves are more abrupt than those of the cocoon at head and anus. The surface is dull, smooth on wing-cases, rather rougher on the other areas, very dark-brown or black, but colour obscured by being dusted over with a whitish powder that gives it a bluish-grey appearance; this powder consists of minute crystals, and renders accurate observation of the sexual organs, spiracles, and other small pupal structures almost impossible. The anus is bluntly rounded; the head, dorsum and anus, with numerous short, stout bristles scattered and in patches, these help largely to retain the white powder on the pupal surface; the prothorax and dorsal headpiece united (and apparently dehisce in one piece) the mesothorax large, the metathorax small; the 4th is the largest of the abdominal segments, both in girth and length (front to back); only a small slip of the hindwings is evident, this reaches to about the middle of the 3rd abdominal; the forewings reach to nearly the end of the 4th abdominal, the outline of the 3rd pair of legs shows as a raised ridge on the costal margin of the wings; the antennæ very short, only about half the length of the 2nd pair of legs, which are two-thirds the length of the 3rd pair; on inner side of the 2nd legs are a joint of the 1st pair of legs, the palpi, and a short maxillary sheath; the mouth-parts are too vague to describe with certainty; the spiracles large and distinct (somewhat obscured by the white crystals); sexual organs not very clearly marked. ♂. The pupa-case is thickly dusted over with pale powder; on portions of the dorsal area, where it is caught by the hairs, it is very thick; on the meso- and prothorax and dorsal headpiece it is "caked" on. Length of pupa 1·25 in., greatest diameter laterally ·375 in., and slightly more than this dorso-ventrally; shape very similar to that of the ♀ pupa, but not quite so thick at middle and rather blunter at anus, tapers less towards head and anus. Sexual organs are poorly developed, if anything less prominent than in the female; the antennæ, as in the imagines, are about equally developed, being broad at base, short, rather bent, and tapering rapidly at or near the bend or elbow. [These are the only differences that I can discern; in both male and female pupæ the structures are much obscured by the whitish powder.] (Bacot). Stout, anal extremity blunt, entire surface covered with thick, whitish, floury powder (Fenn).

Dehiscence.—There is a break along the meso- and metathoracic suture, also along the median line of the mesothorax; another break occurs along the median line of the prothorax and dorsal headpiece. Ventrally there is a fracture along the suture separating the antennæ and wings, but the central mass (consisting of antennæ, legs, mouth- and faceparts) retains its position (Bacot).

Parasites.—Hellins records a bright red, very long-legged mite, which ran with great swiftness, and which he believed was externally parasitic on a larva of *E. quercifolia* received from Wicken Fen.

Foodplants.—*Salix*, *Prunus spinosus*, *Pyrus*, *Graminis* (Linné) [the last-named wants confirmation], fruit-trees generally (Rühl), *Rhamnus catharticus*, *Salix caprea* (Raynor), sallow (Glenny), *Crataegus oxyacantha* (Holland), willow (Hancock), laurel (Pitman), plum (Bowles), pear, peach (Réaumur), barberry (Favre), apple (Speyer), *Salix aurita*, *S. cinerea* (Glaser), *Sorbus aucuparia* (Krieghoff), oak (Rössler), cherry, hazel (Kretschmer). In the Cambridgeshire Fens, buckthorn is the most favoured foodplant, then sallow, but buckthorn will give ten out of every twelve larvæ found; hawthorn and blackthorn are only occasionally chosen (Farren); in Kent blackthorn in hedges, and less frequently whitethorn.

Habits and habitat.—Réaumur describes the similarity of the imago to a bunch of dried leaves, with the pen of a true naturalist. He calls it "Le Papillon paquet de feuilles séches," and after noting that good observers were often deceived when they first saw it, he proceeds: "Ses aîles supérieures qui couvrent tout le corps, au-dessus duquel elles forment un toit, ont des nervures qui, par leur espece de relief et par leur disposition, imitent fort celles des feuilles: leur contour supérieur est dentelé, comme l'est celui de plusieurs feuilles. Les ailes inférieures débordent beaucoup les supérieures, et ont de même et la couleur et les nervures et les dentelures des feuilles. En devant de la tête, il a une espece de bec pointu formé par les deux barbes, ou tiges barbues, qui se réunissent-là l'une contre l'autre; elles semblent être le bout du pédicule d'une des feuilles. Les antennes couchées sur chaque côté du corcelet, et qui vont jusqu' à l'origine des aîles, paroissent être la continuation du pédicule d'une feuille. Enfin, sans expliquer davantage sur quoi la ressemblance est fondée, il est sûr que, quand on voit ce papillon, est qu'on ne sçait pas qu'il est un papillon, on le regarde sans se douter qu'il en soit un (*Mémoires*, ii., p. 283—284). Réaumur further notes that the imago is very quiet during the day, and, owing to its remarkable appearance, rarely observed in the imaginal state, although the larvæ were common in the gardens and orchards around Paris. It is abundant at light, in both sexes, flying from soon after dusk until about 11.0 p.m.; we have seen as many as half a dozen dashing at one time around the light at Wicken Fen, and, on one occasion there, a sweep of the net for a large female resulted in the capture of 3 ♂ specimens of *E. quercifolia* and 2 ♂ *Cosmotriche potatoria* besides, but usually not more than half a dozen will show up even on a good evening. We have also taken the female flying heavily at dusk over a tall whitethorn hedge, possibly ovipositing, and both sexes are frequently taken at lamps on the outskirts of towns. Holland notes a ♀ found on a hedge at Whitley, males at light of signal-box at Bulmershe railway station and at street lamps at Caversham and Reading. Tillyard found it common in 1896 at the electric lights in Norwich, and Morley has taken several at the electric lights in Ipswich, whilst in 1896 Agassiz reported it as very abundant at the electric lights of Aix-les-Bains, and Edelsten, at light in the Norfolk Broads. Lambillion unexpectedly asserts (*in litt.*) that the male also flies by day in the sun as well as in the evening, whilst the ♀ is often found resting on the grass, or near the ground, but we suspect this day-flying habit to be quite unusual. We have already noted (*anteà*, vol. ii., p. 476) that Todd obtained the full development of certain specimens of *Poecilocampa populi* that he removed from the pupa. Standfuss notes that he has repeatedly opened the pupæ of the latter species and of *Eutricha quercifolia* and that some of the imagines had fully developed their wings on the afternoon of the following day, whilst others did not undergo further development at all. It becomes much more interesting, however, to know that Réaumur had, in 1736, performed the same operation. He tells us that on July 15th, 1736, he took a pupa from a cocoon, the pupa already showing dehiscence of the thoracic segments, and he expected it to emerge immediately; however, as it had not done so the next day, and finding that it had not the strength to emerge, he pulled the pupal skin from it, piece by piece, and without injuring it. The freed imago, in spite of the vigour it displayed, remained more than an hour with undeveloped wings, and he feared he had interfered prematurely, but at the end of that time, its wings commenced to expand, and in due course took their regular shape, and the imago (a male) assumed its singular attitude. The habitats of the species are extremely varied—orchards, gardens, roadside-hedges, woodsides, fens and moorlands are among those most frequently noted. Réaumur notes them on the fruit-trees (pears, peaches, etc.) in the gardens around Paris; Lambillion, as common in gardens and orchards in Belgium; in Nassau, it occurs on fruit-trees, especially stone-fruit and pear, even in the gardens of the towns. Miss Ormerod reports the larvæ as doing great damage to apple-trees in Herefordshire in June, 1894; haunts the sallows on the moors and drier marshes in Mecklenburg (Schmidt); probably more abundant in the fens of Cambridgeshire than elsewhere in England (Tutt); prefers fenny situations about King's Lynn (Atmore); on willows in the marshes in the Mansfield district (Daws); frequents the salterns on the Island of Portsea (Moncreaff), chooses the blackthorns on the edge of the saltmarshes near Southend (Whittle); on the stunted blackthorn bushes on Culver Down (Prout); on the whitethorns and blackthorns growing on the cliffs in Guernsey (Luff); prefers the sloebushes on the slopes at Leigh, in Essex (Vaughan); and the stunted thorn-bushes on bare downs at Bloxworth (Cambridge); also the downs at Wilton, near Salisbury (Ridley); it is remarkable that, although it prefers the fens at Wicken and elsewhere in Cambridgeshire, around Cambridge it is quite a roadside species, frequenting the hawthorn hedges (Farren); also affects the hawthorn hedges in Guernsey (Luff), at Aylesbury (Bayne), at Dawlish (Rogers), and at Twyning (Bankes); whilst blackthorn hedges are chosen at Ipswich (Williams), at Southend (Whittle), at Bexley, Darenth, Greenhithe, etc. (Bower); around Strood, Cuxton, Chattenden, etc., both whitethorn and blackthorn hedges are selected. In the Gloucester district it frequents roadside hedges, the larvæ being observed resting high up on bramble branches (Merrin); frequents open hedges at Emsworth (Christy); affects all the hedgerows around Darenth, where larvæ are abundant in April (Newman); frequents thick whitethorn and blackthorn hedges, as well as the woods in the Reading district (Clarke); at Wimbledon, chooses the rough ground south of the butts (Clifford).

Time of appearance.—In Britain, from the second week in June until the first week of August, rarely before or after these limits, the second week to the end of July being the usual time. May and June in the Alpes-Maritimes (Millière); generally in July, but sometimes not until the commencement of August in Livonia (Nolcken); end of June and July in Baden (Reutti); end of June in Switzerland (Frey); Réaumur notes emergences at Paris on July 15th, 1736, and for a few days preceding; Fritsch gives dates in Austro-Hungary from June 14th to August 13th; July in Transcaucasia (Romanoff); end of July at light at Berne (Benteli); June 28th, 1893, at light at Berne, not common (Hiltbold); imagines in June at Bilbao (Rössler); imagines about July 10th, in Belgium (Lambillion); larvæ in June, imagines in July and August in Pomerania (Hering); somewhat rare at light in June and July at Zürich (Nägeli); second week in August at light at Bourg d'Oisans (Tutt); June 15th, 1847, several flying at dusk at Battel (? Battle) (Ellman); two larvæ, May 11th, 1848, at Brighton, produced imagines, June 28th (Cooke); bred July 27th, 1860, from Lewes larva (Wright); July 30th, 1860, at Lee, Kent, June 22nd—July 4th, 1865, bred a long series from larvæ taken at Kidbrook and Plumstead, Kent, larva, May 22nd, 1875, at Sidcup, Kent (Fenn); bred and captured at light, August 1st—14th, 1861, at Worcester (Edmunds); August 1st—18th, 1869, etc., at light, July 29th, 1873, at Eltham (A. H. Jones); larva at Upton St. Leonards, June 20th, 1870, another from same place, June 13th, 1872, spun up on June 17th, and imago emerged July 6th, 1872 (Watkins); July 30th, 1873, at Blackheath, July 18th, 1876, etc., at light at Lee (Bower); July 21st, 1875, a ♀ on a street lamp at Caversham, July 17th, 1889, a ♂ on a lamp at Reading, July 30th, 1890, at Bulmershe, July 27th, 1892, at Whitley (Holland); bred at Mansfield, June 27th, 1880 (Daws); a male at light in Lincolnshire, August 4th, 1883, fullfed larva in Guernsey, July 4th, 1894, made its cocoon July 5th, and imago emerged in early August, imagines at light at Aigle, July 3rd, 4th, 1898 (Lowe); imagines bred, June 27th, 1885, at Brentwood; larvæ, August 19th, 1888, May 25th, 1893 at Bentley, beat a pupa into an umbrella from a hedge at Rainham, June 5th, 1893, which produced an imago uninjured, June 25th, 1893, at

Rainham, an imago captured August 1st, 1899, at light at Mucking, ♂ and ♀ at light at Mucking on July 21st, 1900 (Burrows); June 26th, 1886, bred from Wicken (Warren); fullgrown larva, June 4th, 1888, at Darenth Wood, larvæ also May, 16th—18th, 1891, at Wicken, imagines from the latter appeared from July 12th—August 5th, nearly fullfed larvæ, May 22nd—26th, 1896, imagines emerged from pupæ from these, July 1st—15th; a small larva, September 10th, 1896, at Waldringfield, also an imago at light, August 20th, 1891, and others, July 22nd—26th, 1898, at Wicken at light (James); larvæ nearly fullfed, June 5th, 1888, ♀ on lamp, August 14th, 1888, other imagines, August 10th, 1890, August 12th, 1892, August 7th, 1900, at Reading (Butler); a few imagines at light at Wicken, July 20th, 1890, three larvæ, May 17th, 1894, near Emsworth, feeding openly on hedge (Christy); July 13th 1891, from Ipswich (Williams); July 29th, 1891, at light at Horning (Bowles); Wicken Fen and Winchester, 1892—3—4, larvæ taken by searching, April, May, June, pupated in June, emerged in July (Moberly); larvæ May 24th, 1893, larvæ from Wingham marshes, a male emerged June 21st, and two females on June 22nd and 24th 1893 (Briggs); larvæ June 4th—7th, 1893, and again September 1st—9th, 1893 (before hybernation) at Wicken (Freeman); two imagines July 20th, 1893, at King's Acre, near Hereford (Ormerod); larvæ May 13th, 1894, near King's Lynn, imagines commenced to emerge July 16th, 1894 (Glenny); bred from Wicken larvæ on July 3rd, 1894, and July 16th, 1898, whilst small larvæ at Oxton, September 12th, 1897, and fullfed ones, June, 1898, gave imagines July 11th, 1898, etc. (Studd); larva at Radley, May 14th, 1894, spun up June 16th, imago emerged July 26th, 1894 (Burr); July 22nd, 1894, males at light in Horning Fen (Sheldon); bred, July 23rd—30th, 1894, from Herefordshire larvæ, July 18th, 1898, in New Forest (Adkin); larvæ fullfed, May 27th, 1896, at Twyning, emerged June 25th, 1896 (Bankes); June 3rd, 1896, at Tiddesley Wood, bred June 18th—24th, 1896, from Powick (Rea); imagines, July 7th—22nd, 1896, July 10th—31st, 1897, and August 4th, 1898, also larvæ June 21st, 1899, imagines captured July 27th—August 1st, 1899, whilst a brood reared from hybernating larvæ, emerged July 12th—August 2nd, 1899, all at Chelmsford (Miller); July 12th, 1896, at Roydon (Barclay); imago at Ringwood, August 1st, 1896 (Fowler); imagines at light at Wicken, August 3rd, 1896 (Kaye); larvæ, April 15th, 1897, at Angmering, spun up June 3rd, male emerged, June 29th (Dollman); larvæ, June 1st and 5th, 1897, near Southend, males emerged July 3rd and 5th respectively, August 1st, 1899, on gas-lamps at Southend (Whittle); imagines, July 3rd—9th, 1897, July 13th—14th, 1898, July 3rd—24th, 1899, at Dawlish (Rogers); imagines, July 7th—23rd, 1897, August 1st, 1898, July 21st, 1899, at Boxworth (Thornhill); imagines, July 12th—17th, 1898, at Hayling Island (May); imagines, August 12th, 1898, at light, in Norfolk Broads (Edelsten); July 26th, 1899, and following days at Wicken (Butterfield); larva, June, 1899, pupated June 24th, 1899, emerged July 13th, 1899, at Sudbury, eggs from Henny hatched August 15th, 1899, larvæ pupated first week in July, 1900, imagines, July 25th, 1900, at light at Sudbury, July 27th, 1900 (Ransom); July 20th, 1900, at Hazeleigh (Raynor); July 26th, 1900, at light at Bushey Heath (Burraud); male, July 16th, 1901, at Norwood (Swain); larva, May 28th, 1901, at Monk's Wood, produced imago July 3rd, 1901 (Russell); July 12th, 1901, at Hampstead at light (Hopson).

LOCALITIES.—BEDS: Bedford (G. O. Day), Potton (Bond-Smith). BERKS: Reading (Butler), Tilehurst (Henderson), Whitley, Bulmershe (Holland), Hurst (Broome), Newbury (Hopson). BUCKS: Buckingham, rare (Slade), Eton (Studd), Aylesbury (Bayne), High Wycombe (Peachell). CAMBRIDGE: Burwell Fen, abundant, Wicken Fen, common, Chippenham Fen (Tutt), Boxworth (Thornhill), Bottisham, Quy Fens, Cambridge (Farren), Swaffham Fen (Jenyns), Ely (Cross), Fulbourne Dyke (Moss), Whittlesford (Thurnall), Fulbourne (Raynor), Cherry Hinton, Chatteris, Wisbech, Cowbit (Balding). DEVON: Oxton (Studd), Exeter (Bower), Dawlish (Rogers), Countess Weir (Potter), Teignmouth (Bowles). DORSET: rare, Studland, Glanvilles Wootton (Dale), Bloxworth (Cambridge), Poole (Greer). ESSEX: Chelmsford (Miller), Southend, Benfleet, Wanstead, Brentwood, Rainham, Mucking (Burrows), Epping, Henny, Sudbury district (Ransom), Saffron Walden (Jeffrey), Danbury, Woodham Walter, Maldon, Hazeleigh, Purleigh (Raynor), Leigh (Vaughan), Loughton (Garland), Canvey (Whittle), Colchester (Harwood), Roydon (Barclay), Feering Bury (Reid), Titney Green, near Chelmsford (Pickett). GLOUCESTER: Twyning, near Tewkesbury (Bankes), Baptist Mills (Clarke), Wotton (Perkins), near Stroud (Musgrave), Upton St. Leonards, Painswick (Watkins), Leigh Woods, Bristol (Grigg), Bathampton (Ross), Gloucester district (Merrin), Newnham, Sandhurst, Mitcheldean (Lifton). HANTS: Isle of Wight, Culver Down, Sandown (Prout), Newport (Colthrup), Emsworth (Christy), New Forest (Adkin), Winchester (Hewett), Basingstoke (Holdaway), Hayling Island (May), Long Beaton (Ingram), Titchfield (McArthur), Ringwood (Fowler), Waterlooville, near Portsmouth (Forysth), Portsea Island (Moncreaff), Lyndhurst (Stainton). HEREFORD: Hereford (Chapman), King's Acre (Ormerod), Leominster (Hutchinson), Tarrington (Wood). HERTS: Hitchin (Cottam), Hertford (Stephens), Much Hadham (Newland), Knebworth (Durrant), Bushey Heath (Burraud). HUNTS: St. Ives, common (Jagger), Monk's Wood (Daltry). KENT: generally distributed in the Strood district—Rochester, Chatham, Cuxton, Cobham, Cliffe, etc.—Deal, Sandwich (Tutt), Plumstead Marshes (Butterfield), Chattenden (Turner), Higham Marshes, Paul's Cray Common, Chislehurst, Eltham (Jones), Darenth Wood (James), Folkestone (Knaggs), Ramsgate (Willson), Lee, Lewisham, Sidcup (Fenn), Beckenham (Adkin), Margate (Colthrup), Bexley (Alderson), Dartford Brent (McArthur), Greenhithe, Stone, Blackheath (Bower), Springhead (Andrews), Tonbridge (Raynor), Kidbrook, Dartford (West). LEICESTER: Earl Shilton (Bouskell), Freemans Common (Rowley). MIDDLESEX: Ealing (Bell-Marley), Bushhill Park, Enfield (Edelsten), Hackney Marshes (Clark), Harrow (Barclay), Kilburn, Hampstead, Willesden (Wormald), Ruislip (Melvill), Kingsbury (Bond), Mill Hill (South), Clay Hill, Enfield Lock (Bowles). MONMOUTH: Abergavenny (Chapman). NORFOLK: Norwich, common (Tillyard), King's Lynn (Atmore), Horning (Sheldon), Norfolk Broads (Edelsten), Denton (Cruttwell). NORTHAMPTON: Oundle (Whall), the Mere, near Peterborough (Whitwell), Northampton (Quail). NOTTS: Mansfield (Daws). OXFORD: Radley (Burr), Nettlebed (Henderson), Caversham, Southstoke (Holland), Islip (Burrows), Chinnor (Spiller). SOMERSET: Clevedon (Mason), Taunton (Farrant), Castle Cary (Macmillan). STAFFORD: South Staffordshire (Barrett), Rugeley, Cannock Chase (Freer). SUFFOLK: Bentley (Burrows), Brandon (Balding), Sudbury dist. (Ransom), Waldringfield (James), Ipswich (Williams), Lavenham (Gaze), Brantham (Buckell), Bergholt, Lowestoft, Aldeburgh, Fritton, Needham, Kennett, Higham, Tuddenham, Swefling, Lound (Bloomfield), Stowmarket (Stainton), Assington Woods (Lee), Kelvedon (P. C. Reid). SURREY: Coombe Wood (Stephens), Chobham (Burrows), Box Hill (Clarke), Wimbledon (Clifford), Norwood (Swain). SUSSEX: the Weald dist. (Merrifield), Abbott's Wood (Porritt), Angmering (Dollman), Bexhill (Bloomfield), Lewes (Wright), Arundel (Stevens), Battle (Ellman), Brighton (Cook), Hayward's Heath, Ringmer, Tilgate Forest (Jenner), Shavewood, near Brighton (Merrifield), Ardingley (Russell). WILTS: Wilton, near Salisbury (Ridley), Zeals (Burrows), Salisbury (Gummer). WORCESTER: Tiddesley Wood, fairly common, Malvern, Powick (Rea), near Worcester (Hancock), Hanbury (Barclay). YORKS: Birstwith (F. T. Walker), Askham Bog (Prest), Sheffield (Hope), Wakefield (Marson).

DISTRIBUTION.—ASIA: Amurland, Altai (Speyer), China (Felder), Asia Minor—Brussa (Staudinger), Japan—Yokohama, Fujisan, Corea (Leech), Trijisan (Pryer), Gensan (Fletcher), Eastern Siberia—Ema, Bureja mts. (Bremer), Kentei mts., Odjal, Marjinskipost, Chabarowka, Pokrofka, Wladiwostok, Blagowestschensk, Pekin, Sutschan (Staudinger). AUSTRO-HUNGARY: Tyrol, not rare (Hinterwaldner), Taufers Valley, Innsbruck (Weiler), Ischl (Hormuzaki), Pressburg (Rozsay), Bukovina, distributed in the plains, not observed in the mountains (Hormuzaki), Bohemia, everywhere (Nickerl), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Galicia—Sambor, Lemberg (Nowicki), Brünn (Müller), Hermannstadt (Czekelius), Eperies, not rare (Husz), Chemnitz (Pabst), Hungary—Kocsocz (Vángel), Gölnitz (Hudàk), Fiume (Mann), Lavantthal (Höfner), Upper Styria—St. Lambrecht (Kodermann), Upper Carinthia—Pörtschach (Wagner), Salzburg (Nickerl), Brenner dist. (Galvagni), Podolia (Caradja). Belgium: generally distributed (Lambillion), nr. Brussels (Donckier), Virton (Bray). Bulgaria: Sofia (Bachmetjew). Channel Islands: Guernsey, Herm (Luft), Jersey (Ansted). Denmark: rare (Reuter), Fyen—Odense and Vesterhae, single examples (Bang-Haas). Finland: rare in south-eastern Finland (Reuter), Karelia (Lampa). France: common throughout (Berce), Burgoyne (Constant coll.), Aix-les-Bains, very common (Agassiz), Paris (Réaumur), depts. of Meuse, Moselle, Meurthe (Speyer), Loire-Inférieure—Nantes (Bonjour), Puy-de-Dôme (Guillemot), dept. Var (Cantener), Morbihan (Griffith), Gironde (Trimoulet), Doubs dept. (Bruand), Aude dept. (Mabille), Saone-et-Loire (Constant), St. Quentin (Dubus), Sarthe (Desportes), Aube (Jourdheuille), Douai (Foucart), Auvergne (Sand), Eure-et-Loir, not rare (Guénée), Haute-Garonne (Caradja), Bourg d'Oisans (Tutt), Alpes-Maritimes (Millière), Pluviers (Nainvilliers *teste* Réaumur), Cannes, rare (Constant). Germany: common everywhere (Heinemann), north-west Germany, generally distributed (Jordan), Thuringia—Gotha, Erfurt, Arnstadt (Knapp), Pomerania—Stettin, not common, nr. Zabelsdorf, Nemitz, Grabow, Radekow (Hering), Silesia, not rare (Prittwitz), Dessau, not rare (Richter), Wernigorode (Fischer), Brunswick, common (Heinemann), Hanover, not rare (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), Rhine Palatinate (Bertram), Wurtemberg (Seyffler), Giessen (Dickore), Lower Elbe dist. (Zimmermann), Waldeck (Speyer), Zeitz-on-the-Elster (Wilde), Halle (Stange), Munich (Kranz), Hesse—Grünberg (Glaser), Rudolstadt (Meurer), Mecklenburg, everywhere (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia, distributed and not rare (Schütze), Dresden (Steinert), Prussia—Konigsberg, &c., distributed but rather rare (Schmidt), Upper Lusatia (Moeschler), Ratisbon (Schmid), Alsace (Peyerimhoff), Offenbach (Wiskott), Nassau, Baden dist., common, Karlsruhe (Reutti). Italy: throughout, unless absent in the south and in Corsica, nowhere abundant (Curò), Lombardy—Brianza, Milan (Turati), Modena (Fiori), Sicily—Madonie (Minà-Palumbo). Netherlands: generally distributed, but rare—Holland, Gelderland, Limburg, Gröningen (Snellen), Breda, not rare (Heylaerts). Roumania: common—Grumazesti, Kloster Neamtz, Costrischa, Husch, Slanic (Caradja), Comanesti, Jassy (coll. Leon), Dobrudscha (Mann), Turn Severin (Haberhauer). Russia: southern Russia (Moeschler), Wolmar (Lutzau), Volga district, not rare—Kasan, Orenburg, Sarepta, etc. (Eversmann), Baltic provinces—generally distributed, but somewhat rare (Nolcken), Transcaucasia—Borjom, Souram, Manglis, Helenendorf, Lagodekhi, Guéroussi (Romanoff), St. Petersburg (Erschoff), Moscow district—Ivanovsk (Assmuss). Scandinavia: rare in Sweden up to 60° N. lat. (Aurivillius), Carlscrona, Upsala (Wallengren). Spain: Barcelona district—San Gervasis, Gracia, etc. (Cuní y Martorell), Catalonia (Martorell y Peña), Bilbao (Seebold). Switzerland: everywhere in the plains and hills (Frey), Aigle (Lowe), Berne (Benteli), Zürich (Nägeli), Lower Engadine, above 4,000ft. elevation (Killias), Weissenburg (Huguenin), Valais, not rare in tree region—Ravoire, at foot of Mt. des Ecotteaux, Fully, Sion, Sierre, etc. (Favre). Turkey: Varna (Lederer).

ADDENDUM (vol. ii., p. 468).

Pœcilocampa populi*, Linné.

δ. ab. *albescens*, Heyne, "Soc. Ent.," xiii., pp. 105—106 (1898); Stichel, "Berl. Ent. Zeits.," xliv., p. 144, pl. ii., fig. 13 (1900).—Alis anterioribus latissime albomarginatis, disco nigro griseo vario margine anteriore flavo; alis posterioribus totis albis; ciliis brunneis anguste flavo intersectis. Albino. *Albescens* appears to me to be a true albino, which is lighter in all its parts than the type. In the dense hairs of the head and thorax the difference is only slight; the abdomen in the ♂ is somewhat lighter brown than in *P. populi*; in the ♀ it and the antennæ are rather light yellow-brown. The forewings have a distinctly yellow costa, especially in the ♀, and in both sexes a rather broad white outer-margin; the basal marking, which in *P. populi* is mostly distinctly brown, is yellow-brown in *albescens*.

* To be added to vol ii., p. 468.

The parts of the forewing lying between base and outer-margin show the same light dentate transverse line as in *P. populi*; on the other hand the tolerably uniform black-brown ground colour of *P. populi* is, in *albescens*, more grey and irregularly blotched, since the white ground colour everywhere shows through. The black scales outside the dentate transverse line only occupy a part of the otherwise white outer-margin. The transverse nervure is marked by a yellowish dot, which is black in *P. populi*. Hindwings in the ♀ pure white, in the ♂ with fine and narrow grey nervures. Fringes of all the wings brown, at the ends of the nervures narrowly intersected with yellow. Underside pure white, with the markings of the upper side showing through; all the wings with yellowish costa and very fine yellowish nervures.

Stichel remarks (*Berl. Ent. Zeits.*, xliv., p. 144) that, although Heyne terms this an albino, it is not at all appropriate, since true albinic specimens represent a diseased condition with a reduction of the scaling and a paling-off of the colour, which need not necessarily be white. In this form there is simply an extension of the usual whitish parts with normal development.

ε. ab. *albomarginata*, Heyne, "Soc.Ent.,"xiii., pp.105, 106 (1898); Stichel, "Berl. Ent. Zeits.," xliv., p. 144, pl. ii., figs. 11, 12 (1900). Alis anterioribus latissime albidomarginatis, fascia media fere nigra; alis posterioribus albis, basi tantum griseis; ciliis brunneis latius flavo intersecatis. This would not appear to be an albino, in spite of its resemblance in many respects to the preceding aberration; but the broad black-brown central band of the forewings is just as dark and of the same proportions as in the type, also the basal half of the wing is tinted with grey-brown; therefore, only the broad outer half of hindwings, and the very broad margin of the forewings are white; in the latter the basal patch is large and light, yellowish-white. Fringes nearly uniformly brown, and interrupted with white. Underside of all the wings dark interiorly, white exteriorly; nervures finely yellow.

Stichel notes (*Berl. Ent. Zeits.*, xliv., p. 144) this as varying in the same direction as the preceding, but the basal and central area of the forewings not very different from the type; the outer part, however, very broadly white; the hindwings, from the base outwards to the transverse band, grey-brown, beyond which, to the margin, it is white.

CATALOGUE OF THE PALÆARCTIC LACHNEIDES*.

LACHNEIDES.
CHONDROSTEGIDÆ.
 CHONDROSTEGINÆ.
  CHONDROSTEGIDI.
   Eustaudingeria, Dyar
    vandalicia, Mill.
   Chondrostega, Led.
    pastrana, Led.
     var. hyrcana, Staud.
     var. palæstrana, Staud.
    subfasciata, Klug
    fasciana, Staud.
    constantina, Auriv.
 LACHNEIDÆ.
  MALACOSOMINÆ.
   MALACOSOMIDI.
    Malacosoma, Hb.
     castrensis, Linné
      ab. pallida, Tutt
      ab. obsoleta, Tutt
      ab. taraxacoides, Bell.
      ab. intermedia, Tutt
      ab. virgata, Tutt
      ab. unicolor, Tutt
      ab. rufovirgata, Tutt
      ab. bifasciata, Tutt
      ab. veneta, Stdfss.
      ab. hilleri, Stdfss.
      ab. brunnea, Tutt
      ab. minor, Tutt
      var. (et *ab*) kirghisica, Staud.
     neustria, Linné
      ab. quercûs, Esp.
      ab. ochracea-confluens, Tutt
      ab. annularis, Geoff.
      ab. ochracea-fracta, Tutt
      ab. ochracea-unicolor, Tutt
      ab. confluens, Selys
      ab. virgata, Tutt
      ab. fracta, Tutt
      ab. unicolor, Tutt
      ab. cervina, Tutt
      ab. cervina-confluens, Tutt
      ab. cervina-virgata, Tutt
      ab. cervina-fracta, Tutt
      ab. cervina-vulgaris, Tutt
      ab. vulgaris, Bork.

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* The arrangement of this *Catalogue* is purely tentative. We do not know the early stages of several species, and the position of such remains a matter of great uncertainty.

ab. rufescens - confluens, Tutt
ab. rufescens-virgata, Tutt
ab. rufescens-fracta, Tutt
ab. rufescens - unicolor, Tutt
ab. pyri, Scop.
ab. rufa-confluens, Tutt
ab. rufa-virgata, Tutt
ab. rufa-fracta, Tutt
ab. rufa-unicolor, Tutt
ab. alba, Tutt
var. parallela, Staud.
var. testacea, Motsch.
schaufussi *hybr.*, Stdfss.
caradjæ *hybr.*, Stdfss.
penzigi *hybr.*, Stdfss.
franconica, Esp.
var. lutea*, Oberth.
intermedia, Mill.
alpicola, Staud.
ab. (?*var.*) othello, Blach.
var. prima, Staud.
flavomarginata, Pouj.

PŒCILOCAMPINÆ.
PŒCILOCAMPIDI.
Pœcilocampa, Stphs.
populi, Linn.
ab. virgata, Tutt
ab. albescens, Heyne
ab. albomarginata, Heyne
var. canensis, Mill.
var. calberlæ, Ragusa
var. alpina, Frey

TRICHIURINÆ.
TRICHIURIDI.
Achnocampa, Ramb.
ilicis, Ramb.
Trichiura, Stphs.
cratægi, Linné
ab. pallida, Tutt
ab. (et *var.*) freyeri, Tutt
var. (et *ab.*) ariæ, Hb.

SELENEPHERINÆ.
SELENEPHERIDI.
Selenephera, Rbr.
lunigera, Esp.
var. lobulina, Esp.
var. borealis, Bkh.

LACHNEINÆ.
LACHNEIDI.
Autosphyla, Rbr.
neogena, F. de Wald.
henkei, Staud.
acanthophylli, Chr.
rueckbeili, Græs.
Lachneis, Hb.
rimicola, Hb.
var. inspersa, Staud.
catax, Linn.
lanestris, Linn.
ab. obsoleta, Tutt
ab. quadrangulata, Tutt
var. arbusculæ, Frr.
var. aavasaksæ, Teich
var. grisea, Tutt
var. senecta, Græs.

DIPLURINÆ.
DIPLURIDI.
Diplura, Ramb.
loti, Ochs.
var. algeriensis, Baker

PACHYGASTRIINÆ.
PACHYGASTRIIDI.
Aurivillia, Tutt
davidis, Staud.
datini, Mab.
decolorata, Klug
Pachygastria, Hb.
concolor, Chr.
nana, Staud.
eversmanni, Evers.
josua, Staud.
trifolii, Schiff.
ab. obsoleta-flava, Tutt
ab. pallida-flava, Tutt
ab. flava, Tutt
ab. contracta-flava, Tutt
ab. obsoleta - medicaginis, Tutt
ab. (et *var.*) medicaginis, F. J. A. D.
ab. virgata - medicaginis, Tutt
ab. (et *var.*) ratamæ, H.-Sch.
ab. (et *var.*) cocles, Hb.
ab. obsoleta-cervina, Tutt
ab. cervina, Tutt
ab. contracta - cervina, Tutt
ab. iberica, Gn.
ab. unilinea-typica, Tutt
ab. suffusa-typica, Tutt
ab. obsoleta-rufa, Tutt
ab. rufa, Tutt
ab. contracta-rufa, Tutt
var. mauritanica, Staud.
var. semifasciata, Failla
ab. (et. *var.*) terreni, H.-Sch.
var. maculosa, Rogenhofer
wagneri *hybr.*, Tutt
Lasiocampa, Schrank
serrula, Gn.
var. maroccana, Staud.
var. undulata, Staud.
var. palaestinensis, Staud.
grandis, Rghfr.
ab. sapiens, Staud.
quercûs, Linn.
ab. curvata, Tutt
ab. latovirgata, Tutt
ab. semimarginata, Tutt
ab. marginata, Tutt
ab. basipuncta, Tutt
ab. spartii, Hb.
ab. spartii-curvata, Tutt
ab. roboris, F.J.A.D.
ab. guillemotii, Trim.
ab. spartii - marginata, Tutt

* Kirby places (*Cat.*, p. 832) this in the genus *Lachneis* as a separate species. Staudinger makes it (*Cat.*, 3rd ed., p. 119) a var. of *Malacosoma apicola.*

ab. spartii - basipuncta, Tutt
ab. purpurascens, Tutt
ab. purpurascens-curvata, Tutt
ab. purpurascens-latovirgata, Tutt
ab. purpurascens - semimarginata, Tutt
ab. purpurascens-marginata, Tutt
ab. purpurascens - basipuncta, Tutt
ab. brunnea, Tutt
ab. sicula-latovirgata, Tutt
var. (et *ab.*) sicula, Tutt
ab. sicula-marginata, Tutt
ab. obsoleta, Tutt
ab. virgata, Tutt
ab. ochracea - obsoleta, Tutt
ab. ochracea-virgata, Tutt
ab. ochracea-semimarginata, Tutt
ab. ochracea - marginata, Tutt
ab. rufescens - obsoleta, Tutt
ab. rufescens-virgata, Tutt
ab. rufescens - semimarginata, Tutt
ab. rufescens-marginata, Tutt
ab. brunnea-obsoleta, Tutt
ab. brunnea-virgata, Tutt
ab. brunnea-semimarginata, Tutt
ab. brunnea - marginata, Tutt
ab. tenuata, Fuchs
ab. catalaunica, Staud.
ab. dalmatinus, Gerhard
var. meridionalis, Tutt
var. viburni, Gn.
var. burdigalensis, Gerh.
var. alpina, Frey
var. callunæ, Palmer
var. lapponica, Fuchs
ab. olivaceo-fasciata, Ckll.
ab. olivacea, Tutt
ab. fenestratus, Gerh.
bacoti *hybr.*, Tutt
warburgi *hybr.*, Tutt
intermedia *hybr.*, Tutt
prouti *hybr.*, Tutt
complexa *hybr.*, Tutt
inversa *hybr.*, Tutt
complicata *hybr.*, Tutt

LAMBESSIDI.
Lambessa, Staud.
staudingeri, Baker

EUTRICHIDÆ.
METANASTRIINÆ.
METANASTRIIDI.
Metanastria, Hb.
subpurpurea, Butl.

MACROTHYLACIIDI.
Macrothylacia, Rbr.
rubi, Linn.
ab. rufa-separata, Tutt
ab. rufa, Tutt
ab. rufa - approximata, Tutt
ab. rufa-conjuncta, Tutt
ab. rufa-fasciata, Tutt
ab. rufa-unilinea, Tutt
ab. rufa-obsoleta, Tutt
ab. rufa-dissimilis, Tutt
ab. rufa-virgata, Tutt
ab. ferruginea - separata, Tutt
ab. ferruginea, Tutt
ab. ferruginea - approximata, Tutt
ab. ferruginea - conjuncta, Tutt
ab. ferruginea - fasciata, Tutt
ab. ferruginea - unilinea, Tutt
ab. ferruginea - obsoleta, Tutt
ab. ferruginea - dissimilis, Tutt
ab. ferruginea - virgata, Tutt
ab. pallida-separata, Tutt
ab. pallida, Tutt
ab. pallida - approximata, Tutt
ab. pallida - conjuncta, Tutt
ab. pallida-fasciata, Tutt
ab. pallida-unilinea, Tutt
ab. pallida-obsoleta, Tutt
ab. pallida-dissimilis, Tutt
ab. pallida-virgata, Tutt
ab. grisea-separata, Tutt
ab. grisea - approximata, Tutt
ab. grisea-conjuncta, Tutt
ab. grisea-fasciata, Tutt
ab. grisea-unilinea, Tutt
ab. grisea-obsoleta, Tutt
ab. grisea-dissimilis, Tutt
ab. grisea-virgata, Tutt
ab. cervina-separata, Tutt
ab. cervina - approximata, Tutt
ab. cervina - conjuncta, Tutt
ab. cervina-fasciata, Tutt
ab. cervina-unilinea, Tutt
ab. cervina-obsoleta, Tutt
ab. cervina-dissimilis, Tutt
ab. cervina-virgata, Tutt
var. (et *ab.*) pygmæa, Reut.

PARALEBEDIDI.
Paralebeda, Auriv.
plagifera, Walk.
var. femorata, Mén.

DENDROLIMINÆ.
DENDROLIMIDI.
Dendrolimus, Germ.
pini, Linn.
var. montana, Staud.
var. (et *ab.*) segregata, Butl.
flaveola, Motsch.
dolosa*, Butl.
zonata*, Butl.
superans*, Butl.
spectabilis*, Butl.
fentoni*, Butl.
femorata, Mén.
undans, Walk.
var. (et *ab.*) excellens, Butl.
ab. excelsa, Staud.
var. fasciatella, Mén.
var. unicolor, Oberth.
Syriaca, Tutt
bufo, Led.
ab. obscura, Staud.

PACHYPASINÆ.
PACHYPASIDI.
Pachypasa, Walk.
otus, Drury
limosa, Vill.

TRABALINÆ.
TRABALIDI.
Trabala, Walk.
splendida, Oberth.
cristata, Butl.

CHILENIINÆ.
CHILENIIDI.
Chilena, Walk.
obliquata, Klug
sordida, Ersch.
proxima, Staud.

COSMOTRICHINÆ.
COSMOTRICHIDI.
Cosmotriche, Hb.
albomaculata, Brem.
potatoria, Linn.
ab. berolinensis, Heyne
ab. obsoleta-berolinensis, Tutt
ab. obsoleta - potatoria, Tutt
ab. lutescens, Tutt
ab. obsoleta - lutescens, Tutt
ab. proxima, Tutt
ab. intermedia, Tutt
ab. diminuta, Tutt
ab. extrema, Tutt
var. askoldensis, Oberth.

ROUTLEDGIIDI.
Routledgia, Tutt
laeta, Walk.
var. sulphurea, Auriv.

EUTRICHINÆ.
EUTRICHIDI.
Gastropacha, Ochs.
ilicifolia, Linn.
ab. unicolor - rufescens, Tutt
ab. lutescens, Tutt
ab. rufescens, Tutt
ab. pallida, Tutt
ab. grisea-pallida, Tutt
ab. grisea, Tutt
ab. grisea-suffusa, Tutt
ab. virgata, Tutt
var. sinina, Grumm-Grshm.
var. japonica, Leech
tremulifolia, Hb.
ab. (et *var.*) ambigua, Staud.
? glasunowi, Grumm-Grshm.
suberifolia, Dup.
Eutricha, Hb.
quercifolia, Linn.
ab. incompleta, Tutt
ab. hoegei, Heuäck.
ab. major, Tutt
ab. ulmifolia, Heuäck.
ab. ulmifolia - obsoleta, Tutt
ab. meridionalis, Horm.
ab. meridionalis-obsoleta, Tutt
ab. meridionalis - lineata, Tutt
ab. dalmatina, Gerh.
ab. dalmatina-typica, Tutt
ab. dalmatina-lineata, Tutt
ab. alnifolia, Ochs.
ab. suffusa, Tutt
ab. suffusa-obsoleta, Tutt
ab. purpurascens, Tutt
ab. purpurascens - obsoleta, Tutt
var. salicifolia, Staud.
var. cerridifolia, Feld.
populifolia, Esp.
ab. obscura, Heuäck.
var. autumnalis, Jænich.

ODONESTIDI.
Odonestis, Germ.
pruni, Linn.
var. prunoides, Staud.
? brevivenis, Butl.

NADIASINÆ.
NADIASIDI.
Nadiasa, Walk.
undata, Klug
obsoleta, Klug

PINARINÆ.
BHIMIDI.
Pyrosis, Oberth. (? Bhima, Moore).
eximia, Oberth.

* The whole of these are dropped as forms of *Dendrolimus pini* by Leech (*Trans. Ent. Soc. Lond.*, 1899, p. 110).

idiota, Græs.
PINARIDI.
Taragama, Moore
repanda, Hb.
alpherakyi, Chr.
primigenum, Staud.
stupidum, Staud.
acaciæ, Klug

Superfamily VII : DIMORPHIDES (ENDROMIDES).
Family : DIMORPHIDÆ.
Subfam.: DIMORPHINÆ.
Tribe : DIMORPHIDI.

Probably no superfamily of the lepidoptera is more restricted than this, and it is very doubtful whether more than one species, *Dimorpha versicolora*, is really referable thereto. The exact position of this insect has always puzzled systematists, although there has been a tacit sort of general agreement that the species is in some way allied to the Saturniids and Sphingids. Linné places (*Sys. Nat.*, xth ed., p. 499) it in his comprehensive group *Bombyx*, between *Sphinx* and *Noctua*. Schrank, in 1802, retained (*Fauna Boica*, ii., Abth. 2, p. 150) only *mori* and *versicolora* in the genus *Bombyx*, but *mori* had already been determined by Cuvier as the type of the latter genus, and, as it is quite evident that *versicolora* is not congeneric with *mori*, Hübner quite correctly created the stirps *Dimorphae* (from which the superfamily name is derived) and the genus *Dimorpha* for *versicolora*, in the *Tentamen*, p. 1 (1806). He, however, suggested at this time some strange alliances, which, tabulated, are as follows :

Phalanx III : BOMBYCES.
Tribus 1 : SPHINGOIDES.
Stirps 1 : DIMORPHÆ—*Dimorpha versicoloria.*
Stirps 2 : PTILODONTES—*Ptilodonta camelina.*
Stirps 3 : ANDRIÆ—*Andria vinula.*
Stirps 4 : PLATYPTERICES—*Platypteryx hamula.*
Stirps 5 : ECHIDNÆ—*Echidna tau.*
Tribus 2 : VERÆ.
Stirps 1 : HERÆÆ—*Heraea carpini*, etc.

In 1809, Latreille placed (*Genera*, etc., iv., p. 218) *versicolora* in the mixed genus *Laria*, Schrank, with *bucephala*, *coryli*, *pudibunda*, *dispar*, *versicolora*, *anachoreta*, etc. *Laria* was at the time preoccupied as a generic name, and, in 1810, Ochsenheimer created (*Die Schmett.*, iii., p. 15) the genus *Endromis* for *versicolora*, which, therefore, became a synonym of *Dimorpha*, Hb. About 1822, Hübner used (*Verz.*, p. 143) Ochsenheimer's name, maintaining, however, the tribal and stirps divisions of the *Tentamen*, as follows :

Phalanx III : PHALÆNÆ (PHALÆNÆ—ATTACI et BOMBYCES, Linn.; BOMBYCI, COSSI et HEPIALI, Fab.).
Tribus I : SPHINGOIDES.
Stirps 1 : DIMORPHÆ.
Fam. A : HYBRIDES.
Coitus i : SYSSPHINGES—*Sysphinx molina*, Cram.
Coitus ii : ENDROMES—*Endromis versicolora*, Linn.

It will be seen that there can be no doubt that *Endromis*, Ochs., falls as a synonym of *Dimorpha*, Hb., and one suspects that the action of later authors, who have used *Endromis*, has been due to their ignorance of, or rejection of, the *Tentamen*. The use of *Dismorphia*, Hb., *Verz.*, p. 10, for a group of Pierid butterflies is not only beside the question, but, in our opinion, quite legitimate, as we do not agree with sinking differently spelled names, however close ;

besides *Dimorpha*, Hb., antedates *Dismorphia*, Hb., by at least twelve years.

Hampson unites (*Ann. Mag. Nat. Hist.*, ser. 6., vol. xiv., p. 259) *Endromidae*, *Arbelidae* and *Lasiocampidae*. He places them in division 1 of his group II, defined as:

II. Vein 1 *c* of the forewing lost; vein 5 migrated towards the lower angle of the cell: the bases of some of the subcostals of the forewing usually becoming united—

(1) The *Arbelidae*, *Endromidae* and *Lasiocampidae*: The frenulum lost; the bar between vein 8 and the cell of hindwing retained, or vein 8 united to 7 after its origin.

As further subdivisions of group II we find (2) *Pyralidae*, *Thyrididae*, *Drepanulidae* and *Callidulidae*, (3) *Hypsidae* and *Lymantriidae*, (4) *Pterothysanidae*, (5) *Syntomidae*, (6) *Arctiidae*, (7) *Noctuidae* and *Agaristidae*, all, in our opinion, widely distant from those comprised in subdivision 1. Meyrick unites (*Handbook*, p. 314) the Frenate superfamily *Drepanulides* (under the family name *Drepanidae*) with the *Endromidae* (*Dimorphidae*) and *Lasiocampidae* (without a frenulum) in his group *Lasiocampina* and gives the following table:

1.	Frenulum present	1. *Drepanidae*.
	Frenulum absent	2.
2.	Forewings with nervure 7 out of 10	2. *Endromidae*.
	Forewings with nervure 7 separate from 10	3. *Lasiocampidae*.

We are inclined to disagree entirely with the position here assigned to the Drepanids. The position we have suggested will be seen *anteà*, vol. i., pl. i.

As to possible allies, the most probable relative is the Australian *Chelepteryx* (*collesi*), Grote refers this genus to the *Dimorphides* (*Die Saturniiden*, pp. 2-3), although it still possesses the frenulum which *Dimorpha* has lost. He speaks of *Chelepteryx* as the lower form* and thinks that the discovery of its earliest stages may throw some light on the phylogeny of *Dimorpha*. Kirby notes (*Handbook*, etc., p. 67), however, that "the large Australian moth, *Chelepteryx collesi*, Gray, which somewhat resembles *Dimorpha* in markings, and which some authors have supposed to be allied with it, is proved by its tufted larva to belong to the *Lasiocampidae* (*Lachneidae*)." Meyrick notes (*Handbook*, p. 318) that "only a single species (*Endromis versicolora*) is known in this family, it appears to stand remote from anything else and must be a remnant of an otherwise extinct branch." We are unable to recognise any alliance between *Dimorpha* (*versicolora*) and *Therinia podaliriaria*, a species which Kirby allies (*Handbook*, etc., iv., p. 62) with this species and *Bombyx mori*. *Therinia* appears to be equally misplaced in either *Dimorpha* or *Bombyx* (*sens. strict.*).

We have already discussed at length (*anteà*, vol. i., pp. 124-125; vol. ii., p. 440) the principal facts pointing to the alliance existing between *Dimorpha* and the Lachneids, Saturniids and Sphingids, and we do not propose to repeat what is there stated, but the following

* One is inclined to agree that this view is accurate, although taking the *Jugatae* as moths without the frenulum as the lowest, the *Frenatae* are to be considered as the more specialised superfamilies, but *Micropteryx* is already beginning to develop a frenulum and all the lower forms have it usually well-developed. One suspects, therefore, that all the higher forms without the structure have almost certainly lost it.

supplementary suggestions as to the relationship of *Dimorpha* with the Sphingo - Saturniid - Lachneid stem on characters, other than imaginal, are offered by Bacot, who writes :

EGG : Characters offered by shape and similar proportions between the three diameters. LARVA : Position and development of tubercles ; shagreen development ; coloured bases of secondary hairs ; their distribution in relation to coloured stripes ; the caudal horn on 8th abdominal segment ; oblique stripes. COCOON : Structural resemblance to those of *Eumorpha (Choerocampa) elpenor*, *Aglia tau* and *Caligula japonica* *. PUPA : General resemblance to that of *Aglia tau*, but without the recurved hooks or spines on the anal armature, in this respect the pupa of *C. japonica** is nearer to that of *D. versicolora*, as its cremaster is very broad and spade-like, and the recurved hooks are restricted to a few at either corner of the anal extremity. Among the Sphingids both *Eumorpha* and *Smerinthus* show resemblances, the former in the development of its anal armature and dorsal spines to enable it to emerge from cocoon ; the latter in the anal armature, rugosity, and solidity of structure, characters which it possesses in common with *Citheronia*.

The young larva in its first instar shows Lachneid and Saturniid rather than Sphingid† affinities. The dorsal and lateral tubercles of the abdominal segments, with the exception of ii, being composed of groups of from two to four hairs, the chitinous bases, of which, in i and iii, conjoin to form a single wart, but in the case of iv and v the bases are not as a rule joined. In development, i and iii agree both with Saturniid and Lachneid forms, although they are more primitive than in any larva of the former group that I have yet seen, and iv and v are more primitive in character than in any Lachneid larva with which I am acquainted. On the other hand, ii on abdominal segments is single-haired, and on the meso- and metathoracic segments there are only three tubercles present on either side above the ventral area, all of which are wart-like and bear several hairs. The dorsal one is probably i + ii, or possibly it is i alone, ii having been lost ; iii is in the usual supraspiracular position ; the subspiracular is almost certainly iv + v. It would appear, therefore, on larval evidence, that *Dimorpha* had specialised away from the Sphingid stirps in respect of the multiplication of hairs on larval tubercles, and that its similarity of coloration, &c., in later instars, is due to similarity of needs, habits and environment acting on a but slightly altered constitution. The fact that in some characters it is behind the Lachneids, while in others [loss of ii (or conjunction of ii with i) on meta- and mesothorax] it has advanced further than *Aglia tau* in the Saturniid direction, seems to point to its having branched from the Saturniid stirps ; but the egg would seem to contradict this unless we conclude that the solid opaque and porcelain-like characters of the ova of *Lasiocampa (quercûs)*, *Saturnia (pavonia)* and *Bombyx (mori)* were independently acquired. It seems just as probable, or even more probable, that *Dimorpha* branched before, rather than after, the forking of the Lachneid-Saturniid stirps, and possibly very shortly after this stirps had separated from the Sphingid one, having developed independently as regards the reduction in number of tubercles.

* Larvæ of this species given to me by Dr. Chapman, were, at the time that I received them, too old and specialised to afford much clue to their real position, although both cocoon and pupa suggest primitive Saturniids (Bacot).

† In the Sphingids all the tubercles are single-haired, except iii on the meso- and metathoracic segments where it bears two hairs ; but judging by the structure of the larvæ of such primitive forms as the Hepialids and Zeuzerids, this is in all probability a primitive and not a specialised character (Bacot).

This seems not at all improbable when we consider that specialisation is so frequently accompanied by reduction in number of bones, organs, etc., in vertebrates, and nervures, tubercles, free segments of pupæ, etc., among insects. *Chelepteryx (collesi)*, which is said to have a tufted larvæ, is probably an early branch from the Dimorphid stock that has diverged widely in regard to its larva. So far as I can determine from a superficial examination it is more specialised as an imago than *Dimorpha versicolora*, judging by the fact that the pattern of the upperside is not so exactly repeated on the underside as in *D. versicolora*, and also that the forewing pattern is not so nearly repeated on the hindwings (Bacot, *in litt.*).

With regard to the antennæ of *Dimorpha* compared with those of Lachneids, Sphingids and *Chelepteryx*, Chapman writes: "There is a close general resemblance between the antennæ of *D. versicolora* and those of the Lachneids, but not more than between the antennæ of widely separated forms with pectinate antennæ. The chief difference is that, in the antennæ of *D. versicolora*, the long hairs clothing the ventral aspects of the plumules are irregularly distributed, whilst in Lachneids they are in tolerably regular rows. Though a little bent at the ends, the plumules have the final seta fairly in line with the shaft of the plumule, whilst in most Lachneids the combined bending and clubbing at the end of the plumule make the seta apparently on the forward margin. Sphingids are too different to make any comparison useful. *Chelepteryx* has antennæ very similar to those of *D. versicolora* as to scaling, plumules, and hairs; and, except that they are longer and diminish terminally more gradually, and that the pectinations are comparatively much smaller in the female, there is practically nothing definite to seize as a difference. In connection with the antennæ it may be noted that in both genera, *Chelepteryx* (*collesi*) and *Dimorpha* (*versicolora*), the males have very long well-developed spurs to the anterior tibiæ, whilst in the female of *Chelepteryx* the spur is short and slender, and in that of *Dimorpha* it barely exists, being a mere minute knob at the point of origin. This is a greater sexual difference in this structure than is at all usual."

Packard finds the greatest affinities between *Dimorpha* and the Saturniids, but notes (*Proc. Amer. Phil. Soc.*, xxxi., p. 141) that he is "disposed to think the family *Endromidae (Dimorphidae)* is a natural one, and that it would be a violation of the principles of classification to include *Aglia* with it. The two genera, both as regards their larval and their adult characters, are quite distinct." He finds that *Endromis* (*Dimorpha*) *versicolora* has the head, palpi, antennæ, and the hairy abdomen very closely like those of *Hemileuca maia*, but the median nervure of both wings divides into four branches, and the subcostal nervure of the four wings divides into five branches, as in *H. maia* and the other *Hemileucidae*. He concludes that "*Endromidae* is a branch of the Bombycine tree, parallel to, but distinct from, the *Hemileucidae*, and stands above the latter, connecting the group and the *Ceratocampidae* (*Citheroniidae*) and the *Saturniidae* with the higher families of the Bombyces, in which there are four branches of the median nervure, all the families mentioned agreeing with the *Notodontidae* as having but three. In the general shape, the small retractile head, the mode of coloration, and the caudal horn, the larva of *Endromis* appears to be remarkably near the Sphinges." As to the latter point, he considers *(loc. cit.)* that the *Sphingidae* probably sprung from a form like *Endromis* (*Dimorpha*) rather than *Aglia*, and states that taxonomically *Aglia* is by no means so closely allied to the *Sphingidae* as Poulton infers; in its neuration, *Endromis* (*Dimorpha*) is much nearer, and it is also a more generalised or synthetic form than *Aglia*.

Dealt with seriatim, the various stages of *Dimorpha* suggest to us the following alliances :—Egg.—The egg, with its transparent shell, has most in common with the Sphingid and Citheroniid eggs, less in common with the opaque and porcelain-like eggs of the Lachneids and Saturniids. It appears to differ widely from the Sphingid egg, in that the development of the embryo darkens it, but this is possibly of no very great importance. Larva.—The newly-hatched larva is distinctly Lachneid in the arrangement and character of its warts, *viz.*, i larger than ii, iv and v many-haired, but separate as in *Bombyx (mori)* and the more generalised Lachneids, and not united as in the specialised Lachneids *(anteà*, vol. ii., p. 439). [In the larva of *B. mori*, iv and v are separate and subspiracular (See also Grote, *Die Saturniiden*, figs. 3-4)]. When larger, too, the larva resembles *Bombyx* (*mori*) in the development of the caudal horn, in which character, perhaps, that of *B. mori* approaches more closely to the Sphingid caudal horn. Buckler also notes the head of the larva as being very small, with the thoracic segments tapering to it, and retractile, as in *Eumorpha* (*Choerocampa*) though to a less extent; but it fails entirely in the peculiar development of the prespiracular tubercle of the Sphingids (generally referred to v *), whilst Bacot connects it more closely with the larvæ of the Lachneids, noting that, in the 1st stadium, the larval tubercles i and iii bear 3 or 4 or more hairs in *Dimorpha*, while in the Sphingids they are small, and single-haired. These become atrophied later, in the Sphingids, whilst in *Dimorpha*, on the contrary, the change in the tubercles is apparently similar to that which takes place in the Lachneids, *i.e.*, that at the 1st or 2nd moult, i and ii seem almost (or quite) to disappear and to be replaced by scattered hairs; but this is rather apparent than real, for, in *Dimorpha*, the hairs do not really disappear, but are reduced in size and so are lost among the secondary hairs that arise at this stage, whilst in the Lachneids they do not even become smaller, but are almost inextricably confused among the mass of secondary hairs developed †. Cocoon. — The cocoon reminds one somewhat of those of certain Saturniids, and the gummy substance that makes it waterproof, being very similar to that used in the cocoons of *Saturnia* (*sens. strict.*), aids the resemblance. Bacot also says that it resembles that of *Aglia tau* considerably, and that of *Caligula japonica* very markedly; it resembles somewhat the cocoon of *Eumorpha elpenor* which is

* We suspect this to be not v but a tubercle homologous with the "supplementary prespiracular" of the Lachneids *(anteà*, vol. ii., p. 439).

† In the Sphingids one finds the single primitive tubercular hairs reduced in size and lost among the secondary hairs (shagreen hairs). In *Dimorpha*, the duplicated primitive tubercular hairs are reduced in size, and lost among the secondary hairs (shagreen hairs). In the Lachneids we get the duplicated primitive tubercular hairs obscured among a crowd of secondary hairs, only shagreen in character to the extent that they have coloured bases, usually black. They are simply obscured; there is no reduction in size (Bacot *in litt.*).

of the same pattern but slighter, and other Sphingid cocoons are also of the same pattern. Pupa.—The rough-skinned pupa suggests those of the Smerinthids as much as those of the Saturniids, although structurally nearer the latter. We may here note that the pupa of *Dimorpha versicolora* appears to be an exception to Chapman's general definition of the pupæ-obtectæ, that, as pupæ, they "have no power to emerge from the cocoon or to progress in any way," for the pupa of this species systematically forces itself out of the cocoon before the imago emerges, and, as a pupa, therefore, it comes, as regards this particular character only, under Chapman's division *Incompletae*.

We are not inclined to follow Kirby in going back to Schrank's grouping and in considering Hübner's stirps *Dimorphae* (as represented by *Dimorpha versicolora*) simply a genus of *Bombycidae*, which he defines (*Handbook*, &c., iv. p. 61) as having: "The frenulum absent; the mouthparts rudimentary, the antennæ pectinated in both sexes; the wings broad; the body generally stout; the hind tibiæ armed with two small spurs; the larva naked, with a fleshy horn on the back as in the *Sphingidae*; the pupa enclosed in a cocoon." Grote writes (*Die Saturniiden*, p. 5): "The larva of *Dimorpha* in the first stadium strikingly resembles the larvæ of the Lachneids. The primitive original stadium is wanting. Segments two and three each bear two warts above the stigma. The tubercles are throughout of the form of warts. On the abdominal segments iv and v are separated, on the other hand the presence of the subprimary tubercle vi cannot, with certainty, be made out (*cfr.*, fig. 3). The entire blackish-coloured and bristly creature forms in its first skin a sharp contrast with the naked-green skin of the later stages. The accompanying figure is from a microscopic drawing by Dyar, to whom I sent the larvæ in question. The seta marked vi (?) stands too low down to be referred with certainty to the subprimary, particularly one might assume that this seta would have to be referred to vii, especially since the light-coloured wart also is here wanting."

We may here note that Hermann (*teste* Standfuss) obtained pairings between *Dimorpha versicolora* ♂ and *Aglia tau* ♀, but the eggs were infertile. Standfuss records (*Handbook*, pp. 124, 125) an experiment on pupæ of this and other species that appears to show that a hurrying of the pupal stage tends to produce less well-marked specimens. He says that out of a large number of pupæ of *Dimorpha versicolora*, *Saturnia pavonia* and *Aglia tau*, he had a few emergences of imagines without previous hybernation of the pupa. The aspect of the individuals belonging to the first two species was markedly altered in the direction of decidedly weakened and less distinct markings. He further notes that large numbers of pupæ of *Saturnia* (in these cases from 200-400 specimens were used) were kept very dry for 7-10 weeks, from June to the end of September. They were then freely and repeatedly moistened, and about 1 per cent. of the moths emerged from these pupæ 10-20 days after the damping. The fully-developed moths mostly show a departure from the ordinary form of the species, the elements of the pattern being less sharply outlined, more or less washed-out and confused, and the repetition of the experiment shows that this cannot be merely a matter of chance.

Genus: Dimorpha, Hübner.

Synonymy.—Genus: *Dimorpha*, Hb., "Tent.," p. 1 (1806); "Franck Cat.," p. 88 (1825); Tutt, "Pract. Hints, &c." pp. 19, 61, 75 (1901). *Phalaena-Bombyx*, "Sys. Nat.," 10th ed., p. 499 (1758); 12th ed., p. 817 (1767); "Fn. Suec.," ed. 2., p. 294 (1761); Bkh., "Sys. Besch.," iii., p. 42 (1790); Brahm, "Ins.-Kal.," pp. 183, 526 (1791); [F.J.A.D.,] "Bork. Rhein. Mag.," p. 327 (1793). *Phalaena*, Hufn., "Berl. Mag.," ii., p. 400 (1766); Rott., "Naturf.," viii., p. 102 (1776); Scheven, "Naturf.," xiv., p. 66, pl. iii., figs. 1-5 (1780). *Bombyx*, Fab., "Sys. Ent.," p. 565 (1775); "Spec. Ins.," ii., p. 178 (1781); "Mant. Ins.," ii., p. 113 (1787); "Ent. Sys.," iii., pt. 1, p. 427 (1793); [Schiff.,] "Schmett. Wien.," p. 49 (1775); ed. ii., p. 55 (1801); Esp., "Schmett. Eur.," iii., pl. xxiii (1783); p. 115 (1784); Hb., "Eur. Schmett.," figs. 1-2 (*circ.* 1800), text p. 102 (1805); Schrk., "Faun. Boica," ii., 1, p. 245 (1801); ii., 2, p. 150 (1802); Haw., "Lep. Brit.," p. 80 (1803); Latr., "Hist. Nat.," xiv., p. 181 (1805); Godt., "Hist. Nat.," iv., p. 149 (1823). *Bombyx* (-*Laria*), Latr., "Gen. Crust.," iv., p. 219 (1809), *nec* Schrank. *Endromis*, Ochs., "Die Schmett.," iii., p. 15 (1810); Oken, "Lehrb. Zool.," i., p. 715 (1815); Sam., "Ent. Comp.," p. 247 (1819); Hb., "Verz.," p. 143 (*circ.* 1822); Stphs., "Ill. Haust.," ii., p. 34 (1828); "Cat. Br. Ins.," ii., p. 45 (1829); "List Br. An. Br. Mus.," v., p. 44 (1850); Meig., "Eur. Schmett.," ii., p. 153 (1830); Bdv., "Eur. Lep. Ind. Meth.," p. 50 (1829); "Gen. et Ind.," p. 74 (1840); Wood, "Ind. Ent.," p. 21 (1839); Dup., "Cat. Méth.," p. 80 (1844); Humph. & Westd., "Brit. Moths," p. 79 (1841); Evers., "Faun. Volg.-Ural.," p. 119 (1844); H.-Sch., "Sys. Bearb.," ii., p. 98 (1846); Boh., "Vet. Ak. Handl.," 1848, pp. 150-1 (1850); Heyd., "Eur. Lep. Cat. Meth.," ed. 3, p. 28 (1851); Sta., "Man.," i., p. 159 (1857); Spey., "Geog. Verb.," i., p. 415 (1858); Hein., "Schmett. Deutsch.," p. 199 (1859); Humph., "Gen. Brit. Moths," p. 20 (1860); Staud, "Cat.," ed. 1, p. 30 (1861); ed. 2, p. 70 (1871); ed. 3, p. 125 (1901); Rbr., "Cat. Lép. And.," p. 367 (1866); Snell., "De Vlind.," p. 193 (1867); Berce, "Faun. Franç.," ii., p. 203 (1868); Nolck., "Lep. Fn. Est.," i., p. 131 (1868); Newm., "Brit. Moths," p. 47 (1869); Wllgrn., "Skand. Het.," ii., p. 125 (1869); Curò, "Bull. Soc. Ent. Ital.," viii., p. 153 (1876); Frey, "Lep. Schweiz," p. 99 (1880); Kirby, "Eur. Butts. and Moths," p. 125 (1880); "Cat.," p. 723 (1892); "Handbook," etc., iv., p. 67 (1897); Buck., "Larvæ," etc., iii., p. 60 (1889); Meyr., "Handbook," etc., p. 319 (1895); Tutt, "Brit. Moths," p. 47 (1896); Grote, "Die Saturn.," p. 5 (1896); Barr., "Lep. Brit.," iii., p. 50 (1896). *Dorvillia*, Leach, "Edinb. Encycl., ix., p. 132 (1815).

Dimorpha was the generic name given to *versicolora* by Hübner in 1806, in the *Tentamen*, p. 1, the species having been previously figured and described by him (*Eur. Schmett.*, p. 102, pl. i., figs. 1—2) under the name of *Bombyx versicolora*, and this species, being the only one mentioned, became the type of the genus. The genus was, however, first diagnosed by Ochsenheimer (*Die Schmett.*, iii., p. 15) in 1810, as follows:

Endromis.—The antennæ bipectinate; the abdomen very hairy, the wings thinly scaled, with a hook-shaped median spot. The larva naked, with a pyramidal hump on the last segment. Cocoon of the texture of parchment.*

Meyrick considers the characters of the genus to be those of the family, and diagnoses them (*Handbook*, pp. 318—319) as:

Imago: Head densely rough-haired, ocelli present. Eyes glabrous. Tongue rudimentary. Antennæ under $\frac{1}{2}$, in ♂ bipectinated to apex. Labial palpi rather short, densely hairy. Thorax densely hairy above and beneath. Abdomen densely hairy. Femora and tibiæ densely hairy, posterior tibiæ without middle-spurs, end-spurs very short. Forewings: 1 *b* simple, 4 and 5 connate from lower angle, 6 from near 9, 7 and 8 out of 10. Hindwings without frenulum, 4 and 5 connate from lower angle, 6 and 7 connate, 8 connected by bar with cell near base. *Ovum:*

* Ochsenheimer gives the following note on the genus: "In this genus also, which differs essentially from all others, there is only *one* European species. Schrank, in his *Fauna Boica*, has united *mori* and *versicolora* under the name *Bombyx*, but *mori* belongs as little to the European products as do the exotic plants which only thrive in hot-houses, and, therefore, cannot find place in the series of *Schmetterlinge von Europa*."

Rounded-oblong, smooth. *Larva :* Stout, attenuated anteriorly, with few hairs ; all prolegs developed. *Pupa :* In a tough elongate-oval cocoon above ground.

The species is occasionally gynandromorphous. Schultz notices no fewer than 7 examples which he describes (*Illus. Woch. für Ent.*, ii., p. 494, and iii., p. 184). The first of these to be made known to entomologists was that figured by Ernst and Engramelle, *Pap. d' Europe*, iv., pl. 1, suppl. fig. 169. For the complete list see *posteà*, pp. 238—239.

Standfuss reared this species in large numbers in successive years, and gives the following as representing the numbers of each sex reared, *viz.*, 1886—21 ♂ s, 31 ♀ s; 1888—198 ♂ s, 57 ♀ s; 1889—72 ♂ s, 193 ♀ s=291 ♂ s, 281 ♀ s.

Like so many of our species that we consider have spread to us from northern latitudes, this species frequently exists for two and three years in the pupal state; imagines have been known to emerge from pupæ that have been in the latter stage at least five years.

Packard states (*Textbook of Entomology*, p. 634) that "the imago of the Attacine moths cuts or saws through its cocoon by means of a pair of large, stout, black spines (sectores coconis), one on each side of the thorax at the base of the forewings, and provided with five or six teeth on the cutting edge (*cfr.* fig. 591, p. 635). . . . . The cocoon-cutter occurs in all the American genera (*Samia*, etc.), and is large and well-marked in the European *Saturnia pavonia-minor* and *Endromis* (*Dimorpha*) *versicolora*." What the imago of *Dimorpha* wants with a cocoon-cutter, considering that the pupa and not the imago emerges from the cocoon, has not yet been explained, and, as a matter of fact, Chapman notes that *D. versicolora* has no cocoon-cutter; it has the portion of wing-hinge that becomes a cocoon-cutter in *Antheraea*, &c., but it is not much more developed than in many moths, such as Lachneids, etc. Chapman points out (*Ent. Rec.*, xiii., p. 300) that the cocoon-cutter of *Actias luna* acts by teasing out the silk and not by cutting it, the silk being first softened by an abundance of fluid exuded by the moth.

DIMORPHA VERSICOLORA, Linné.

SYNONYMY.—Species: *Versicolora*, Linn., "Sys. Nat.," xth ed., p. 499 (1758); xiith ed., p. 817 (1767); Schev., "Naturf.," xiv., p. 66 (1780); Fab., "Sys. Ent.," p. 565 (1775); "Spec Ins.," ii., p. 178 (1781); "Mant. Ins.," p. 113 (1787); "Ent. Sys.," iii., pt. 1, p. 427 (1793); Sulz., "Abgek. Gesch. Ins.," p. 159, pl. 21, fig. 4 (1776); Esp., "Schmett. Eur.," iii., pl. xxiii (1783), p. 115 (1784); View., "Tab. Verz.," i., p. 38 (1789); Bkh., "Sys. Besch.," iii., p. 42 (1790); Brahm, "Insek.-Kal.," ii., 1, pp. 183, 526 (1791); Hb., "Eur. Schmett.," text p. 102 (1805); "Verz.," p. 143 (*circ.* 1822); "Franck Cat.," p. 88 (1825); Latr., "Gen. Crust.," iv., p. 219 (1809); Ochs., "Die Schmett.," iii., p. 16 (1810); Godt., "Hist. Nat.," iv., p. 149 (1823); Stephs., "Illus.," ii., p. 34 (1828); "Cat. Br. Ins.," ii., p. 45 (1829); Bdv., "Eur. Lep. Ind. Meth.," p. 50 (1829); "Gen. et Ind. Meth.," p. 74 (1840); Dup., "Cat. Méth.," p. 80 (1844); Evers., "Faun. Volg.-Ural.," p. 119 (1844); Herr.-Sch., "Sys. Bearb.," ii., p. 98 (1846), Boh., "Vet. Ak. Hand.," 1848, pp. 150—1 (1850); Heyd., "Eur. Lep. Cat. Meth.," ed. 3, p. 28 (1851); Sta., "Man.," i., p. 159 (1857); Speyer, "Geog. Verb. Schmett.," i., p. 415 (1858); Hein., "Schmett. Deutsch.," p. 199 (1859); Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 70 (1871); 3rd ed., p. 125 (1901); Gascoyne, "Entom.," ii., p. 184 (1865); Ramb., "Cat. Lép. And.," p. 367 (1866); Snell., "De Vlind.," p. 193 (1867); Berce, "Faun. Franç.," ii., p. 203 (1868); Nolck., "Lep. Fn. Estl.," i., p. 131 (1868); Wllgrn., "Skand. Het.," ii., p. 125 (1869); Curò, "Bull. Soc. Ent. It.," viii., p. 153 (1876); Frey, "Lep. Schweiz," p. 99 (1880); Kirby, "Eur. Butts. and Moths," p. 125 (1880); Meyr., "Handbook," &c., p. 319 (1895); Barr., "Lep. Brit.," iii., p. 50 (1896); Grote, "Die Saturn.," p. 5 (1896). *Versicoloria*, Linn., "Sys. Nat.," xith ed., p. 499 (1760); Hfn., "Berl. Mag.," ii., p. 400 (1766); [Schiff.,] "Sys. Verz.," ed. 1, p. 49 (1775); ed. 2, p. 55 (1801);

Rott., "Naturf.," viii., p. 102 (1776); Hb., "Eur. Schmett.," figs. 1, 2 (*circ.* 1800); "Tent.," p. 1 (1806). *Versicolor*, Linn., "Faun. Suec.," ed. 2, p. 294 (1761); Scheven, "Naturf.," xiv., p. 66, pl. iii., figs. 1—5 (1780); Schrk., "Faun. Boica," ii., 1, p. 245 (1801); 2, p. 150 (1802); Latr., "Hist. Nat.," xiv., p. 181 (1805); Oken, "Lehrb. Zool.," i., p. 715 (1815); Sam., "Ent. Comp.," p. 247 (1819); Meig., "Eur. Schmett.," ii., p. 153 (1830); Stephs., "List. Br. An. Br. Mus.," v., p. 44 (1850); Wood, "Ind. Ent.," p. 21, fig. 38 (1839); Humph. and West., "Brit. Moths," p. 79 (1841); Humph., "Gen. Brit. Moths," p. 20 (1860); Newm., "Brit. Moths," p. 47 (1869); Buck., "Larvæ, &c.," iii., p. 60, pl. xxi., fig. 3 (1889); Auriv., "Nord. Fjär.," p. 65 (1889); Kirby, "Cat.," p. 722 (1892); "Handbk.," iv., p. 67 (1897); Tutt, "Brit. Moths," p. 47 (1896). *Versicolorus*, Haw, "Lep. Brit.," i., p. 80 (1803). *Visicolora*, Leach, "Edin. Encycl.," ix., p. 132 (1815).

ORIGINAL DESCRIPTION.—*Phalaena Bombyx versicolora*, elinguis, alis reversis griseis; strigis nigro-albis, fronte thoracis albo. Gadd, *Satag.*, 82, Phal. alis lineis albis et nigris undatis. Roes., *Ins.*, app. 39, f. 3. Wilk., *Pap.*, 45, t. 1, *a.* 1. Habitat in Europa (Linné, *Sys. Nat.*, xth ed., p. 499). To this description Linné adds: "Speciosa, magna. Thorax antice albus linea nigra terminatus. Alæ superioris angulus posticus maculis 3 albis; inferioris macula diaphana ad apicem" (*Sys. Nat.*, xiith ed., p. 817).

IMAGO.—49mm.—87·5mm. in expanse. ♂. Collar whitish, thorax orange-brown mixed with grey scales, abdomen orange-brown. Anterior wings deep orange-brown with two brown-black transverse lines, the basal one curved, edged internally (nearest base) with whitish, or whitish-ochreous, the outer one deeply angulated below its centre, edged externally with whitish; a pale subterminal line, made of large arches, including the pale portions of the nervures towards the outer margin, and ending in three silvery-white spots (often united) near the apex; basal tuft greyish-white; the discal area, sometimes suffused with grey, contains a dark <-shaped discal spot with point towards base. Posterior wings orange or orange-brown, with a single, median, transverse black line (continuation of the angulated one on forewing), an ill-defined discal spot, a transverse series of dark spots, the outer edge of which is continuous with the subterminal of forewings, and ends at apex in two silvery-white or ochreous spots. ♀. Paler; the anterior wings with the pale areas much enlarged, the <-shaped mark often obsolete; the posterior wings white instead of orange-brown. Fringes practically obsolete in both sexes.

SEXUAL DIMORPHISM.—The male is smaller, darker in colour, much more active than the female, which is paler, less brown, with a much larger and heavier abdomen. The three apical spots remain white in the ♂s, whilst all the other pale forewing markings that are whitish in the ♀s tend in varying degrees to become reduced in size or entirely suffused with pale brown in the ♂s. (This is not invariably the case, as in some ♂s the pure white is maintained and its effect heightened by the deeper and richer, normal, male ground colour). The hindwings exhibit still greater differences, those of the ♂s only showing two white (or ochreous) spots at the apical angle, and even these are sometimes strongly suffused by the yellow-brown which, in this sex, usually replaces the white areas of the ♀ hindwing. The pale markings of the hindwings of the ♀s are so enlarged (perhaps it would be more correct to say the brown markings are so reduced) that one might call the ground colour white, whilst that of the forewings is pale brown. In size the males in our collection vary from 49mm.—67mm., the ♀s from 62·5mm.—87·5mm. (Morton notes Scotch ♀s up to 87mm. and Meyrick to 85mm.) Chapman gives the following notes on the antennæ: "♂. Length, 11mm. of about 46 joints; longest plumule about 1·5mm. long. Broadly, this is a Lachneid antenna, in the bend (about 16 to 20 segments), and in the lop-eared arrangement of the plumules springing from the ventral aspect of the segments. It differs in the irregular arrangement of the hairs on the plumules, which are not in regular rows as in Lachneids, and in their carrying no baton, but only a bristle. To say that the hairs are irregularly placed is perhaps incorrect, since they seem to be placed very regularly, but not in any row or describable pattern. The dorsal scaling of the shaft is very sparse and hair-like; the scales are more scale-like distally, quite irregular, and in at least 4 rows. No scales on plumules. The plumules have a sweeping bend forwards towards their apices at a point where there is a somewhat clubbed thickening, beyond which they taper to a rather smaller apex. ♀. Length, 10mm. of about 44 joints; scaling sparse as in ♂; plumules short (0·4mm. longest), somewhat clubbed, and more distally bent forward towards their apices; a small terminal bristle; hairs much fewer and shorter than in ♂s, they tend to invade upper surface towards ends of plumules (*in litt.*)."

Gynandromorphism. — The following gynandromorphous examples have been described or figured—

α. Left ♂, right ♀. Figured by Ernst, *Pap. d'Eur.*, pl. i; supp. Cl., *Ic.*, f. 169 *m—n*; Lefebvre, p. 148. Borkhausen (*Rhein. Mag.*, i., p. 327) mentions (without describing it) this hermaphrodite as being in Gerning's collection, and bred at Solingen.

β. Right ♂, left ♀. Completely gynandromorphous; abdomen ♀, but on the right side coloured like the ♂; anus very hairy; genitalia not visible. Vienna Museum, from Mazzola's collection (Ochsenheimer, *Die Schmett.*, iv., p. 187; Rudolphi, p. 52; Burm., p. 340; Lefebvre, p. 147).

γ. Right ♂, left ♀. Halved, gynandromorphous; the thorax also divided. Figured and described by Ballion, *Hor. Soc. Ent. Ross.*, iv., p. 33, pl. i., fig. 2 (1866—1867).

δ. In all respects a ♂, except that it has a ♀ antenna on the right side. Bred at Zürich (Wiskott, *Festschrift Ver. Schles. Ins.*, (1897), p. 124). [This would appear to be the specimen, bred by Standfuss and sent to Wiskott, that is mentioned *Illus. Woch. für Ent.*, i., p. 384, where we read: "Another gynandromorph bred by Standfuss, is in the possession of Herr Wiskott of Breslau."]

ε. Incomplete. In all respects a ♂ except that the right antenna is ♀ in form (Schultz, *Ill. Woch. für Ent.*, ii., p. 462). [There is nothing to show whether this is or is not the same as the preceding.]

ζ. Right ♂, left ♀. Coloration of wings very intense; left antenna (much crippled) male, right female. Dividing line on body present; the scales of the body on the right of the line brown, on the left whitish-grey; on the left side of the anus a clasper and anal tuft are visible; on the right the body is considerably more bulky, and at the end of it the retracted ovipositor can be clearly distinguished. From Berlin. In the Daub coll., Carlsruhe. Described by Gauckler (Schultz, *Illus. Woch. für Ent.*, ii., p. 462).

η. A male example with distinct whitish female coloration. In the Bernard coll., Dantzig (Schultz, *Illus. Woch. für Ent.*, ii.,p. 462).

θ. A similar example in the Rosser collection, Berlin (Schultz, *Illus. Woch. für Ent.*, ii., p. 462).

ι Body left side completely ♀, inclusive of antenna and wings, right side throughout ♂; a line, only perceptible with strong lens, divides the body from the front of the head to the anus into two halves; while the ♀ side of the thorax is more arched and fuller, the ♂ part is stronger and longer-haired; in the abdomen, the ♀ side is somewhat broadened and less haired; . . . . the hind margin of the anus is rather truncate as in a normal ♂; the ♀ genitalia are concealed under a dense tuft of hairs; although it appears from the marked development of the ♂ genital organs that this specimen is principally male, yet the tendency towards the ♂ form decreases in the wings. Were the example a normal male one would call it a giant, the ♀ wings being of normal size, and the ♂ wings but little less. For the specimen I have to thank a highly-esteemed friend in Russia (Rühl, *Societas Entom.*, vi., p. 98).

κ. Halved. Left completely ♀, right ♂. Left side of wings and left antenna ♀; right side of wings and right antenna ♂. Body divided into two halves following the two sexes, thus differing strikingly the one side from the other in build, colour, and clothing (♂ side with longer hairs). In the Museum at Altenburg (Schultz, *Illus. Zeits. für Ent.*, iii., p. 184).

Variation.—The species does not appear to be subject to much variation. In size, as already pointed out, males vary from 49mm.—67mm. and females from 62·5mm.—87·5mm., whilst in colour the males sometimes approach the female, and the females the male, coloration. Barrett notes (*Lep. Brit.*, iii., p. 52) that "variation appears to exist only in the intensity of colour and of clouding, but in some individuals the darker clouding is almost absent. In the Doubleday collection is a very dark male, and, in that of Bond, a female with the hindwings nearly white. As a rule, specimens from Scotland are of deeper, richer colour than those from the south of England." In the British Museum collection, one ♂ (from the Frey coll.) has the white on the forewings very strongly developed and the brown is also deepened and intensified, producing a much more strongly marked example than the majority of the British Museum specimens; one may summarise the differences in the latter as being confined to the depth and extent of the brown areas as opposed to the white. Frings records (*Soc. Ent.*, xiii., p. 129) a very dark marked ♀ aberration with pale red-brown hindwings from Russia. One suspects that the wing-markings are very primitive, since those of the forewings are practically repeated on the hindwings. In our British series, there is much difference in the intensity of the markings, the depth of the ground-colour, and the quantity of pale shading, more especially in the ♂s. In some specimens, too, the discal V-shaped mark is reduced to a mere point, or it may be altogether absent. The silvery-white apical spots vary considerably in size, they are also, in some specimens, united, in others very distinctly separated. In the hindwings of the ♂s the markings are sometimes almost obsolete, and the wings practically unicolorous, whilst the normally white apical spots are frequently absorbed in the ground-colour. In the hindwings of the females the presence of a brown line within and crossing the angle made by the median line and a tendency to the development of dark spots on the outer margin are the most noteworthy features. There is insufficient variation to form any really useful tabulation; the only attempt we have made at grouping the males may be noted as:

1. *a*. Forewings pale orange-brown, with distinct transverse lines, the pale margins not pure white; the median area paler and greyer; the hindwings orange-brown with distinct markings, and whitish apical spots=ab. *pallida*, n. ab. *β*. Similar, but with ill-developed or obsolete markings on hindwings=ab. *pallida-obsoleta*, n. ab.

2. *a*. Forewings bright orange-brown, rather darker than 1; the shading between the elbowed and subterminal lines still darker, and forming a better contrast. Hindwings orange, with distinct markings, apical spots ochreous rather

than white=*versicolora**, Linn. β. Similar, but with the markings of the hindwings ill-developed or obsolete=ab. *obsoleta*, n. ab.

3. Forewings deep fuscous-brown; basal tuft quite white; transverse lines exceptionally dark, contrasting strongly with their white edgings, with the pale median shades, the pale arches of subterminal, and the white apical spots. Hindwings deep orange-brown, median line and external transverse shade strongly marked; apical spots pure white; outer margin dark-shaded, with pale nervures=ab. *clara*, n. ab.

4. *a*. Forewings dull ochreous-brown, the paler markings suffused with ochreous, apical spots white. Hindwings dull ochreous, dark marginal markings also dull, apical spots entirely lost in ground colour=ab. *obscura*, n. ab. β. Similar, but with the markings on the hindwings ill-developed or obsolete=ab. *obscura-obsoleta*, n. ab.

The only described form appears to be the following:

a. var. *lapponica*, Bau, "Stett. Ent. Zeit.," xxxviii., p. 152 (1877); Auriv., "Nord. Fjär.," p. 65 (1889); Staud., "Cat.," 3rd ed., p. 125 (1901).—♂. Alis anticis obscure griseo-fumigatis, nigro-notatis; margine anteriore subtus nigro; posticis sordide ferrugineo-fulvis, fasciis infuscatis. ♀. Alis obsolete cinereo fulvoque nebulosis. ♂. The forewings dark smoky-brown with a good deal of black; the white markings of the type-form usually only just indicated, sometimes entirely wanting; margins of underside black. Hindwings dirty red-brown with darker bands. ♀. Pale drab-brown with a good deal of black, the white portions with a weak tinge of brown; generally the normal black area is more extended, especially on the undersides of the wings. The femora, dark-brown in the type, are, in the variety, shiny black. The white of the thorax is mixed with brown. The larvæ were obtained by Kricheldorff in Swedish Lapland last year, on a birch bush (Bau).

EGGLAYING.—The eggs are laid side by side along a twig of birch, their long axes transverse to that of the twig, and a second and even third row may be placed on top of them. In laying her eggs, the moth feels the twig and the preceding egg with her ovipositor carefully getting it into position, in a way difficult to describe, passing it in some degree round the twig, the extremity of the ovipositor corresponding with the micropylar end of the egg, which is gradually thrust out a short way and then rapidly into its position, in a way that makes one sure it cannot possibly reach and stop at its right place, which it nevertheless does, the cement that afterwards holds it so firmly in place, apparently acting as a perfect lubricant (Chapman). The eggs found in the woods are laid in little batches of 6 to 8 or so, in double rows, on small outside twigs of birch, 2 ft.—4 ft. from the ground; the eggs are pale at first, but darken in a day or two to a purple-brown colour, just like the birch twigs (Holland). The ova are laid in rows, side by side (somewhat like those of *Trichiura crataegi*), the number in a row varying considerably (Bacot). In nature, a batch of eggs usually numbers 10—18 (very rarely 20 or more go to form a batch), attached in a double row to birch twigs on the outside of the bushes; when a ♀ has deposited one small section of her eggs, she flies from 15 yds.—20 yds. before selecting another bush; after darkening, the eggs are most perfectly protected (Clarke). A ♂ and ♀ emerged in the afternoon of February 27th, 1893, and paired almost immediately; they remained *in copulâ* till 10 p.m. the same evening, and at 10.45 p.m. the ♀ began egglaying on dead twigs of birch, to which they were fastened by their long sides in rows of from 6 to 10; in one case a second row was laid on the first. After several rows had been thus laid, cracks in the box in which the

* Linné's original description evidently refers only to the ♀. We have selected this as the typical form of the male, being, at any rate with us, the commonest

♀ was confined were utilised, the ovipositor being thrust round in such a manner as to suggest that this may be a frequent habit in nature. The eggs are conspicuous when first laid, but soon darken; this ♀ laid just 100 eggs, and died on March 4th, the abdomen being quite empty; the larvæ commenced to hatch on April 6th. A second ♀ found *in cop.* before 5 p.m., February 28th, 1893, separated from the male at 10.30 p.m., and commenced laying the same night in crevices of box, between two layers of cardboard; some of these rows consisted of as many as 20 eggs and were very regularly arranged. This ♀ laid 136 eggs and died on March 5th; the larvæ commenced to hatch on April 11th (*Ent. Rec.*, iv., p. 156). Gascoyne, who noticed that the females blundered much in laying their eggs in a box, "placed a ♀ on the main stem of a young birch-plant, growing in a flower-pot; she at once commenced to ascend, and, passing along one of the thin lateral twigs, the before awkward moth now seemed quite at home, and with perfect freedom of movement she clasped the branch, adjusted herself beneath it, and, curling up the abdomen, passed it up one side of the twig, bringing it forward until it approached the hinder legs; then, passing the ovipositor over to the upper surface, deposited the first egg, close to the hind legs and across the twig, a little towards the side from which it was delivered; then, slightly elongating the body, another was laid alongside the first, followed by a third and so on, until nine or ten had been deposited in the most regular manner, and having the appearance of a row of miniature vegetable marrows, laid side by side. The abdomen having now been elongated to its fullest extent, she withdrew it, and, passing it to the opposite side of the twig, bringing over the ovipositor as before, placed an egg exactly end to end with the first one laid, and so on throughout the second row; a third row is sometimes laid on the first." Gascoyne further observes that he has batches of the shells where third and even fourth rows have been raised, and adds: "The female now takes wing, alighting on a neighbouring twig, and the operation is repeated with intervals of rest until she has laid about half her store, the remainder being laid on a subsequent evening. The exact moment for laying the eggs appears not to be under the direct control of the female, for, when the impulse is on, she is most impatient to adjust herself, and if she has not completely succeeded when the proper moment arrives for the passage of the egg, she appears to have no power to retain it, and it becomes attached to any part that the ovipositor may happen to touch at the moment of emission. The number of eggs averages about 160, those emitted rarely exceed 120. Strong, healthy females will lay their eggs with the greatest precision and nicety, the smaller and weaker ones are generally bunglers throughout, and deposit them very irregularly." Merrifield notes* complete batches laid by two females that emerged and paired respectively on March 24th, 1859, and March 25th, 1859, as consisting of 150 and 154 eggs apiece, and laid between these dates and March 31st in batches of from 12 to 44, the eggs being chiefly deposited between 2 p.m—4 p.m., and at dusk. Another female, between April 2nd and April 4th, laid 158 eggs in batches of from 4 to 35, and, being dissected, 35 eggs were found in the body, most of which were small and soft, only about 10 being full-sized and hard. Another ♀ paired on April 4th, and by 1 p.m. on April 5th had laid 174 eggs in 5

* Merrifield gives (A.B., *Ent. Wk. Int.*, vol. x., pp. 47—48) a further excellent account of the egglaying of this species.

batches. The eggs laid by the second ♀ between March 25th and 27th commenced to hatch April 23rd, and continued to do so until after April 28th. Jones found at Rannoch in May, 1883, 11 ova laid in a row, side by side and touching, on a small twig of birch; these hatched June 1st, all the larvæ coming out of the same end of the eggs, and each making a circular hole in it. Wynn discovered eggs in 1891 in Wyre Forest laid in little clusters, at the end of thin twigs of birch. Day found eggs at Rannoch at the end of May, 1898, laid scattered on twigs of alder. Buckler notes that a small batch of a dozen eggs from Rannoch began to hatch May 22nd, the larvæ continuing to appear at intervals throughout that day, and up to the next morning when the two latest were hatched. Jenvey writes (*i.l.*) that two batches (laid by ♀ s, which were both fertilised by the same male) consisted of 126 and 138 eggs respectively, and were deposited on birch twigs. Holland records eggs as being found wild at Burghfield on a birch bush on May 13th, 1891.

Ovum.—When first laid yellow, soon assuming a dirty tint, the colour getting deeper, till it is of a deep purple or red-brown hue with a strong tinge of bluish. Before hatching, air penetrates between the larva and the shell, the colour being then a dirty white, *i.e.*, a white semitransparent shell over a black (brown-haired) larva. The eggs are plump and round when laid, but soon, by desiccation, develop a deep dent on one side, and this may assume really large proportions without detriment to the final exclusion of a healthy larva. The egg is nearly cylindrical with hemispherical ends; it does, however, deviate a little from a strictly cylindrical form. The length is barely 2·0mm., and the greatest diameter, 1·15mm., the least being 1·00mm. This is the extent of the flattening in a plump egg, but the flattening from shrinkage soon makes this flattening much more pronounced. The micropyle is represented by a minute cell surrounded by a rosette of eight rather elongated cells, the whole rosette being about 0·03mm. across, and, outside this, is an area about 0·5mm. in diameter, with a well-marked network of cells, apparently separated by slightly raised lines; these cells are of very irregular form, usually lengthened in a direction radial from the micropyle, often four-sided, twice as long as broad, and about 0·025mm. in length, but longer as they recede from the micropyle; outside this area they become less distinct, but can often be made out, although they usually present the appearance of a minutely undulated surface. There is another appearance that is very marked, but of the exact nature of which it is more difficult to be sure. This may be described as beginning outside a radius of ·25mm. from the micropyle, and affecting more or less the rest of the egg, and presenting the appearance of a number of fine spicular hairs arising at a considerable number of the points of intersection of the mesh of network. These are very fine and have a silvery sheen. Sometimes they appear to rise from a globular base. In some aspects, however, they look like small raised splashes, or marks of exclamation, laid flatly on the egg surface, with a minute free point standing off. They probably are portions of the network specially developed, and are not free spicules, except perchance at their extreme ends. The egg-shell being almost transparent, and being on a dark ground, its inequalities and markings probably produce these puzzling effects in various lights

(Chapman). The egg is long, nearly 2mm., somewhat cylindrical in shape, but almost twice as long as broad, the extremities rounded, a distinct longitudinal depression on upper surface of egg; the colour at first pale yellow *, rapidly becomes dirty yellow and after three days orange-brown, whilst the development of the embryo can be observed, certain dark areas being very pronounced; the colour then gradually changes to purple-brown, and, five days after being laid, the eggs are of a tint roughly corresponding with that of the dead birch twigs (the infertile ones remaining yellow); the empty eggshell is glassy, transparent, and distinctly iridescent (*Ent. Rec.*, iv., p. 156). The egg is about 2mm. in length, rather more than 1mm. wide, in shape much like that of a brick with rounded-off angles, slightly depressed on the upperside, sometimes on both sides, the surface apparently smooth and very glossy; when first laid, of a light green colour, changing in the course of a few days to dark brownish-purple, much the colour of a fresh birch twig; this lasts for about fifteen days, and it then assumes a purplish-violet tint, gleaming like an amethyst, and the interior seems a little cloudy; a few hours later it is fainter and pinkish, and then the larva soon hatches; the empty shell, with the circular hole of egress at one end, still retains a faint tinge of pinkish-violet after the larva has escaped (Buckler). The eggs when first laid are of a bright yellow colour, but soon assume a rich brown tint, much the colour of the twigs on which they are deposited; in warm, sunny weather, the change of colour will be effected in 24 hours, but when cold and dull it occupies several days; in this state the eggs remain about three weeks or a month, varying with the temperature; the movements of the young larva can be seen within the pellucid shell, and the young larva nibbles a hole at the end of the egg, the majority getting clear in half-an-hour (Gascoyne). The eggs at first bright yellow change gradually to pale purple-brown, becoming brown rather than yellow in three days from laying (Merrifield). Length of egg 2mm., width 1·2mm., thickness at larger end 1mm., at thinner end just under 1mm.; in outline, a long, rather brick-shaped oval, flattened on sides and edges, but full and rounded at ends; a large depression on upper surface, a small one on lower; colour finally of a livid leaden hue; surface smooth and varnished. The micropyle forms a dark spot at one end, the surrounding network of cells faintly but clearly marked; the general surface only with the slightest trace of any reticulation (Bacot). It is essential that the ova should be kept in the shade and not exposed to the full rays of the sun until they begin to hatch (Bernard-Smith).

Habits of larva.—As soon as the larvæ emerge, they congregate and feed gregariously, sitting closely together on a twig of the foodplant, clinging by their prolegs and holding the head and thoracic segments away from the twig. When startled, they rapidly throw themselves up, and much resemble *Tenthredo* larvæ, although the latter cling by their true legs and elevate the posterior segments.

* We are informed that some error seems to have crept into the original here, the egg being noted as first "pale green, then yellow," and several observers agree that there can be no doubt that the egg is not green but yellow when laid It is strange, if this be so, that Buckler (*Larvae*, &c., iii., p. 61) makes exactly the same error of observation. Is there any variation in the tint of different batches?

The gregarious habit usually lasts until the third moult, occasionally, it is stated, to the fourth. In very suitable weather the first ecdysis takes place in about 6 days from hatching, the second some 6 days later, another 6 days is sufficient for them to have completed the third moult, whilst the fourth takes place some 7 or 8 days after the third; the larvæ then feed for about a fortnight after the fourth moult before they attain full growth. Sometimes, however, almost double this time is required in the early stadia. When almost fullgrown the larvæ are very lethargic, show no disinclination to be handled, rest side by side, and have a most contented appearance. When, however, quite ready for pupation, they become restless and wander about until they find a suitable position in which to pupate (Tutt). The young larva nibbles a hole at one end of the egg, and half-an-hour is generally sufficient for the majority to clear. They wander over the shells, gently feeling each other as they come in contact, and, starting a trail, commence their first journey in life; one leaves the batch, makes its way up a twig, followed by the others in single file, following the leader, and if one "loses trail," it tries back until it has again fallen into the line of march. They then assemble near the tip of a twig, adhering when at rest by the claspers, the anterior portion of the body being erect, and closely resemble in colour, shape and size, the little black stumps so common on the twigs of birch. Another part of the batch may go off in another direction, having failed to strike the original trail. When the produce of a batch divides into two companies it frequently happens that, when removing in search of fresh food, each part, descending its respective twig, falls into a common trail on the main twig, becoming united, probably to be again divided at a subsequent migration. When some ten days have elapsed the body thickens, the larva ceases to eat, the head slips out of its old cover (which is empty and transparent) into the prothorax, the skin breaks down the back, and is slipped off segment after segment until it is gathered into a little heap behind. The first moult singles out the weak or diseased individuals, which die under, or without accomplishing, the operation. The larvæ, now of a dull green colour, bear, as they sit in groups, a remarkable resemblance to bunches of the birch-catkins, and it requires a practised eye and close examination to distinguish one from the other. At times, when resting in small groups, or even singly, in a reflexed posture, the rigid prolegs extend and give an outline more or less resembling the mid-rib and serrated edges of a birch-leaf, and the larvæ evidently trust to these attitudes for concealment. They still continue to feed in groups, marching in company from branch to branch as the food becomes exhausted; the groups appear to feed systematically, the larvæ going out two or three at a time to the neighbouring leaves, and returning to fall in, others advancing to take their place; after about ten days more the second moult takes place, after which the larvæ, becoming too large to derive security from their resemblance to the catkins, disperse, their attitude and colour daily assuming more resemblance to a leaf. After another moult they grow rapidly, feed incessantly, and become very handsome; and, in this stage, the female larva may be distinguished from that of the male, being far more robust and sluggish. When fullfed the larvæ assume a rosy tint, and then go down into the moss, leaves, or other *débris*, to spin their cocoons (Gascoyne). One of 10 eggs hatched on May 6th, 1858, the young larva took short excursions on the twig and returned to the other eggs, by next morning two more eggs had hatched, the three larvæ sitting together under a leaf, on the 8th none came out, but by the 9th another had emerged, and on the 10th a fifth left the egg and they all moved to another leaf, still keeping to the underside and near the leaf-stalk; the fifth, however, was not very sociable and died on the 15th. The young larvæ take up a position at rest perhaps rather approaching that of *Lophopteryx camelina* than that of *Sphinx*, only with the head not quite so far turned back, and with a smaller part of the posterior end of the body attached to the leaf. The larvæ appear to feed chiefly (certainly not exclusively) by night; from the first they have, in eating, attacked a leaf sideways, biting through the whole substance. On May 24th, three of the larvæ changed their first skins, the other the next day; they still rested under the leaf but fed rapidly in the sunshine, and maintained strictly their gregarious habit, resting in actual contact, crawling or stretching forward to the edge of the leaf when hungry; they are very economical feeders, wasting nothing, but, after eating the nearer part of a leaf, they attack the distant part, and, having eaten until the piece on the outer edge is almost detached, they stretch out to their utmost, nibble away at the outlying piece till it is so narrow that they can get the extremity into their mouths and munch it away as Kentish men do a stick of celery; they were again noticed feeding at dusk, also later at about 10 p.m. On the evening of June 2nd they again moulted, and two again on the 9th, and two on the 10th, and in their 4th stadia were about an inch long when not stretched out; on the 14th they were transferred to a breeding-cage and completed their development there. In nature the habits were further observed on July 2nd—3rd, 1858, at Green Trees Forest, when, by turning back the branches of the smaller birches that had evidently been well eaten, so as to see the undersides of the leaves, the whitish backs of the larvæ (which made them very conspicuous) were also exposed to view; the larvæ were most abundant on bushes of from 2 ft. to 6 ft. high, and affected the middle and lower branches quite as much as the upper, eating off whole leaves, sometimes also leaf-stalks. They appear to be more or less gregarious to the last, usually more than one is found on a tree, on one occasion 7, and on another 5, nearly fullgrown larvæ were found upon a little tree, not 3 ft. high, two on the same twig, and within an inch of each other. Although generally adhering so closely to their resting-place, they sometimes fling themselves off like a larva of *Cucullia verbasci*. They become fullfed from about July 9th (Merrifield). Poulton notes (*Proc. Ent. Soc. Lond.*, 1892, p. xv) that, in the second stadium, "the larvæ arrange themselves in small groups upon the leaves and leaf-stalks of the birch, and when disturbed they raise the anterior part, bending the head over the dorsal surface of the posterior part of the body. In this attitude they strongly remind the observer of those *Tenthredo* larvæ, which, when irritated, bend the tail forwards over the anterior part of the body; the fact that the head is raised in the one and the tail in the other does not cause any conspicuous difference when the larvæ are seen from a little distance. The larvæ of the common Tenthredinid, *Croesus septentrionalis*, are of about the same size as these small lepidopterous larvæ, feed in similar small groups when large (when small the groups contain far more individuals), and also often frequent the birch. Experiments have shown that Tenthredinid larvæ are, as a whole, far more unpalatable than lepidopterous larvæ, so that the resemblance would be of advantage to the *Endromis* larvæ." White and Griffiths had previously shown (*loc. cit.*, 1888, p. xix) the resemblance that these larvæ have in their third stadium to the catkins and leaves of their foodplants; the latter had noticed "the habit of the young larvæ to congregate at the ends of the twigs of birch with their heads nearly always in the direction of the end of the twig, and in their favourite resting attitude, in which the fore-part of the body was elevated at a curve, they bore a great similitude to the young catkins; larvæ had also been noticed to eject from the mouth a greenish fluid, which was assumed to have a protective value, and to be produced under sudden alarm; it was also a common habit for them to swerve their heads sharply round in a threatening manner when the anal hump was touched." Bacot notes that "the larvæ in the 1st and 2nd stadia rest in little batches of 6 to 12, at or near the extremity of a twig or branchlet, and, if possible, will feed without crawling. The whole batch, however, will crawl slowly forward by stages along the leaf stalk, one or two eating and the others resting." He suspects that they eat by turns, but they move as short a distance as possible; if a more extensive movement becomes necessary, the whole batch, or a portion of it, if large, migrates together, and, if disturbed, the larvæ will wander singly about the leaf stems or twigs, but always come to rest again in little groups. He cannot say, however, if these groups are always composed of the same individuals or not, but observes that "the larvæ sometimes rest with their heads and thoracic segments curved backwards in the characteristic manner, at others stretched at length. They do not all moult together, so that a group may be composed of individuals in two different stadia. In the 3rd stadium the habit of resting in groups (rarely more than 3—6 in a group) is still maintained, but is not so marked as hitherto, and the position not so crowded, rarely more than two couples on adjacent leaf-stalks (of course their size now prevents some 5 or 6 getting on a single petiole). In the 4th stadium they are usually solitary, although occasionally they rest in couples, probably the result of being kept in a confined space, and they would possibly scatter widely if opportunity offered; they still rest with the backward curve already mentioned, as characterising younger larvæ. Before pupating the larva changes to a livid hue, pinkish or purplish on the dorsal area; it shrinks considerably, and the skin becomes moist as though the larva was in a profound sweat. The excrement is mixed with a dark-green fluid, just before they leave off feeding; in this, the species resembles *Saturnia pavonia* and some of the other large cocoon-spinning species. I have always connected this trait with silk-spinning, but am by no means sure that there is really any connection." Jenvey gives (*i.l.*) the following notes as to larval habits—eggs laid April 7th, 1900; 19 larvæ emerged April 24th and 25th, young larvæ entirely social, forming one colony only during the whole of the 1st stadium; larvæ rested 36 hours and then moulted

May 6th and 7th. In second stadium, larvæ fed in groups of 4 or 5, rested again for 36 hours, and moulted May 16th and 17th. In third stadium, larvæ fed solitarily, the resemblance in size and general appearance to birch catkins most striking, rested 48 hours and entered upon the fourth stadium from May 26th to 28th; fed on solitarily, rested when fullfed in this instar from 48—60 hours, and entered the fifth stadium from June 6th—8th. On June 18th the three most advanced larvæ presented a very handsome appearance, a pronounced pink blush mingling with and almost killing the former green hue; within twelve hours these larvæ commenced to form their cocoons. The whole spun up between June 18th and 23rd. The most forward individuals occupied the following time to complete the larval stage: 1st stadium, 12 days, 2nd stadium, 10 days, 3rd stadium, 10 days, 4th stadium, 11 days, 5th stadium, 12 days=55 days altogether. Buckler notes that a batch of newly-hatched larvæ that he reared showed a disposition from the first to feed at intervals on two particular leaves near the top of a spray of birch whereon they had all assembled, holding to the twig by their ventral anal prolegs only, the fore-part of each body being bent back away from the twig, leaving the anterior legs free; after the second moult they were an inch long, and then broke up their society and separated for independent existence, yet were sufficiently amiable whenever they chanced to find themselves near each other to agree perfectly well at any time; while resting they still elevated the front part of their bodies as when younger; after the fourth and last moult their docile behaviour continued to be remarkable, as they showed no disinclination to be handled, but grew quite lethargic, often sleeping side by side contentedly like so many fat pigs, but when awake they made good use of their time, consuming a great quantity of birch, and their growth was commensurate. He further observes that, when fullfed, the larva becomes restless until it finds the moss and leaves needful for its retirement and the construction of its cocoon. Weaver records that he found, on June 30th, 1845, eleven larvæ feeding on one leaf at Rannoch, and that, on being disturbed they threw up their heads and bent their bodies just as do the larvæ of the *Tenthredo*. The eggshells from which these had hatched were arranged in a double row around one of the twigs. Chapman notes that very young larvæ in their early gregarious stage pine and refuse to eat when solitary. Holland says that when the newly-hatched larvæ emerge they arrange themselves neatly on the twigs, and when at rest, side by side, completely encircle the twig, attached only by their claspers, with the front segments thrown back. They are black-looking little things at first, but gradually become green, and then rather conspicuous, much like a bunch of sawfly larvæ, particularly when the twig is touched. They are gregarious till the last moult but one, only as they get larger a fewer number usually go to form a bunch, and what was at first one bunch will form two. When they break up altogether they wander a good bit, and seldom more than 3 or 4 are found on a bush, and these usually on the higher parts, looking now very like the great green catkins on the birch at this time. They will fall to the beating-stick, but searching pays best. June (early) is the best time to look, as the larvæ have reached a good size and yet not separated; even after the companies have broken up and wandered, searching seems best, as stripped twigs then show their whereabouts. They spin up from the middle to the end of July. Wainwright finds the nearly fullfed larvæ difficult to see owing to their resemblance to leaves, the larvæ taking up such a position on the stem as to make this similarity very striking. Bankes notes: "It is remarkable that whereas in some localities the larvæ are quite easy to rear, in others even experienced breeders find them impossible to manage, *e.g.*, they are no trouble at Corfe Castle, yet at Leominster, Hutchinson always fails with them; the different results may be due to difference of soil on which the birch trees are growing. Those on which my broods were sleeved grew on stiff clay." Tugwell observes of some larvæ, bred in 1882 from Rannoch ova, that they went on well until nearly fullfed, when they were attacked by diarrhœa, the frass became moist, &c. Each larva was held under a tap of cold water, gently brushed with a camel-hair pencil, rinsed in a stream of dripping water, and put on clean dry food; every larva thoroughly recovered, and formed a healthy pupa, some imagines emerging in April, 1883, the rest going over. It may be noted that the larvæ cling very firmly, and should be searched for, they can only be beaten with difficulty; wild larvæ (small) taken June 13th, 1858, at Tilgate (Tugwell); July 7th—9th, 1858, fullfed, at Tilgate (Merrifield); June 3rd, 1867 (Haines); June 14th, July 10th, July 19th (some of these very large), 1891, at Burghfield (Holland).

Larva.—*First stadium* (newly-hatched): Length about 5mm. Head large, rounded, dull black with scattered hairs; antenna and mouth-parts yellow, rather prominent; a small whitish slip at base of clypeus (? labrum). Body black, skin dull, much wrinkled, scutellum large, but not differing in appearance from general skin surface, except that it bears a large orange patch on either side of median line. True legs orange, but black at base. Hairs tapering, simple, bright brown in colour. Skin surface without spicules. Thoracic segments rather larger than abdominals (except 6 and 7, which appear swollen); prothorax wider than meso- and metathorax on account of great size of head. Spiracles large with a bold, raised, black, chitinous rim, approaching circular. Tubercles form raised chitinous warts, black, shiny, unlike general skin surface, which is dull. On the abdominal segments, i is large, carrying four setæ; ii small, bearing one seta; iii large, well above spiracles, with three setæ; iv and v raised on lateral flange, in same horizontal plane, just below spiracle, v slightly before, iv slightly behind, the spiracle, but both so close, and the setæ belonging to each so scattered that they may be roughly described as a single group on lateral flange; v bears three, and iv two, setæ, the bases of which are large, but the raised skin area bearing them is not so specialised or wart-like as that of i, ii, and iii; there is a basal group vii, but vi is not traceable; on the prothoracic segment, i and ii produce setæ scattered over dorsal area, but the prespiracular carries 3 setæ; on the meso- and metathoracic segments i and ii are apparently consolidated into one large tubercle, iii is large, and iv and v are also consolidated; on the 8th abdominal the two anterior trapezoidals (i) are united and mounted on a tall, fleshy, nearly circular base, ii fall behind these and are not raised. The meso- and metathorax and the abdominal segments 1—8 have three clearly marked subsegments. *First stadium* (full-grown): Now of adult shape, tapering gradually from 1st—8th abdominal, and more rapidly to head; the 8th abdominal is strongly humped (almost a short stout horn); the anal segment bears three plates, one above and one on either side of the anal orifice. Tubercles iv and v are now clearly separated on lateral flange of abdominal segments; on the 8th abdominal one of the setæ belonging to iii is slightly apart from tubercle, and has a distinct chitinous button; marginal tubercles (vii) present, but no trace of vi; setæ of v have, on some segments, distinct and separated chitinous buttons at base, *e.g.*, on the 6th and 7th abdominal segments the hairs are a short but distinctly perceptible distance apart (May 5th, 1900). *Second stadium* (fairly grown): Length 14mm. Body of fairly even thickness except 7th and 8th abdominals, which are somewhat smaller than the 5th and 6th; the body tapers gradually from metathorax to head, the latter rather large (very large, directly after moult), the 8th abdominal bearing a tall pyramidal hump giving rise to a short blunt horn. Head squarer in shape but still rounded, slightly notched at crown; slopes back at an angle of about 45°; pale cream in colour with a slight greenish tinge; clypeal triangle bright green; a broad black band on either lobe at crown, tapers downwards to base of antenna; a similar black band down either cheek, the surface of head smooth and dull; hairs short, but numerous. Body: scutellar plate still apparent, chiefly because it bears very small black spots; ground colour pale sea-green, thickly covered with black pigmented areas surrounding the bases of shagreen hairs on ventral as well as on lateral and dorsal areas. These dark spots poorly developed or absent on the area of the cream-coloured stripes; a distinct dark mediodorsal stripe*, starting behind head and ending at anal plate (passing up the front and down the back of the horn on the 8th abdominal segment); the anal plate of a somewhat brighter tint than rest of larva and edged by a narrow cream-coloured border; a short subdorsal cream-coloured band crosses the prothorax and is faintly continued as far as the metathorax (this is apparently a continuation of the pale area between the dark stripes on the head); a broad vivid cream-coloured lateral band starts on prothorax and ends at beginning of 1st abdominal; in addition to these short subdorsal and lateral bands there are 7 oblique stripes on either side, sloping from head to anus (the opposite direction to those of Sphingid larvæ) at an angle of 45°, an additional short one at base of horn; and a very faint trace of yet one other on the metathorax and 1st abdominal; each stripe runs over two segments, the first over abdominal segments 1 and 2, the second over 2 and 3, and so on. These oblique stripes increase in strength from the first (weak) to the 7th (strong). Tubercle i, represented by a group of 5 hairs, is not raised perceptibly above the skin, each hair has a separate black chitinous button at its base, surrounded, as are the other shagreen hairs, by a pigmented skin area; these hairs are arranged in a ring, the skin immediately surrounding them being free from shagreen hairs, and serves them as a background, whilst an additional prominence is given by the oblique stripes ending in the open area, surrounding the spot; the number of setæ in the spots (representing i) is variable; in one larva examined, on the 3rd abdominal segment, the right hand one bears 4, whilst that on the left bears 5, setæ; and on the 2nd and 4th abdominals, there are 4

* This dark mediodorsal stripe is a coloured streak and not merely a massing of the hairs and spreading of the pigmental areas at their bases (Bacot).

setæ on the right and 5 on the left (tubercle i) in each segment; tubercle ii is represented by a single chitinous button, with pigmented area bearing a single seta, and it would be quite lost among the shagreen hairs if it were not for the fact that it bears a longer hair, the hairs occupying primary tubercular areas being longer than the others; tubercle iii is represented by a group of 3 setæ close together, above, and slightly in front of, the spiracle; iv and v are rather obscured, there are two little groups of setæ, 3 in each (sometimes 3 in one and 2 in the other) rather conspicuous beneath spiracles which appear to represent these tubercles. The whole body is thickly sprinkled with small chitinous cone-shaped black tubercular points, each bearing a short spiny hair (These are referred to above as shagreen tubercles and shagreen hairs respectively). The skin, for a considerable area (compared with the size of the tubercular points) around each point, is dark sepia- or smoky-green, black to the naked eye. Spiracles large, almost level with skin surface, white with a black chitinous rim, placed rather forward on segments (except that on prothorax, where it is, as usual, posteriorly situated). Hairs on head short and numerous; on body often tapering, but sometimes blunt-ended, and apparently slightly notched (but I have not mounted them to make certain); the setæ arising from the primary tubercles are about twice the length of the others. The 7th and 8th abdominal segments are much shorter than the others, and the 9th is a mere slip (May 10th, 1900). *Third stadium* (well-grown): 19mm.—22mm. in length, short, stout, and Sphingid-like in appearance, tapering from 2nd abdominal to the small head, does not differ much in general appearance from the 2nd stadium, but is plumper and of a brighter and more vivid green. Head rather tall, with tendency to squareness, and slopes at an angle of about 45°; bright green in colour, the cream-coloured subdorsal and lateral bands of thorax continued on head until they meet at base of antennæ, between them a dark green band, whilst another borders the lateral and ventral edges, and a third occurs just above the continuation of the subdorsal band, running from crown of head to just inside the antenna; the area between these last dark stripes and clypeal triangle cream-coloured. A few very small fine hairs occur on the head, but do not form a noticeable feature; there is but a slight tendency to develop black bases to the head hairs (although this is a conspicuous feature of the body hairs), and, where present, it is most marked on the dark green areas. The dark green stripe at edge of ventral area, which runs beneath the continuation of lateral band, becomes tinged with pink near the antenna, and is continued as a dark pinkish stripe across the mouth. The body is pale whitish-green on dorsal area, deepening to a lovely pellucid apple-green on sides and ventral area; the black spots surrounding bases of short shagreen body hairs are strongly in evidence, closely crowded together on the ventral and lateral areas, but fading on the upper lateral, and becoming mere black specks on the dorsal, area; they (the black specks) are also either absent or exceedingly minute on the area of the pale cream stripes. There is a dark green median stripe, almost black, on the prothorax, and quite black where it ascends and descends the stumpy horn on the 8th abdominal. The subdorsal stripe on the thoracic segments is faint and poorly marked, but the lateral band on the same segments is strong and clearly marked. The oblique stripes are faint, except the 7th (crossing the 7th and 8th abdominal segments) which is very bold; that portion of it on the 8th abdominal is bordered above by a black stripe, apparently formed by an extension of the black area at base of shagreen hairs. The scutellar plate is not noticeably different in colour from the general skin surface, but the anal plate and plates on bases of anal claspers are free from shagreen spots and of a vivid green, bordered with cream-colour. The oblique stripes, 2—5, are faintly continued down the prolegs, and there is a ring of deep orange just above the feet. Tubercles i are faintly traceable, the dark spots of the 2nd instar can be discerned, and there is a little ring of 4 or 5 shagreen hairs on the area, which, however, do not appear to differ from the other shagreen hairs. One of the subspiracular hairs is much longer than the others and belongs to that group referred to iv in 2nd stadium. The position of iii can also be made out, owing to the longer hairs, but that on i is indistinguishable from the secondary hairs in size. The yellowish stripes down the sides of the horn are still present, the horn is slightly notched longitudinally at tip; the hairs on it longer than elsewhere. The spiracles are large, white, edged with black. Traces of a lateral flange are present on the thoracic, but not on abdominal, segments. The abdominal segments appear to be subdivided into 4 subsegments, the anterior of which is much larger than the others. The true legs are yellow-brown with black tips. *Fourth stadium* (well-grown): The larva is very short and plump, the head and thoracic segments very small compared with the bulky abdomen. The dark band on head is reduced to narrow line-like borders to the cream-coloured stripes. The dorsal area of body a whitish-green, and quite free from the dark spots surrounding bases of shagreen hairs that are still present on lateral and ventral areas. The mediodorsal line distinct and sharp, and the stripes stronger and clearer. The upper half of the oblique stripes bordered with bright green, the lower half faint except that of the last (7th), which is bordered above its lower half with black. The short stripes up the sides of the horn strongly marked. The lateral band on thorax is narrowly bordered above by a black line. The shagreen hairs are now very small, iii is the only tubercular group that can be discerned with tolerable clearness. The horn still persists, and the mediodorsal line is black where it crosses it. True legs yellowish. Feet of prolegs red (May 27th, 1900). *Fifth stadium* (adult): Length $2\frac{1}{4}$ in.—$2\frac{3}{8}$ in., greatest breadth $\frac{3}{8}$ in. or slightly over. Practically no difference from the fourth stadium, the dark line on head greatly reduced and only apparent close to the mouth; the line on the ventral area of head still sharp and clear. The double character of the horn still apparent at apex. Spiracles white, edged with black (June 10th, 1901) (Bacot). On *leaving the egg-shell*, the larva is a stout and robust creature of cylindrical figure; the head, as usual at this time, the largest segment, is of a dark black colour, with greenish mouth; the body velvety-black, with a dingy olive-greenish plate on the 2nd segment, having a wide black dorsal division; on the other segments are olivaceous, greenish-yellow, tubercular warts, each anterior pair on the back being distinctly larger than the others, which are very minute, all bearing a few weak, soft, yellowish hairs; a black dorsal blunt projection is on the twelfth segment; the anal plate and outer sides of the anal legs are pale olive-greenish yellow ; the ventral prolegs are blackish on the outside, with greenish inner side, the anterior legs olivaceous-yellow and shining, by the fourth day their colouring had become dingy blackish-olive, with the mouth orange-ochreous, a blackish dorsal line, black tubercular spots, a conical hump on the twelfth segment, a faintly paler spiracular ridge on the thoracic region, and the anterior legs pale-orange, with black bases. *After the first moult*, the ground colour was of a subdued green, thickly freckled with black atoms ; the head and plate on second segment paler, of sober greenish-yellow, as were also the spiracular ridge on the thoracic segments, and a green backward-slanting stripe on the side of each of the others, and this was still paler and yellower on the eleventh and twelfth, on which last a stripe began at the top of the blunt eminence ; the anal flap was margined with the same colour ; the head was marked with two black stripes on either side ; a black dorsal line divided the front plate and continued throughout over the hump as far as the anal flap. *After the second moult* they were an inch long, the colour of the back was much lighter green, the dorsal line dark green, except at the apex of the hump, where it was black ; the sides were of a fuller green, finely dotted with black. On the back the dots showed greenish, though they had become nearly obsolete there ; the stripes on the head were alternately whitish-yellow and dark green, on the thoracic segments the whitish spiracular ridge was conspicuous, as also, on the other segments, were the side stripes of yellowish-white bordered above with deep green, and these also now not only reached the segmental division in their downward slant, but crossed it, and were thence continued narrowly and obscurely below on the segment following. *After the third moult* their growth was quick ; two days' feeding increased the length from 1 inch 3 lines to 1 inch 4½ lines, with greater stoutness also in proportion, the thoracic segments decidedly tapering to the small head ; the relative colouring much as before, paler whitish-yellow-green on the back, with deeper green dorsal line, black at top of the prolonged hump, which was now seen to be slightly divided into two blunt points ; the yellowish side stripes, margined both above and below with deep green, and the sides below them of still deeper green, irrorated with fine black dots, except just where the attenuated continuations of the side stripes could be traced ; the bases of the anterior legs black. *After the fourth and last moult*, by the 26th of June, some were 2 inches 3 lines in length, others, later, as much as 2 inches 7 lines, and bulky in proportion ; the head very small, with the thoracic segments rapidly tapering to it, and retractile, as in *Eumorpha (Choerocampa)*, though to a less extent. The middle of the body is rather the thickest, and the twelfth segment, with its humped elevation, bluntly pointed and slightly divided, slopes backward at an angle to the anal flap ; the ventral and anal prolegs are developed much after the fashion of *Smerinthus;* the other segments are lightly subdivided into four nearly equal portions by slight wrinkles, the segmental divisions more strongly defined, especially on the belly. The skin is soft and smooth, glistening on the head, which is green, and has two whitish or yellowish-white stripes beginning on either side, and continuing to the end of the thoracic segments, the uppermost as a subdorsal, and the lower as an inflated, spiracular stripe ; the back is pale opaque green, slightly inclining to yellowish in the lightest, and to bluish in the deepest, portions and in the dorsal line; below the yellow stripes, which are bordered above with green, the ground colour of the sides is of a very deep and rich full green, increased in depth by the close irroration of minute black dots, and relieved by the white oval spiracles delicately outlined with black;' in front of these comes a thin line of quiet ochreous-greenish, as though a continuation of the slanting stripe from the preceding segment, more noticeable on approaching the ventral prolegs, which, like the base of the anal pair, are bright crimson; the whitish-yellow stripe on the side of the eleventh segment continues downward beneath the spiracle on the twelfth. From the top of the white, horn-like hump, which is divided by a thin line of black, a whitish stripe descends on either side in a slight backward curve, and the anal flap is margined with yellowish; the anterior legs are pale green, sometimes tipped with red, and with a black hook. When fullfed all the green colours of the larva change to brown, and it becomes restless until it finds the moss and leaves needful for its retirement and the construction of its cocoon (Buckler, *Larvae Brit. Butts.*, &c., vol. iii., pp. 62—65). Two beautiful figures of the larva are also given by Buckler (*loc. cit.*, pl. li., figures 3, 3*a*).

Change of colour in fullfed larva.—Before pupating, all the green parts of the larva change to red-brown as is the case with many of the Sphingid larvæ. At this time it leaves the tree on which it has fed in order to find a suitable place for pupation. There can be no doubt that this change of colour is highly useful for protective purposes.

Pupation.—The larvæ spin up among the roots of low plants, just below or upon the surface of the ground near the bushes upon which the larvæ have fed (Reid); among moss, leaves, or such other *débris* as may happen to be at hand, usually at the latter end of June or early in July (Gascoyne); fastened up in dead leaves about the roots of trees (Merrin); just below the surface of the ground (Rühl). In confinement, place the fullfed larvæ upon sandy earth, mixed with cocoa-nut fibre, and they will spin up readily and keep safely (Bernard-Smith).

Cocoon.—The cocoon is made of tough brown silk, in the outer part of which, moss, leaves, &c., are interwoven; it narrows off somewhat at each end. Looked at against the light it is found to consist of a loose network, and the pupa may be seen inside; at one end the structure is looser in order to facilitate the escape of the imago; the inside of the cocoon is smooth and shiny, covered with a salivary-looking varnish, making the structure probably waterproof (Tutt). Buckler says that the cocoon varies in length from 1″ 4‴ to 1″ 7‴, and is of long elliptical shape, being from ·6 ins. to ·8 ins. in width; it is composed of an open-worked reticulation of coarse black or black-brown silk threads, with round or broad oval interstices; the fabric is extremely strong, tough and elastic, covered externally with moss and birch leaves firmly adherent. Bacot says that cocoons containing ♂ pupæ average 1·2in. in length and ·5in. in width, those containing ♀ pupæ 1·8in. in length and ·7in. in width; usually spun in an almost upright position, although others are almost horizontal; formed of an open network of strong, tough, brown silk (in texture it reminds one of a cane-chair bottom on a miniature scale, only the mesh is relatively coarser), exceedingly stiff, hard and very strong, the individual silk threads being thick and stout, and having the appearance of coarse isinglass. The rupture in the ♀ cocoon is not exactly at the top, but slightly to one side or to the shoulder; in one specimen the pupa forced its way entirely from the cocoon, in the other only partly, *viz.*, as far as end of 4th abdominal. The cocoon appears to be ruptured by the threads being frayed or worn through, and Bacot considers this is done by the serrate-edged V-shaped ridge on the anterior beak-like face-piece of the pupa, between the bases of antennæ, and he suggests that probably the pupa revolves and forces its head against the shoulder of cocoon.

Pupa.—The pupa is of a dingy blackish-brown colour, exceedingly rugose, and thickly covered over with minute blackish points. The skin is remarkable for its dense solidity. The head is ventral, the antennæ (which are very curved) originating on the front of the prothorax and extending ventrally as a ventral margin to the edge of the wings. A small prominence at the base of the maxillæ. The legs well-developed, the antennæ strongly segmented. The wings very narrow, compared with the size of the imaginal structures, the costal margins meeting much before the apex. The glazed eye indistinct and sunk in a depression near base of antenna. There is a remarkable beak or cocoon-opener, very like that of a Cossid or Sesiid. This beak is placed between the antennæ, and has a strengthening ridge running back on each side; above the labrum is a blunt projection of some prominence, and on each side the lappets, that are jaws, or the jaw-covers of the face; maxillæ large in centre. A portion of the head (between ridges of the cocoon-opener) is directed forwards, but is part of the face-piece; there is no dorsal headpiece. The prothorax prominent with three short longitudinal ridges on its front face. The prothoracic spiracle deeply placed and conspicuous. The mesothorax well-developed, the metathorax narrow. The 1st, 2nd and 3rd abdominal segments, although narrow from front to back, are much fuller than the thoracic segments. The 4th, 5th, 6th and 7th abdominal segments are much larger, and movable incisions occur between the 4th—5th, 5th—6th and 6th—7th, and the movement between 7th—8th appears to have been only recently lost. The intersegmental membrane* is smooth and black, very different from the rest of the pupal surface. The dorsum of the 5th, 6th and 7th segments, and to a less extent the 8th, is thickly studded with projecting sharp points, chiefly collected in transverse rings on the front and back of each segment, but not entirely so. They are less strongly marked ventrally, but still there is one well-

* An important feature of the pupa is the existence of a structure called in butterfly pupæ, where it is more obvious than in other pupæ, the intersegmental subsegment, and which is rarely to be detected with any certainty in Heterocerous pupæ. It is obscurely indicated in some Citheroniids, but in *D. versicolora* it is very obvious as a dividing line near the posterior margin of the abdominal segments 4, 5 and 6, between the scars of prolegs and the spiracles, and can be followed round the segments; on the 7th abdominal, the obvious portion that looks like ankylosed intersegmental membrane is more probably really this structure, and not the remains of true intersegmental membrane, which possibly do not here come to the surface (Chapman).

marked central ring of points there. The position of the larval prolegs is marked, and the sexual organs are distinct. The abdominal spiracles are very distinct, and consist of a somewhat linear slit, with a black raised rim surrounded at some little distance by another double raised black line. The cremaster forms a somewhat flattened horn-like projection bent downwards, the tip provided with a few golden-brown hairs arising in the hollows between the sharp points clothing the horn (Tutt). ♂. 1in.—1·1in. long, ·3in. wide at the broadest part; ♀, 1·2in.—1·3in. long, ·35in.—·4in. wide. The anal armature is very long, varying in length from 1·2mm.—2·5mm.; the pupal skin is deep red-brown, darkest on the dorsal area, where it is nearly black, paler on the wing-cases, with some slight differences in individual examples; the ventral outline is nearly straight, the dorsal curved, the anterior end rather blunt; the pupa tapers from the 7th abdominal to the anus, the 1st, 2nd and 3rd abdominal segments small, the 4th large, twice as long as 3rd; 5th and 6th are rather larger, 7th considerably shorter, the 8th still less; the 9th is a mere slip, whilst the 10th is represented by the anus and the anal armature (a long, curved, flattened, ventrally-hollowed projection); sexual organs clear and distinct; wing- and appendage-cases are small and short in comparison with the abdominal segments; no trace of waist or marked constriction between abdomen and thorax; the wings extend to but little more than half the length of 4th abdominal. A very slight slip of the hindwings shows beyond the forewings to middle of 4th abdominal segment; the 2nd pair of legs show inside the wings and extend to end of 3rd abdominal; tips of antennæ only reach to about level of the 3rd abdominal spiracle; the tips of 1st legs to same distance; the face above labrum is raised into a triangular projection or small beak; the glazed eye is small just at base of antenna; beneath face are two small angular pieces (labrum), and between these and 1st legs two considerable-sized pieces form the haustellum. The remainder of the mouthparts is indistinguishable on account of the rugosities; there is no dorsal headpiece, although a portion of the head is quite anterior. A fair-sized but angular prothorax, a large mesothorax, but a small slip forms the metathorax, which is only slightly larger than the 1st abdominal; the movable incisions are between the 4th—5th, 5th—6th, and 6th—7th abdominal segments. The surface of the pupa is exceedingly rugose, especially on antenna-, leg- and appendage-cases; the antennæ are ridged across like the teeth of a file; the dorsal area is also conspicuously rough, while on the 5th abdominal and following segments the rugosities rise into ridges of backward-pointing pyramidal spines, especially prominent on the 7th abdominal; there are also spiny processes on the anal horn; the roughness is also increased into poorly-developed spines on the posterior ventral edge of abdominal segments 4, 5, and 6; the spiracles are large and prominent from the 2nd abdominal to the 7th; on the 8th is a spiracular scar only; the active spiracles are large oval depressions, each with a central longitudinal slit. In the pupa of this species no great, if any, difference exists as regards the development of the ♂ and ♀ antenna-cases. In that of *Aglia tau* the superficial likeness due to roughness, colour, and shape of the anal horn, is departed from widely in certain features, such as the absence of the serrated V-ridge on front of headpiece, and the presence of recurved hooks or bristles fitted to hold the pupa to the silk of the cocoon; in the pupa of *D. versicolora* the spines on the horn are pyramidal and pointed only, and with no hooks, but with fine brown bristles between the spines; the pupa of *A. tau* emerges as far as middle only, while that of *D. versicolora* may entirely emerge (Bacot). Buckler gives the measurement of a ♂ pupa as 12—15 lines, of a ♀ pupa 17—18 lines, or a little more; the pupa very stout, the diameter across the bulkiest part at the end of the wing-covers in the male ranges from 4—4½ lines, in the female 6 lines; the head has the mouth-parts a little produced in a squarish form, flanked by the curved antenna-cases in high relief; thence the head is bluntly rounded above in an unbroken swelling curved outline to the end of the wing-covers, including the thorax and upper abdominal rings; the movable abdominal rings are very deeply cut, and, below, these are well-defined, the last ring ending with a prolonged flattened caudal process tapering a little to the squarish extremity, where it has a margin of hooks and bristles; the surface is remarkably dull and rough everywhere, except in the divisions between the movable rings, yet even there it is quite dull; the roughness on the head, thorax, upper rings and wing-covers is striated, granulous, or wrinkled; the movable and lower rings of the abdomen have on the back transverse rows of stout and sharp hooks pointing behind; the colour is a sooty or dingy brown, black in the abdominal divisions. Poulton describes and figures (*Morph. Lep. Pupa*, p. 208, pl. xxi., fig. 14) the terminal abdominal segments of the pupa as follows:

Fig. 14 × 7. The last three segments seen from the dorsal aspect. The surface of the pupa is extremely rough and richly beset with spines, which take a backward direction, and probably assist in emergence from the cocoon. The scar of the caudal horn is unusually distinct and large in the individual figured; it is placed, as in the pupæ of *Sphingidae*, upon the 8th abdominal.

Poulton further notes that the blunt horn of the larva leaves in the pupa a very large scar very different in appearance from the rest of the pupal surface.

Pupal habits.—Merrifield notes that, in 1859, of some two dozen pupæ, 12 to 15 were showing, by March 12th, their black heads in all directions, having forced themselves up out of their cocoons, whilst a few had quite disengaged themselves; four or five had already worked their heads out of the cocoons by March 5th. Gascoyne observes (*Ent.*, ii., p. 184) that pupæ should, in spring, have the benefit of the sun's rays, and will then, towards the end of March commence working, head foremost, out of the cocoons, coming up naturally through the moss, remaining exposed for a week or ten days, more or less, as the weather may be warm or otherwise, until the imagines appear; the moss in a cage with many cocoons becomes, at this time, studded with the brown heads of the pupæ looking very like the ends of cigars. Buckler compares the emergence of the pupa from its cocoon, before the emergence of the imago, with that of a Cossid or Zeuzerid pupa. He notes that about a week or ten days before the time of emergence the cocoon is pushed by the enclosed pupa from a prone to a vertical position, the upper end is ruptured, and the pupa protrudes its head through the opening. It continues by degrees to advance until it is exposed as far as the end of the wing-covers. Fixed in this position, it remains quiet a longer or shorter time till the insect is able to escape, though in two or three instances the pupa had worked itself out entirely free from the cocoon before the moth could be disclosed. Bankes has pointed out (*E.M.M.*, xxxv., pp. 137-139), that, in confinement, the pupa does not always so emerge. Of 15 cocoons, 5 pupæ emerged completely from the puparia, 4 others stood upright, half out of the cocoons, whilst 6 did not emerge even partially, although all 15 produced imagines. The reason that 6 did not emerge appeared to be that there was some hard substance, such as a dried leaf or another cocoon, against the emergence-end of the cocoon, sufficient to prevent the pupa from forcing its way through, but not sufficient to prevent the more powerful and better equipped imago from doing so. This was clearly the case with one cocoon in which a hard dry birch leaf was firmly attached to the emergence-end of the cocoon, which had proved too much for the pupa, though the moth had finally freed itself by forcing a passage upwards, just past the edge of the leaf. . . . The pupa, after breaking through the cocoon, soon works its way upwards out of it about as far as the end of the wing-cases ; there it remains upright, generally either for a few days, after which it further advances completely out of its cocoon and lies on the moss for a few days more until the emergence of the moth or else for the whole period (which varies much in duration) until the disclosure of the moth. Bankes then gives the following details :

Pupa.	Standing upright half out of cocoon.	Entirely out of cocoon.	Imago emerged.	Remarks.
♂	February 28th, 4 p.m		March 10th, *circ.* 1 p.m.	Lifted out of cocoon, March 2nd.
♂	March 10th, 2 p.m.	March 11th, 4 p.m.	March 30th, 10.15 a.m.	
♂	March 10th, 2 p.m.		March 30th, 10.15 a.m.	Never came entirely out of cocoon.
♀	March 11th, 9.30 a.m.		March 31st, 10.30 a.m.	Never came entirely out of cocoon.
♀	March 13th, 10 a.m.	March 19th, 12.30 p.m.	March 25th, *circ.* 12.30 p.m.	
♀	March 13th, 3 p.m.	March 20th, 10 a.m.	March 30th, 11.45 a.m.	
♂	March 21st, 9.45 a.m.	March 24th, 10 a.m.	March 26th, 10.15 a.m.	
♀			March 30th, *circ.* 11 a.m.	Never came even partially out of cocoon.
♀			March 31st, 10 a.m.	,, ,,
♂			March 31st, 10 a.m.	,, ,,
♀			April 1st, *circ.* 11.30 a.m.	,, ,,
♀	March 31st, 10 a.m.		April 3rd, *circ.* 11 a.m.	Never came entirely out of cocoon.
♀			April 6th, 10.45 a.m.	Never came even partially out of cocoon.
♂			April 7th, *ante* 8.30 a.m.	,, ,,
♀	March 31st, 10.30 a.m.	April 5th, 4 p.m.	April 10th, 9.30 a.m.	

We suspect that this failure to emerge rarely happens in nature, at least pupæ that have spun up singly and with an abundance of room, among their foodplant have not been noticed so to fail.

Dehiscence. — No part of the pupal skin is detached on dehiscence; it splits between the meso- and metathorax and between the fore- and hindwings as far as the end of the 3rd abdominal segment, also along the median line of the meso- and metathorax to the face-piece; the fission then continues between the prothorax and the face-piece and between the antenna- and wing-cases for about half the length of the former (Bacot).

Extended duration of pupal stage.—It is a very common thing for this species to pass more than one winter in the pupal stage. Fritsch notes pupæ as frequently going over two winters, and remarks that, in one instance, an 1833 larva produced an imago in 1838, whilst Fenn records (*Ent. Rec.*, ii., p. 90), on the authority of Tester, a pupa going over five years before the emergence of the imago. Tugwell notes 1881 eggs (Rannoch) producing 7 ♂s and 1 ♀ in 1882, and 6 ♂s and 7 ♀s in 1883. Buckler says that of a dozen pupæ, formed in 1881, no imagines appeared in 1882, and only 3 were bred in 1883. (For several other instances see *posteà*, pp. 261 *et seq.*) Adkin observes (*Ent. Rec.*, ii., p. 90) of two different batches in which the greater number of imagines emerged in the second year, that, whilst in one batch, those that lay over until the second year were all males, and all except one that came out the first year were females, in the second batch males alone came out the first year and females the second year. A little judicious forcing at the end of February and early March will bring out almost all the imagines that are ready to emerge, and reduce the percentage of deaths, although it cannot possibly affect any pupæ that are going over to a second year.* The difference in the temperature of a cold greenhouse and a kitchen mantelpiece is often quite sufficient (*vide*, *Ent. Record*, iv., p. 79). Chapman notes as to this: "On January 18th, 1902, pupæ of *D. versicolora* contained fully developed imagines, or were still in the milky stage; the developed imagines were quite ready to emerge, except that they were still bathed in fluid, and the tracheal linings were not fully loosened; breathing might be difficult did this happen till the last moment—at any rate so it was."

Foodplants.—Birch, alder (Reid), *Betula alba*, *Salix caprea* (Lambillion), *Corylus avellana* † (Borkhausen), *Carpinus betulus*, *Tilia europaea* (Ochsenheimer), sallow (Favre).

Parasites.—Frings records (*Soc. Ent.*, xi., p. 171) opening a pupa and finding in it a fully developed ♂, which could not have been dead more than two days, but whose abdomen contained a

* Chapman notes: "In view of my observations on *Lachneis lanestris* (*Ent. Rec.*, xiii., pp. 284, *et seq.*), there is no doubt, I think, that forcing in February and March will bring out those that meant to come out, and which probably began to get ready to do so in October or November, and may save them from dying instead, but will have no effect whatever on those that are going over, since no development has so far taken place in them."

† Borkhausen says (*Rhein. Mag.*, i., p. 327) that as birch and alder do not keep well in water, he has reared this species, and also *Notodonta dromedarius*, *Brephos parthenias*, &c., on *Corylus avellana*, and has been quite successful, even when rearing them from the egg.

very large and active *Tachina* larva, which, therefore, had not hindered the development of the moth.

Habits.—The males are the first to emerge, a few sunny days sufficing to bring them out; the females soon follow, both sexes almost always appearing before or about noon. The females (at least in captivity) "call" at intervals, both during the day and evening; at times they will cease simultaneously, and the restless, impetuous males then immediately settle down as though some mysterious influence had passed over them; on the "calling" being renewed, the males wake up and resume their impetuous career until union is effected, and when a male disappears beneath the shadow of the wing of the much larger females, one knows that one is in a fair way to secure fertilised eggs. Those who are desirous of obtaining perfect specimens bred in confinement should place ♀s, in the act of "calling," on upright stems about the thickness of a quill, and although the removal will momentarily stop the "calling," it will quickly be renewed. The duration of union varies from 6—30 hours; in one case, after a pairing of not more than ten minutes, only the first 5 eggs laid were fertile. In a normal batch, barren eggs generally lie side by side, having followed each other from the ♀, and it would appear that, for the moment, the fertilising fluid had ceased to perform its function, but quickly to have resumed doing so again (Gascoyne). Butler notes (*Ent. Rec.*, xiii., p. 328) that he placed two ♀s on a birch bush, at 3.15 p.m., April 17th, 1901. One commenced to "call" at once, and in 10 minutes a ♂ that came up against the wind was paired with her; the other ♀ did not commence to "call" until 4.50 p.m., when another ♂ came up and paired directly. The ♂s were placed next morning with fresh females and both paired again in less than 15 minutes. The males, when at rest, hold their antennæ half extended in front, almost as do those of *Lasiocampa quercûs*. Emergence usually take place in the morning from 8 a.m., but sometimes much later—1 p.m., etc. Pairing generally takes place in the morning, or early afternoon, and the moths usually continue paired until nearly dusk, when egglaying almost immediately commences. On one occasion a male paired with a female at 2 p.m. (March 31st, 1859), and these did not separate until 7 p.m. on April 1st, the copulation lasting for 29 hours. A male will pair with more than one ♀. On March 24th, 1859, a pairing took place between a ♂ and ♀, and on the next day the same male paired with another female, both laying full batches of fertile eggs. The females appear to begin to "call" about three hours after their emergence from pupa, and quickly pair if a ♂ be available; if none, they continue to "call" until considerably after 4 p.m. if the weather be sufficiently warm. A male that emerged on April 4th, 1859, paired on that date with a female that emerged on March 28th, without hesitation, at about 1 p.m. (Merrifield). Bernard-Smith also observes that the moths often pair more than once with evident advantage to the fertility of the ova. Alderson observes that a ♂ and ♀ he had, paired about 12 noon on March 10th, 1891, remained *in copulâ* till 6 p.m., after which the ♀ laid 120 ova. We have obtained large numbers of pairings at various times, all, however, before 5 p.m., the copulation frequently lasting until 8.30 p.m. or 10 p.m. A moderately high temperature is necessary for pairing to take place, and Tugwell notes that in early March, 1883, a ♂ and ♀ emerged, but hung almost lifeless for three weeks, during which the weather was cold, until March 31st, pairing at once with a change to milder weather. The ♂s assemble readily in suitable weather to a newly-emerged ♀. Thus Draper notes (*Zool.*, p. 6066) 118 specimens being attracted by a single bred ♀ on April 8th, 1858, at Tilgate Forest, whilst some 600 others were taken or seen simultaneously with the above; one suspects that herein lies an explanation of the decadence of the species in Sussex. The males fly swiftly in the morning sunshine in search of the ♀s, and continue on the wing till 3.20 p.m., and will do so without sun if the temperature be suitable, later in the day they may be kicked up from the heather, although one has been found clinging to the needles of a Scotch fir. During the day the females usually hang suspended from birch twigs and are then somewhat conspicuous, but sometimes they are to be found clinging to a sprig of heather, low down, and are then difficult to see. The female flies at dusk for the purpose of oviposition (Clarke). The males fly chiefly in the morning and at midday, when the sun is warmest, *i.e.*, from about 10.30 a.m. to 2 p.m.; after this time they are to be found at rest (Holland). The males appear to commence flying about 10 a.m., the females are sluggish and sit exposed on the twigs of birch, heather, etc. (Image). The males fly best on bright, sunny, and not too windy, days at the beginning of April (Jeffrey). The female sits quietly on the heather in the sunshine whilst the males are on the wing, but one male was found sitting low down in the heather, and another on the bole of a birch tree in Tilgate; the females are rarely found before the males have been out in the same localities for a week or more (Andrews). Horne records a female resting on a juniper bush in the Blackall Wood, Kincardineshire; and Norman the males in great abundance in the Altyre woods in 1868, whilst a ♀ was taken sitting quietly on the bare birch twigs in April. Rühl observes that, in the Zürich district, the male flies wildly by day, the female sits at the foot of beech trunks or on bushes; whilst Nolcken says that the males fly in the afternoon, the ♀s at night, the latter about dwarf birches for the purpose of oviposition. The insect appears to be much more abundant in some years than in others. Peyerimhoff observes it as usually rare in Vendenheim Forest, but abundant in 1865, and Snellen records it as very common in 1888 at Apeldoorn, whilst Hofmann notes the uncertainty of its appearance at Stuttgart—for 10 years, he says, it was sought in vain, and then, in 1860, Hahn found a brood of recently hatched larvæ on a young birch. Bankes says that the species can be inbred for a few years, but that, without the introduction of fresh blood, the moths gradually dwindle in size and become less fertile.

Habitat.—Open woods, plantations, moors, hillsides and seaside sandhills, among small trees of birch and alder in the various Scotch localities (Reid); in Rothiemurchus Forest, on the little birches, the defoliated twigs betraying the presence of the larvæ (Morton); common in the Altyre wood and among the stunted birches on the Culbin sands (Horne); among the alders at Rannoch, but among the young birches at Forres and on the Culbin sandhills

(McArthur); in all the heathy parts of Tilgate and Balcombe forests, where there is a low birch growth to be found (Merrifield); in woods in the Reading district (Holland). On the Hartz mountains it occurs at about 2300 feet elevation, between the Brocken and Schierke (Speyer); distributed in the valleys and on the mountains of Baden as far as Wertheim, but not to be found in the plains (Reutti); in some of the large German forests, in one of which, in the spring of 1890, hundreds of females were found drowned during heavy floods (*Ent. Rec.*, i., p. 58).

Time of appearance.—The imago emerges (according to the season) from the end of March until the commencement of May, April being the usual month, in nature, for its appearance, whilst, rarely, autumnal specimens are reared in confinement. Imagines April and beginning of May, larvæ end of June and July in Pomerania (Hering); March 16th, 1882, near Paris (Dupont); May 15th, 1883, a ♀ in the Anclam district (Homyer); imagines in March and April, in the Valais, everywhere rare in the coppices of the lower region, near Sion, Sierre, etc. (Favre); Nolcken states that, in the Baltic provinces, the imagines appear in most years in the middle of April, but after the cold spring of 1867, he obtained a ♀ as late as May 20th; Fritsch gives dates for the Vienna district from March 26th—May 21st; but Frisch notices (*Soc. Ent.*, xi., pp. 19, 148) the emergence of nine specimens between October 11th—19th, 1894, and Gauckler mentions (*Illus. Woch. für Ent.*, ii., p. 32) the emergence of a fine imago on December 1st, 1896 from a pupa that had passed the winter of 1895-6 in the pupal stage; Alderson records (*Ent. Rec.*, ii., p. 296) the emergence of one on October 6th, 1891*, and Kricheldorff notes several bred about September 12th, 1899 †, whilst Reutti states that occasional October specimens occur in Baden, from pupæ of the preceding year. Such autumnal emergences appear, however, to be very rare. A larva beaten from birch in Darenth Wood, June 6th 1805, spun up July 8th, imago (♂) emerged March 20th, 1806 (Neale, *Tr. Ent. Soc. Lond.*, 1812); a ♀ on alder trunk, April 15th, 1810 (Hatchett *teste* Neale, *loc. cit.*); Stephens notes (*Ill.*, iv., App. p. 385) that on April 8th, 1833, he saw several specimens on the wing at Coombe Wood; April 30th, 1839, resting on iron railings on the bank of the river Monnow at Monmouth (Parry); March 5th, 1846, at Worcester, after being in pupal stage eighteen months (Stevens); April 10th, 1857, many seen at St. Leonard's Forest (Jeffrey); April 16th, 18th, 21st, 1857, April 5th, 8th, 9th, 13th, 19th, 1858, April 4th, 1859, at Tilgate (Image); April, 1857, 6 ♂ s and 3 ♀ s at Tilgate (Price); April 17th—May 12th, 1857, a fine series at Kinloch

* Alderson reared a large number of *D. versicolora* in 1890—in the following spring only about one-half of the pupæ emerged—these were followed by a fine ♀ that emerged on the evening of October 6th, 1891, the pupæ having been kept indoors.

† Kricheldorff records (*Berl. Ent. Zeits.*, xlv., Sitz. p. 39) that he obtained ova of *D. versicolora* from a ♀ from the Carpathians in 1898. The larvæ fed up and in due course pupated, the pupæ being placed in the open for the winter. In March, 1899, the breeding-cage was taken indoors, and all but a dozen produced imagines; the remaining pupæ being alive, the cage was again put out of doors, when, about September 12th, a few of the pupæ produced imagines, the remaining pupæ going over the winter of 1899-1900.

Rannoch (Harding); April 22nd, 1857, at Tilgate (Andrews); Standish notes pupæ (*Ent. Wk. Int.*, iv., p. 154) going over from 1857 until 1859, the summer of 1858 very hot. March 29th, 1858, fine but cool, several seen and caught at Tilgate; March 14th—April 4th, 1859, about 40 imagines taken by Cooke at Tilgate; 17 on April 7th, 1860, attracted by a ♀, observed 6 days earlier by Tester, but not abundant until the 6th; March 6th, 1861, males flying in sunshine, all at Tilgate; bred March 14th—April 4th, 1859, 4 ♂s and many ♀s, the latter sex largely outnumbering the former, 4 of the same lot overwintered again, and emerged March 18th, 30th, April 3rd and 7th, 1860, and a ♂ from pupæ kept out of doors all winter emerged March 3rd, 1861 (Merrifield); April 8th, 1858, 118 ♂s assembled to a bred ♀ at Tilgate (Draper); ♂s April 12th, 1858, at Tilgate (Tugwell); March 20th—30th, 1860, bred at Newark (Gascoyne); March 21st—23rd, 1860, from Tilgate (Machin); 1st week in April, 1861, flew to light between 8 p.m.—9 p.m. at Ashford, Kent (Dowsett, *Ent. Wk. Int.*, x., p. 35); March 19th—22nd, 1865, bred at Torquay (Greene); May 5th, 1867, near Petersfield (Bond); April 13th, 1869, a single ♂ attracted by a ♀ in Tilgate Forest by Tester (T. Briggs); April 10th, 1870, at Altyre Woods (Norman); a fine ♀ at Rannoch, May, 1874 (Carrington); April 13th, 1875, near Ipswich (Last), 40 pupæ in winter of 1879 gave only 20 moths, 17 ♂s and 3 ♀s, which emerged from the beginning of March till April 5th, 1879 (Wailly); eggs commenced to hatch May 31st, 1880, the larvæ from which pupated between July 9th—18th, imagines bred March 19th—25th, 1883, and 1 ♂ January 13th, 1882; ova hatched, 6 on May 18th, 18 on May 19th, 1881, the larvæ from which pupated from July 5th, no imagines bred; ova hatched April 10th, 1884, the larvæ from which pupated June 2nd—15th, imagines bred (1 ♂ and 8 ♀s) April 19th—25th, 1885, and from same batch 12 ♂s April 3rd—20th, 1886; ova received May 8th, 1888, larvæ hatched and all pupated by July 4th, imagines bred March 30th —April 4th, 1889 (2 ♂s only), and March 22nd—April 16th, 1890 (1 ♂ and 5 ♀s); ova hatched May 17th, 1890, larvæ pupated middle of July, imagines bred April 9th, 1892 (R. Adkin); eggs hatched May 24th, 1881, larvæ fullfed second week in June, first moth bred March 6th, 1882 (Bower); 1881 eggs gave larvæ and pupæ that produced 7 ♂s and 1 ♀ in 1882 and another ♂ February 15th, 1883 (in cage out of doors), 2 other ♂s and 1 ♀ in February, and then a cessation till March 31st, 6 ♂s and 7 ♀s appearing altogether by April 17th, 1883 (Tugwell); eggs April 18th, 1882, the earliest imagines from these made their first appearance April 1st, 1883, and March 22nd, 1884 (Sladen); June 1st, larvæ hatched, first moult June 8th, second June 19th—20th, third June 29th, fourth July (th—11th, spun up July 22nd—August 5th, 1883, ♂ emerged March 16th, 1884, another March 22nd, 1884 (St. John); bred February 14th, 1884, from Rannoch eggs (Anderson); ova, 1884, from inbred Rannoch parents, on April 9th, 1885, and following days, 9 ♀s emerged (no ♂s), in April, 1886, 12 ♂s appeared (Hill); bred February 25th, 1890, February 18th, 1891, and week following, from Scotch pupæ, in the open at Kingstown (Kane); April 20th, 18 0, at Glenalmond (Wylie); pupæ from 1890 emerged partly in 1891, but one on February 20th, 1892, others still pupæ in April, 1892 (Blagg); March 3rd, 1891, and following days, after being in pupal stage two years (Kimber); March 10th, 1891, 2 ♂s and 1 ♀ emerged, March 15th, 1891, 1 ♀, and on October 6th, 1891, 1 ♀ in cold attic, on March 9th, 1892, 1 ♂ and 1 ♀ appeared from the 1891 pupæ, on March 7th, 1893, 2 ♀s, on March 8th, 1893, 1 ♀, and March 31st, 1893, 1 ♂, also from 1891 pupæ; April 4th, 1899, 1 ♀ (Alderson); bred in cool conservatory at Winchester, March 13th, 1891 (Hewett); April 23rd, 1891, a ♂ at Burghfield, April 27th, 1891, a ♀ hanging to a birch bush; on April 11th, ♀ from birch bush, April 21st, ♀ on heather twig by Mrs. Bazett, April 24th, 1892, ♂ at rest on heath in afternoon; April 3rd, 4 ♂s taken, April 4th, 3 ♂s, April 5th, 1 ♂ at rest at 10.20 a.m., sun not being well out, April 9th, 1893, 3 ♂s taken (Holland); earliest dates at Reading, April 26th, 1891, April 11th, 1892, common; April 3rd, 1893, April 7th, 1894, April 10th, 1895 (two others April 11th and one on April 12th, 1895), April 6th, 1896, March 19th, 1897 (the last-named bred from larva found when not more than ten days old, on June 13th, 1896), April 8th, 1898, April 3rd, 1899 (Clarke); April, 1892, a male flying in Tilgate in sunshine (Sheldon); imagines bred April 9th, 13th, 1892, March 5th—April 10th, 1893 (an abnormally hot spring), February 28th—April 10th, 1894 (an abnormally warm winter and spring) three already emerged, March 14th, 1895, all reared at Corfe Castle from Morayshire ova; March 24th—April 10th, 1897, from Reading ova (Bankes); February 26th—March 1st, 1893, by forcing (Tutt); 27 pupæ obtained in the autumn, 1893, 19 gave imagines April, 1894, others put by, but one emerged October 11th, 1894, and seven others in the next eight days (Frisch, *Soc. Ent.*, vol. xi., pp. 19, 148); bred January 13th, 1894, at Nottingham (Carlyon); March 6th, 1894 (Freer); April 10th, 1895, at Reading, only 1 ♂ flying, 3 ♀s taken on birch twigs, one of which laid a large batch of eggs, the larvæ from which were in their third stadium by May 13th (Barnes); April 27th, 1895, a ♂ on a birch at Grumazesti (Caradja); imagines commenced to appear March 27th, 1896, from these, larvæ were obtained on June 7th, 1896, which pupated and gave imagines April 3rd, 1897, imagines April 21st, 1898, April 16th-23rd, 1900, at Wyre Forest (Rea); April 6th, 1896, a fine ♀ and two small batches of ova, March 20th, 1897, April 8th, 1898, April 3rd, 1899, April 11th, 1900, April 17th, 1901, all at Reading (Butler); April 18th, 1896, near Reading, ♂ seen and ♀ captured (Nash); larvæ second half of July, 1896, at Rothiemurchus Forest, imagines from these, first half of April, 1897, and others February 13th-26th, 1898, these latter somewhat forced (Morton); bred February 14th, 1897 (Garland); February 6th-17th, 1900, 1 ♂ and 7 ♀s from 10 cocoons (Jenvey).

LOCALITIES.—ABERDEEN: near Banchory and many other localities (Reid), Tarland, not rare (Horne). ARGYLL (Reid). BERKS: Reading (Clarke), Burghfield (Holland). ELGIN: Forres, Culbin Sands, near Elgin (Reid), Altyre Wood (Norman). FORFAR (Reid). GLOUCESTER: Bristol, Lower Guiting, on the Cotswolds (Stainton). HANTS: [Andover (see *Ent.*, xviii., p. 323)], Petersfield (Bond). HEREFORD: Tarrington district (Wood), Leominster (Hutchinson). INVERNESS: Rothiemurchus Forest (Morton). KENT: Darenth (Neale), Ashford (Dowsett). KINCARDINE: Blackall Wood (Horne). [MERIONETH: Festiniog (Hughes, *Ent.*, xv., p. 255).] MONMOUTH: bank of the river, Monnow, at Monmouth (Parry), see also *Ent. Rec.*, v., p. 207, where Clark records three bred from Monmouthshire ova. [? NOTTINGHAM: Nottingham

(Carlyon), Newark (Gascoyne).] PERTH: Rannoch, common on alder trees on hillside above and to the east of Allt Drinthe (Reid), Kinloch Rannoch (Harding), Perth, rare, Glenalmond (Wylie). SHROPSHIRE: Wyre Forest (Rea). SOMERSET: Nightingale Valley, Leigh Woods, the Somerset side of the Avon, Bristol (Vaughan). STAFFS: Burnt Wood, not since 1869 (Woodforde). SUFFOLK: near Ipswich in 1828 (Kerridge), near Ipswich, April 13th, 1875, by T. Last (Bloomfield), Holbrook Park, Bentley formerly (Garrett). SURREY: Haslemere (Barrett), Coombe Wood (Stephens). SUSSEX: Tilgate Forest (Image), St. Leonard's Forest (Jeffrey), Green Trees Forest, opposite Norfolk Arms, Balcombe Forest (Merrifield), Horsham [Brighton (Stainton),] East Grinstead (Thomas). WARWICK: Wyre Forest (Rea). WICKLOW: Deer Park, Powerscourt (Birchall). [? WORCESTER: Worcester (Stevens).]

DISTRIBUTION.—Central and northern Europe, northern Italy, and doubtfully from the Urals (Staudinger). AUSTRO-HUNGARY: Tyrol. not rare (Hinterwaldner), Innsbruck (Weiler), Lavantthal, rare (Höfner), Bohemia in some years common, Upper Carinthia, rare, Salzburg (Nickerl), Gölnitz (Hudák), Hungary—Trencsen, Teplitz (Vángel), Chemnitz (Pabst). Epiries, not rare (Husz), Brünn (Müller), Agram, Freistadt, Iglau, Kremsier, Rosenau (Fritsch). Pressburg (Rozsay). Bukovina (Hormuzaki), Galicia, distributed but local (Garbowski), Neu Sandec (Klemensiewicz), Lemberg, &c. (Nowicki), Stanislawow (Werchratski), Carniola (Speyer), Transylvania (Caradja). Linz dist (Hinsl). BELGIUM: distributed but rare (Donckier), Namur, rare, Liége, common (Lambillion). ? DENMARK (Bang-Haas). FINLAND: distributed to 66° N. lat. (Reuter). FRANCE: throughout the country, but nowhere common (Berce), dept. du Nord, rather rare—Raismes, Forêt du Clair, Marais, Arques (Paux). Aube (Jourdheuille). Douai (Foucart). Auvergne—Indre, Cher Loiret (Sand), Bordeaux, &c. (Brown), Eure-et-Loir, very rare (Guénée), Puy de Dôme (Guillemot), depts. Meuse, Moselle, Meurthe (Speyer), Gironde—once at Pessac (Trimoulet), Doubs, very rare—valley of Loué, Châtillon-sur-Lison (Bruand), Saone-et-Loire, rather rare (Constant), Loire-Inférieure (Bonjour), Seine-Inférieure—Forêt Verte, rather rare (Viret), Sèvres near Paris (Dupont). GERMANY: generally distributed (Heinemann), south-west Germany, distributed (Koch), north-west Germany, generally distributed (Jordan), Rhine Palatinate, rare (Bertram), Giessen (Dickore), Lower Elbe (Zimmermann), Waldeck—Arolsen, Korbach, rare, Oberharz—at 2300 ft. between Brocken and Schierke (Speyer), Thuringia—Gotha, Siebleber Wood, Suhl, Hirzberg, Georgenthal (Knapp), Pomerania, everywhere but not common—Misdroy, Stepenitz, Carolinenhorst, Tantow, Garz (Hering), Mangfall dist. (Gumppenberg), Silesia, not rare—Leubusch (Prittwitz), Lübeck, very scarce (Paul), Anclam (Homeyer), Erfurt (Keferstein), Halle—Dolau (Stange), Munich, very rare (Kranz), Rudolstadt—extremely rare (Meurer), Hildesheim (Grote), Mecklenburg—generally distributed, but rare (Schmidt), Bremen, rare and local (Rehberg), Saxon Upper Lusatia, distributed and not rare (Schutze), Upper Lusatia, distributed but not common (Moeschler), Dresden (Steinert), Prussia, rather rare—Dantzig, Königsberg, etc. (Schmidt), Rastenburg (Klups), Nassau, not common (Rössler) Würtemberg, distributed, often not rare (Hofmann), Ratisbon (Schmid), Dessau (Richter), Alsace, rare, but abundant in 1865 in the Vendenheim Forest (Peyerimhoff), Wernigerode (Fischer), Brunswick, sparingly—Helmstadt, &c. (Heinemann), Hanover, rare (Glitz), Frankfort-on-Oder (Kretschmer), Baden, distributed, in the mts. nr. Wertheim, Bavarian Palatinate, &c. (Reutti). ITALY: northern valleys of Piedmont, rare—Bergamasco (Curò). NETHERLANDS: the eastern provinces—Gelderland, Limburg, Utrecht, &c., very rare, larvæ abundant, 1888, at Apeldoorn, also at Enschedein, Overijssel (Snellen), N. Brabant—Breda, very rare (Heylaerts). ROUMANIA: Grumazesti, Slanic (Caradja). RUSSIA: eastern Russia (Caradja), St. Petersburg (Erschoff), Volga dist., rare—Kasan (Eversmann), Moscow dist (Albrecht), Baltic Provinces (Sintenis), Lechts, Pichtendahl, Schleck, Pussen, Kirchholm, Kokenhusen, Wolmar (Nolcken). SCANDINAVIA: not common, but distributed over Sweden, Norway and Finland to 66° N. lat. (Reuter), Norway—Christiania, Aas, Drommon, Naes Vaerk, Espeland (Siebke), Scania—Norrbotten, Lule Lappmark, central and southern Norway (Lampa), Lapland-Tornensis, Lapland-Bothnia (Zetterstedt). SWITZERLAND: not in the south-west of the country (Frey), Grisons—Chur (Killias), Ragaz (Eisenring), St. Gallen, Toggenburg (Täschler), Glarus, nr. Mollis (Heer), Winterthur (Frey), Thurgau—Dusnang (Eugster), Aargau, the Bünzener turfmoor nr. Bremgarten (Boll), Eigenthal, to 3212′, on Pilatus (Wullschlegel), Berne (Meisner), Gadmen (Letzterer), Basle (Riggenbach-Stehlin), Zürich dist.—on the Uto and Zürichberg (Rühl), Valais rare throughout—Sion, Sierre, &c. (Favre and Wullschlegel).

Superfamily VIII: ATTACIDES*.

Possibly no group of lepidoptera of similar extent has received more attention than, or has been so generally studied as, this, yet the authorities are at present entirely at variance as to the limits of the families and their relationship to each other, whilst the origin of the superfamily and its relationship to other superfamilies, although generally agreed upon, are far from satisfactorily determined when one considers matters of detail. Great differences exist between the main families into which the Attacids are divided in the egg, larval, pupal and imaginal stages, these differences being largely due to specialisation in various directions, and are particularly marked in the larval and imaginal stages. In the larvæ one can readily mistake secondary developments for primary structural characteristics, and thus be easily misled as to real relationships. Packard observes (*Proc. Amer. Acad. Arts and Sciences*, 1893, p. 58) that the tubercles of the fullgrown larva of *Saturnia* (*pavonia*, *pyri*, &c.) are on the same plane of development as are those of the embryo, just before exclusion from the egg, of the more highly specialised *Attacinae* (*Callosamia*, &c.), and that the fullgrown larva of one of the most generalised of the *Attacinae* (*Platysamia*, &c.) is only on the same plane of specialisation as the larva of *Callosamia* in its third instar. Dyar, referring to the same fact, says (*Trans. N.Y. Acad. Sci.*, 1894, pp. 54—55) that, "in a section [*Saturniidae* (=*Attacidae*)] of this group, the primitive first larval stage is wanting, the larvæ hatching in an advanced degree of specialisation. In the more generalised forms, the tubercles have only a single seta, the base usually prolonged into a stiff (often branched) chitinous rod, absent in the case of tubercles ii, and but a single rod bears iv and v. Dorsally, on the 8th abdominal segment, the two tubercles i are usually consolidated, and sometimes also on the 9th abdominal segment; or, the tubercles may be enlarged and bear a crown of hairs, or become developed into a bunch of spines." From an examination of the newly-hatched Attacid larva, Dyar thinks that the single process or wart below the spiracle (mentioned above as "a single rod") is derived from tubercles iv and v consolidated and not from v alone. Wailly's notes (*Ent.*, xxix., p. 354) are not only suggestive as showing other remarkable larval specialisations, but hint distinctly that many so-called African Attacids may not belong to this family (*Attacidae*) at all. He describes the larva of a species allied to *Saturnia suruka* as "a false Geometer, beautifully black, ornamented on its segments with thorny projections, yellow on the last eight segments and pink on the first. The body is covered with spots of the same colour as the tubercles. The spiracles are black, bordered with yellow; the claspers of a fine shining black." It is difficult to know how an Attacid larva (*sens. strict.*) can be "a false Geometer," but Wailly goes on to state that other South African species, placed by systematists in the genera *Antheraea*, *Gynanisa* and *Bunaea*, have very different habits from typical Attacids. Thus the larvæ of the three

* The oldest plural name, applicable to the group, appears to be Linné's *Attaci*, which was given in 1767, and it, therefore, seems to us necessary to call the superfamily ATTACIDES. We understand that Grote concurs with this although he has in his recent writings used the superfamily name SATURNIIDES (*Die Saturniiden*, p. 24).

species known as *Antheraea menippe*, *A. tyrrhea*, and *A. cytheraea (dione)* do not form an ordinary *Antheraea*-like cocoon, but "burrow into the ground without forming any cocoon or shell of any sort," whilst "the bare pupæ of these species resemble each other so much that it is difficult to distinguish them from one another." Similarly the larvæ of *Gynanisa* or '*Saturnia*' *isis* and *Bunaea caffraria* also "burrow into the ground without forming any cocoon."

The early authors really knew nothing of the relationships of the Attacids until Hübner worked out his scheme of classification about 1822 in the *Verzeichniss*. Linné, in the *Systema Naturae*, 10th ed., pp. 495—497, included them in his *Phalaenae-Bombyces*, but in the 12th ed., pp. 808 *et seq.*, separated them from these, and called them *Phalaenae-Attaci*, whilst, with the exception of the separation of *spini*, *pyri*, *carpini* (*pavonia-minor*) and *tau* under the name *Saturnia*, by Schrank, in 1802, and the grouping of these species into two sections by Hübner in the *Tentamen* in 1806—*Heraeae* for *Heraea carpini* and *Echidnae* for *Echidna tau*—there really was no attempt to classify the heterogeneous material according to the relationship of the species until Hübner's classification was given us in the *Verz.*, pp. 143 *et seq.* So important was this, that most of Hübner's names stand to-day. His grouping is as follows:

Phalanx III: PHALÆNÆ (PHALÆNÆ-ATTACI et BOMBYCI, Linn., BOMBYCI, COSSI et HEPIALI, Fab.).
Tribus I: SPHINGOIDES.
Stirps 5: ECHIDNÆ.
Fam. 1: CAUDATÆ—
- *a.* Coitus: *Dysdaemoniae—Dysdaemonia boreas*, Cram.
- *b.* Coitus: *Eudaemoniae—Eudaemonia semiramis*, Cram., *E. uroarge*, Hb. (*argus*, Stoll).
- *c.* Coitus: *Tropaeae—Tropaea luna*, Linn., *T. selene*, Hb. (*luna*, Cram.).

Fam. 2: LUNATÆ—
- *a.* Coitus: *Antheraeae—Antheraea mylitta*, Dru., *A. paphia*, Linn., *A. jana*, Cram.
- *b.* Coitus: *Agliae—Aglia tau*, Linn., *A. cytherea*, Fab., *A. tirrhaea*, Cram.

Fam. 3: COMMUNIFORMES—
- *a.* Coitus: *Dirphyae—Dirphia tarquinia*, Hb. (*tarquinius*, Cram.), *D. acidalia*, Hb. (*tarquinia*, Cram.), *D. speciosa*, Cram., *D. agis*, Cram.
- *b.* Coitus: *Citheroniae—Citheronia regis*, Abb. (*regalis*, Fab.), *C. anassa*, Hb. (*laocoon*, Cram.), *C. phoronca*, Cram.).
- *c.* Coitus: *Eaclae—Eacles imperatoria*, Abb. (*imperialis*, Stoll), *E. penelope*, Cram., *E. acheloë*, Hb. (*achelous*, Cram.), *E. cynira*, Cram., *E. eulalia*, Stoll.

Fam. 4: RECONDENTES—
- *a.* Coitus: *Imbrasiae—Imbrasia epimethea*, Cram.
- *b.* Coitus: *Bunaeae—Bunaea caffra*, Hb. (*caffraria*, Stoll), *B. alcinoe*, Cram.).
- *c.* Coitus: *Teleae—Telea polyphema*, Hb. (*polyphemus*, Cram.).
- *d.* Coitus: *Automeres—Automeris janus*, Cram., *A. armidis*, Cram., *A. salmonea*, Cram., *A. liberia*, Cram., *A. irene*, Cram., *A. jucunda*, Cram., *A. egeas*, Cram., *A. meta*, Cram., *A. arminia*, Cram.
- *e.* Coitus: *Gameliae—Gamelia abasia*, Cram., *G. abas*, Cram., *G. irmina*, Cram.
- *f.* Coitus: *Hyperchiriae—Hyperchiria nausica*, Cram., *H. io*, Cram.

Fam. 5: SPECULARES—
- *a.* Coitus: *Attaci—Attacus atlas*, Linn., *A. talas*, Hb. (*atlas*, Cram.), *A. aurota*, Cram., *A. hesperus*, Linn.

b. Coitus: *Samiae—Samia cynthia*, Cram., *S. cecropia*, Cram., *S. promethea*, Cram.

c. Coitus: *Rhescyntes — Rhescyntis erythrinae*, Fab., *R. cassandra*, Cram., *R. sylla*, Cram., *R. hippodamia*, Cram.

Tribus II: VERÆ.

Stirps I: HERÆÆ.

Fam. I: SPECIOSÆ.

a. Coitus: *Pavoniae—Pavonia pyri*, Schiff., *P. spini*, Schiff., *P. carpini*, Schiff.

b. Coitus: *Henioche* [sic]—*Heniocha appollonia*, Cram.

Fam. 2: DILUCIDÆ.

a. Coitus: *Saturniae — Saturnia maja*, Dru. (*proserpina*, Fabr.).

b. Coitus: *Pharathyrides* [sic]—*Pharathyris* [sic] *perspicilla*, Stoll, *P. cedonulli*, Cram., *P. pandiona*, Cram.

It may be here noted that in Tribe ii, the stirpes ii, iii and iv comprise the *Lymantriides*, v the *Melalophae*, vi the *Lithosiae*, vii the *Hipocritae*, viii the *Callimorphae*, ix the *Hypercompae*, x the *Lachneides*, xi the *Eutrichae*, xii the *Trichodae*, xiii the *Heteromorphae*.

We have already stated (*antea*, vol. I., p. 126) our inability to agree with Packard's views of the evolution of the Attacids from the *Citheroniidae* (*Ceratocampidae*) through the Notodonts and Syntomids. Both these last-named superfamilies belong to the upright-egged stirps, the former in close connection with the Noctuids, the latter with the Arctiids. With the near relationship of the Lachneids, Dimorphids, Bombycids (*sens. strict.*), Citheroniids, Attacids, Hemileucids and Sphingids, which he places on the same main evolutionary stem we are of course in accord*. Later he restates his adherence to the alliances to which we take objection, and hazards (*Proc. Amer. Phil. Soc.*, xxxi., p. 141) the suggestion that all the Bombycids except the Arctians and Lithosians (which are not Bombycids in the sense that the latter are considered in this work) may have evolved before the *Sphingidae* appeared, and goes on to say that, judging by the characters of the head, antennæ, thorax, and especially of the neuration, the *Sphingidae* are far removed from the *Citheroniidae* (*Ceratocampidae*) and their origin from the latter must have been at least remote, whilst there must be some lost annectant forms which originally connected them.

Comstock places the Lacosomids among the *Saturniina*, but Dyar points out (*Ann. N. Y. Acad. Sci.*, viii., p. 202) that the former belong to the generalised Frenatæ, and adds that he believes the resemblance of the imagines in the two groups to be fortuitous, the result of convergence and not indicating close relationship; that the Lacosomid larvæ are generalised, and the imagines specialised. Later, however, Dyar notes (*Trans. N. Y. Acad. Sci.*, xiv., p. 51) that

* Of the general relationship of the Lachneids, Dimorphids, Attacids, Bombycids and Sphingids, Chapman writes that this group has (at least) three branches: (1) The *Lasiocampa* and *Eupterotida*; (2) *Endromidae* (*Dimorphidae*), possibly passing by *Aglia* to (*a*) the *Citheroniidae* and *Sphingidae*, (*b*) the *Bombycidae* and *Saturniidae*. He explains that his observations on the species of the Cochlidids, *Eacles* and other species of Attacids, and Sphingids, together with the published observations of Packard, Poulton, Weismann, and others, leave no room for doubt that these families are related to the exclusion of the Geometrid stirps. . . . He observes that some Lachneid pupæ can travel to and fro in their cocoons, whilst the Dimorphids and Sphingids actually present instances of pupal emergence from the cocoons (*Trans. Ent. Soc. London*, 1896, p. 584).

the structure of the subspiracular wart, by consolidation of iv and v, would make the Saturniids (=Attacids) one of the specialised superfamilies in the same line of descent as the generalised Lacosomids. His action, however, in placing (*loc. cit.*, pp. 53—54) the latter in his heterogeneous *Cossina*, and his statement that they cannot be properly classed with the *Saturniina* on larval characters, though the difference is not fundamental, leaves us in great doubt as to his real opinion. He adds : "In the *Saturniina* the unpaired dorsal tubercle is not an invariable character, in one section it is absent on the 9th abdominal, and in one genus (*Anisota*) on the 8th, so that it is not difficult to imagine the *Lacosomidae* to represent the most generalised condition of the *Saturniina* in which the consolidation of tubercle i has not taken place on either segment." With regard to the larval specialisation of Attacids and Sphingids, Dyar offers further remarks ("Class. Lep. Larvæ," *Ann. N. York Acad. Sci.*, viii., pp. 200—201), but they are too general to be of much service here. Nothing, however, that this author has written, lays itself out for criticism more than does his attachment of the Notodonts and Lymantriids to the Lachneid branch of his phylogenetic tree (*Proc. Bost. Soc. Nat. Hist.*, xxvii., p. 146, and *Journal N. Y. Ent. Soc.*, iv., pl. iii). Here he combines the Notodonts, Eupterotids, Lymantriids, Lemoniids and Lachneids in one evolutionary stem. The synopsis which he here gives of the characters for the separation of the Attacids and Sphingids appears, however, to be sound enough. This reads :

Subprimary setæ absent or all greatly obscured after the first moult by secondary characters :

1. Tubercles iv and v united, all the setæ borne on prolonged tubercles subject to various modifications. Usually an unpaired tubercle on the 8th or 9th abdominal segment	SATURNIIDES (ATTACIDES).
2. Tubercles iv and v remote, v higher than iv, obscured after first moult. An unpaired process bearing tubercles i on the 8th abdominal segment	SPHINGIDES.

Packard gives (*Proc. Amer. Phil. Soc.*, xxxi., pp. 139—192) an interesting account of the *Citheroniidae* (*Ceratocampidae*), supposed by some lepidopterists to be the connecting group between the Attacids and Sphingids. He considers the group to be well circumscribed, and the most generalised forms to be *Dryocampa* and *Anisota*, whilst *Sphingicampa* may be regarded as transitional, connecting *Dryocampa* and *Anisota* with *Eacles* and *Citheronia*. His note that the larvæ of *Aglia (tau)* and *Eacles* (*imperialis*) in their third stadia resemble each other very closely is interesting, still more so, that *Aglia*, at its last ecdysis, passes (so far as the larval appearance is concerned) from one family to another, and that "the ontogenetic development of this larva epitomises that of two families, whereas that of most Bombyces is simply usually only an epitome of that of a subdivision of a family, or of a small group of genera." Packard, after further discussion, suggests that *Aglia* should be regarded as the type of a distinct subfamily of *Ceratocampidae* (= *Citheroniidae*), and that the latter family might thus be divided into the two subfamilies, *Ceratocampinae* and *Agliinae* ; whilst from their larval and imaginal characters, and in their mode of spinning a cocoon, he is disposed to consider the *Hemileucidae* as a family closely allied to, though distinct from, the *Citheroniidae* (*Ceratocampidae*). Later he makes (*Bombycine Moths of America*, p. 39) *Aglia* a connecting link between the true Citheroniids and Attacids, and points out that, as Duponchel and Poulton have shown, the larva wholly discards the congenital characters exhibited in its spinous armature (Citheroniid) at its last moult, and assumes an entirely different shape, being destitute of spines, and taking on the general appearance of an Attacid larva. Side by side with this change in appearance, Packard notes a difference in habit, the larva now feeding passively on its foodplant, and depending upon its colour to escape its enemies, and, if discovered, utilising the *Sphinx*-like attitude and its large terrifying eye-spot to frighten away any aggressor.

Smith followed Packard in separating the *Hemileucidae* as a distinct family from *Citheroniidae* (*Ceratocampidae*) and *Attacidae* (*Saturniidae*), but Dyar (*Trans. N. Y. Acad. Sci.*, xiv., p. 55) criticised this conclusion, stating that the characters on which the Hemileucids and Attacids (Saturniids) were separated by Smith, *viz.*, that the antennæ of the latter were doubly bipectinate in the ♂, and those of the former singly so, was not sound, "many genera presenting a most interesting gradation in this respect, the females being generally behind the males in degree of specialisation," and he further suggests that it is clearly an arbitrary division to draw the line between these families on this character alone, without further evidence that this separation really corresponds to a dichotomous division in the line of descent. He points out that if the ♀ sex had been chosen instead of the ♂, the division would have corresponded with one based on larval characters and the families could then be described:

1. HEMILEUCIDÆ: Antennæ of ♀ moth singly bipectinated, of ♂ either singly or doubly so. Larvæ with primitive first stage, a dorsal tubercle on 9th abdominal segment and none on anal plate; tubercle shafts densely covered with sharp defensive spines.

2. SATURNIIDÆ *: Antennæ of both sexes doubly bipectinated. Larvæ lacking the primitive first stage; no dorsal tubercle on 9th abdominal segment, but a pair on the anal plate; tubercle shafts, short or smooth, with few weak spines or hairs.

Bodine, on antennal characters, shows (*Antennae*, etc., p. 42) that the *Bombycidae* are not a constituent part of the superfamily *Saturniina* (as the superfamily *Attacides* has been called by some American authors). He places the *Attacidae (Saturniidae)* near the *Citheroniidae (Ceratocampidae)* and finds both rather distinct from the *Hemileucidae.* His grouping is as follows:

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* In the European *Aglia tau*, the larva possesses all the characters of the *Saturniidae* (*Attacidae*), but differs in the great inequality in development of the tubercles. Their final disappearance in the last stage is less distinctive (compare the American *Samia ceanothi*). In the imago the male antennæ are doubly bipectinated, the ♀ are serrate (singly). This combination of characters probably entitles the genus to family rank. Packard places (*Proc. Am. Phil. Soc.*, xxxi., p. 140) it as a subfamily of the *Ceratocampidae* (= *Citheroniidae*); but this is negatived by the arrangement of the larval tubercles (though favoured by their unequal development) and by the structure of the antennæ of the moth (Dyar). Packard says (*loc. cit.*, p. 139): "*Aglia* appears to be a Ceratocampid in its earlier larval stages, the caterpillar in its final stage, however, and the moth being very near to the Saturnians." Grote considers (*Can. Ent.*, 1895, p. 283) that this quite excludes *Aglia* from the *Citheroniidae*, and states that it may be entitled to family rank. Dyar further notes that, in *Anisota*, i and ii are both present, i unconsolidated; although earlier, he had erroneously stated i to be absent (*Ann. N.Y. Acad. Sci.*, viii., p. 232).

A. Pectinations ventral, single pair to each segment .. BOMBYCIDÆ.
AA. Pectinations dorsal
B. Single pair to a segment .. .. HEMILEUCIDÆ.
BB. Two pairs to a segment
C. Distal portion of clavola filiform .. .. CITHERONIIDÆ.
CC. Clavola pectinate throughout .. .. SATURNIIDÆ.

He notes (*loc. cit.*): "The *Hemileucidae* exhibit a line of development distinct from that of the *Bombycidae* on the one hand, in having the pectinations dorsal instead of ventral, and from the *Citheroniidae* and *Saturniidae* on the other, in having a single pair of pectinations to a segment. Thus it appears that the Hemileucids belonged to the branch which produced the Citheroniids and Saturniids after it had separated from the branch giving rise to the *Bombycidae*. The *Citheroniidae* and the *Saturniidae* have followed the same line of development in that they both have two pairs of dorsal pectinations to a segment. The first family has not progressed so far as the second; its members do not have their antennæ pectinate throughout. The antennæ of these families show a high degree of development also in the arrangement of the hairs of the third type. The spaces between the pectinations are nearly filled with long, interlacing hairs, which are regularly arranged in a distinct line of from two to three rows extending continuously from the apex of one pectination along the dorso-lateral surface of the segment to the apex of the other pectination of the same side.* Still another feature showing remarkable development of sense-organs is exhibited in the higher forms, especially in *Tropaea* and *Samia* of the *Saturniidae*. This is the multiplication of cones. While in nearly all other moths cones are limited to one or at most two to a segment, we here find them literally heaped up on the ventro-distal edge of the segments of the distal portion of the antennæ; and on the pectinations also there are often several either at the apex or along the pectinations at various intervals. Fig. 7 shows this condition in the antenna of *Tropaea luna*." A number of African forms and some others, that appear to be very close to typical Attacids, differ, nevertheless, in having antennæ with single pectinations. *Eudaemonia* seems exceedingly close to *Actias*, yet it has but a single pair of pectinations to a segment, and there are many similar parallels. It follows that a second pair of pectinations can be lost *per saltum*, and frequently is so lost, and that some conditions, especially African ones, promote this tendency, or, taken in conjunction with remarks already made (*antea*, pp. 265—267) about the forms of larvæ and methods of pupation in African species, it is by no means impossible that an Attacid stirps, beginning as low down as the *Hemileucidae*, and, failing to develop the second pair of pectinations, did, nevertheless, undergo an evolution, very parallel, not generally merely, but in considerable detail, with the ordinary Attacids. Such an occasion would not be out of accordance with what is found in many other portions of the biological field (Chapman).

As a more satisfactory subdivision, based on larval characters alone, Dyar gives the following tabulation:

A single dorsal tubercle on 9th abdominal segment
A pair of tubercles on anal plate .. .. .. CITHERONIIDÆ.
No tubercles on anal plate .. .. HEMILEUCIDÆ.

*Bodine's fig. 54 represents the arrangement in *Dryocampa rubicunda*.

No single tubercle on 9th abdominal segment
- Tubercles prominent .. .. SATURNIIDÆ.
- Tubercles very unequally developed, later aborted .. AGLIIDÆ.
- Tubercles greatly reduced .. .. BOMBYCIDÆ.

Grote discusses (*Can. Ent.*, 1895, pp. 263—271) the classification of the American Attacids, with the following results:

I. Fam. SATURNIIDÆ. Group 1—*Attacus*, L., *Philosamia*, Grt., *Callosamia*, Pack. Group 2—*Samia*, Hb., *Saturnia*, Sch., *Agapema*, Neum. and Dyar. Group 3—*Actias*, Lch., *Telea*, Hb.

II. Fam. HEMILEUCIDÆ.—*Automeris*, Hb., *Thauma*, Hy.-Edw., *Coloradia*, Blake, *Argyrauges*, Grt., *Hemileuca*, Walk., *Pseudohazis*, Grt. and Rob.

III. Fam. CITHERONIIDÆ.—*Eacles*, Hb., *Citheronia*, Hb., *Sphingicampa*, Walsh, *Anisota*, Hb.

Later, however, basing his results on the neuration of the imagines, Grote gave (*Die Saturniiden*, pp. 2—5) the following comprehensive table of families, subfamilies and genera:

Radius of forewing with 3—4 branches—III_1, III_{2+3}, III_{4+5}, or III_1, III_2, III_3, III_{4+5} .. .. .. SATURNIIDES.

I. Nervure $IV_1 + IV_2$ of forewings forked .. .. .. SATURNIIDÆ.

A. Hindwings with only one inner marginal nervure. Nervure III_1 of forewings rises out of III_2 above and outside the discoidal cell (in *Attacus* it arises out of the radius).

1. Discoidal cell open .. .. ATTACINÆ.
   - Cocoons attached to branch by a stalk
     - Abdomen furnished with small tufts .. .. *Philosamia.*
     - Abdomen not furnished with small tufts
       - Central spots transparent .. .. .. *Attacus.*
       - Central spots opaque .. .. *Callosamia.*
   - Cocoons directly attached without stalks .. .. *Samia.*
2. Discoidal cell closed .. .. SATURNIINÆ.
   - Joints of the antennæ of the ♀ provided with double teeth of equal length .. .. *Agapema.*
   - Joints of the antennæ of the ♀ with double teeth of unequal length
     - Central spots opaque
       - Thorax clothed with soft wool .. .. *Saturnia.*
       - Covering of thorax mixed with longish flat hairs ("platte Haaren") .. *Polythysana.*
     - Central spots transparent
       - Hindwings rounded .. .. .. *Antheraea.*
       - Hindwings with produced angles .. *Telea.*
       - Hindwings tailed
   - Joints of the antennæ of the ♀ with teeth of normal length, tails narrow .. .. *Actias.*
   - Joints of the antennæ of the ♀ shortly toothed, tails broad .. .. *Graëllsia.*
   - Joints of the antennæ of the ♀ bear a single tooth
     - Forewings with the apices rounded .. .. *Perisomena.*
     - Forewings with the apices acutely falcate .. *Cricula.*

B. Hindwings with two hind-marginal nervures .. .. .. HEMILEUCINÆ.
- Wing margins entire
  - Antennæ of the male with double teeth .. *Coloradia.*
  - Antennæ of the male with a single tooth
    - Antennæ yellowish .. .. *Argyrauges.*
    - Antennæ blackish
- Body rough-haired, anus of the male with a mixture of red hairs .. .. *Hemileuca.*
  - Without this distinction .. .. *Pseudohazis.*
- Wings dentate and sinuate
  - Body stout, hindwings bluntly tailed . .. *Dysdaemonia.*
  - Body slender, hindwings rounded .. .. { *Draconipteris.* / *Teratopteris.* }

II. Nervure IV_1 and IV_2 not forked but separate .. AGLIIDÆ.

A. Hindwings with only one inner marginal nervure. Antennæ of male pectinated to the tip	
1. Nervure III_1 arises from the upper corner of the discoidal cell ..	AGLIINÆ.
Wings broader, the apices of forewings rounded ..	*Loepa.*
Wings narrower, the apices of forewings acute	
Central spots transparent	*Salassa.*
Central spots opaque	*Aglia.*
2. Nervure III_1 arises above the radius	AUTOMERINÆ.
Forewings falcate	*Gamelia.*
Forewings with outer margin entire	
Hindwings above marked with large ocellated spots ..	*Automeris.*
Ocellated spots imperfect	*Mollipe.*
Hindwings without ocellated spots. Upper row of pectinations of antennæ of the male more than half as long as the lower row. Nervure III_1 and IV_2 of hindwings forked	
Nervure IV_2 of upper wings arises from the middle of the closed discoidal cell	*Ormiscodes.*
Nervure IV_2 arises near the upper corner of the closed discoidal cell	*Thauma.*
Nervure III and IV_1 of hindwings separate ..	*Plateia.*
Smaller species with falcate forewings	*Hylesia.*
Upper row of pectinations of antennæ of male less than half as long as lower row	*Eudyaria.*
Antennæ of male with a single row of teeth ..	*Dirphia.*
B. Hindwings have two inner marginal nervures. Antennæ of male pectinated for two-thirds of length only	
3. Nervure III_1 arises from the upper corner of discoidal cell or immediately beyond	CITHERONIINÆ.
Nervure III_1 arises beyond the end of cell	
Outer margin of forewings longer than inner margin	*Anisota.*
Outer margin of forewings shorter than inner margin	
Medium-sized species; The sexes similar ..	*Adelocephala.* *Sphingicampa.*
The sexes dissimilar ..	*Syssphinx.*
Nervure III_1 arises from upper corner of discoidal cell	
Large species: The abdomen scarcely longer than hindwings	*Eacles.*
The abdomen exceeds the hindwings	*Citheronia.*

Dyar criticises (*Ent. Rec.*, x., pp. 36—37) Grote's arrangement, and offers the following (based on larval characters) as a more natural grouping (compare *antea*, pp. 270—271):

I. A single dorsal tubercle on 9th abdominal segment, the primitive first stage present:	
1. Anal plate tubercular; tubercles unarmed ..	*Citheronia.*
2. Anal plate smooth; tubercles covered with modified urticating setæ—	
a. Tubercle i with long shaft	*Automeris.*
b. Tubercle i with short shaft	*Hemileuca.*
II. No single dorsal tubercle on 9th abdominal segment, anal plate tubercular:	
1. Primitive first stage present*, spines unequal; mature tubercles atrophied	*Aglia.*
2. No primitive first stage, spines subequal—	
a. A dorsal tubercle on 8th segment	*Attacus.*
b. No unpaired dorsal tubercle	*Saturnia.*

Dyar objects (*loc. cit.*) to Grote's division of the Attacids into two groups on a single neurational character—the degree of approach that IV_2 has made to the apex of cell, and points out that the variation in the position of the nervure does not lend itself to the establishment of a dichotomous division. On the other hand, if the number of anal nervures in the hindwing be taken as a basis—

* We are not quite sure what Dyar means by "primitive first stage" in *Aglia*. Poulton's figures 1 and 3 (*Trans. Ent. Soc. London*, 1888, pl. xvii) appear to us to show an exceedingly specialised first stage.

(1) *Citheronia* and *Hemileuca* (with two such nervures) fall together, (2) *Automeris*, *Aglia*, *Saturnia* and *Attacus* (with one). By a combination of the neurational characters exhibited by the fore- and hindwings, one gets:

Group 1 (generalised)—(*a*) *Citheronia*, *Hemileuca*, with two anal nervures. (*b*) *Automeris*, with only one, but with IV_2 of forewing stationary.

Group 2 (specialised)—*Aglia*, *Saturnia*, *Attacus*, with one anal nervure. [*Aglia* is to be considered the lowest, as nervure IV_2 is less intimately related to IV_1 than in *Saturnia*.]

This Dyar states agrees with the classification on larval characters (*suprà*), and asserts that the neurational characters broadly interpreted confirm the larval ones. Grote, however, maintains (*Ent. Rec.*, x., pp. 145—146) his views, and considers *Aglia* to be a specialised Automerid, and *Hemileuca* a generalised Saturnian, explaining the similarity of nervure VIII in *Hemileuca* and *Citheronia* as a matter of convergence, and asserts that all the other imaginal characters contradict the bringing of *Hemileuca* and *Citheronia* into one group. He further states that the female antennæ in *Aglia* are Citheronian and Automerid in character, whilst those of *Hemileuca* are of the Saturnian type. [See also Grote's paper on the subject (*Proc. South Lond. Ent. Society*, 1897, pp. 82—85)]. Grote further states (*in litt.*) that the subfamilies indicated by him could, at least in part, be regarded as families, when his classification would read as follows:

Fam. I: ATTACIDÆ.
  Subfam. 1: *Attacinae*.
  Subfam. 2: *Saturniinae*.
Fam. II: HEMILEUCIDÆ.
Fam. III: AUTOMERIDÆ.
  Subfam. 1: *Agliinae*.
  Subfam. 2: *Citheroniinae*.

A complete study of all the early stages of the Attacid (*sens. lat.*) species can alone eliminate all the disturbing elements arising from convergence, and give us a satisfactory classification based on true ancestral characters. As a contribution to this end, Packard discusses (*Bombycine Moths of America*, pp. 40—43) the salient ontogenetic features of several Attacid species, separating what are most probably congenital from later adaptational characters, and thus distinguishing between ancestral characters denoting relationships and superficial specialisations developed to meet individual needs. Packard has selected the larvæ of *Platysamia* (*cecropia*), *Callosamia* (*promethea*), *Telea* (*polyphemus*) and *Actias* (*luna*) as typical genera for treatment. After noticing the great contrasts between the first and later larval instars, both in armature and coloration, he gives the following summary of what he considers the salient ontogenetic features:

PLATYSAMIA (CECROPIA).—A. *Congenital characters*: (1) The setæ in stage 1 blunt, slightly bulbous and glandular. (2) The tubercles all of the same size. (3) Body in stage 1 dark, almost blackish-green, head jet-black, tubercles yellowish-green. (4) The homologue of the caudal horn shows plainly its double origin. (5) The differences between the colours of the larva in the first and last stages very marked. B. *Evolution of later adaptational characters*: (1) The thoracic dorsal tubercles in stage 2 and onwards are larger than the abdominal ones. (2) Five rows of indistinct spots along the body in stage 2 (not so distinct as in *S. cynthia*, the body being still dusky-green), not originating from lines. At the end of stage 2 the larva is more like that of *S. cynthia* of the same age, the body being more yellow and the black spots more distinct. The spots disappear at the end of stage 4. (3) The thoracic dorsal tubercles deep orange, their homologues on the abdominal segments amber-yellow. (4) The tubercles at the end of stage 2 and in stage 3 spotted with black. (5) In stage 3 the dorsal tubercles of meso- and metathorax showy coral-red, the subdorsal and infraspiracular tubercles, tipped with pale blue; in stage 2 the same tubercles are almost entirely pale blue. (6) The head becomes green in stage 4, with a black spot on the side. (7) The larva is most gaudily coloured and conspicuous in the last two stages while in *S. cynthia* there are not such marked differences between the different stages, though the last is the most variegated, owing to the beautiful turquoise-blue trappings.

CALLOSAMIA (PROMETHEA).—A. *Congenital characters*: (1) Hatched with heavy black transverse bands on a yellow body, and the head black-banded with yellow, the bristles moderately long (the larva is thus already rather conspicuous). (2) The dorsal thoracic tubercles already differentiated in size and colour from those on abdominal segments 1 to 7. The differences between the freshly-hatched larva and the last stage, very marked (more so than in *Platysamia* or *Samia*). B. *Evolution of later adaptational characters:* (1) In stage 2 the body becomes paler, and shows the black bands more conspicuously. The second and third thoracic dorsal tubercles, and those on abdominal segments 1—8, are now all yellowish and of the same size. (2) Disappearance in stage 3 of the transverse black bands. The abdominal tubercles all become blackish. (3) In stage 4 the head becomes yellow, being less conspicuously marked, and the dorsal abdominal tubercles are about half as long and large as those on the meso- and metathorax. (4) The body becomes, in the last stage, much smoother than before, the dorsal prothoracic and abdominal tubercles being much shorter than in stage 4.*

TELEA (POLYPHEMUS)†.—A *Congenital characters:* (1). The setæ of stage 1 but little longer than the tubercles, and both truncate and distinctly bulbous at tip. (2) A slight but distinct differentiation in size and colour of the dorsal tubercles, those of the third thoracic and 9th abdominal segments being of the same size and larger than those on uromeres 1-7, and of a deeper yellow shade (stage 1). (3) The homologue of the caudal horn is distinctly double and more deeply divided than in any other American genus of *Attacinae*; each fork about as long as thick (stage 1). (4) Abdominal prolegs with 24 crochets a larger number by 6 to 8 than in the other genera (stage 1). (5) Each abdominal segment or uromere with a lateral pair of transverse black slashes in stage 1. (6) The two tubercles in stage 1 on the suranal plate, slender, papilliform and approximate. B. *Evolution of later adaptational features:* (1) The lateral pair of black transverse stripes on each uromere nearly or quite disappears in stage 2. (2) The segments more convex and angular in stage 3. (3) Appearance of a yellowish lateral oblique stripe connecting the lateral tubercles of the lower and upper row in stage 3. (4) Appearance of the pale purplish edging of the suranal plate and anal legs in stage 3. (5) Appearance in stage 4 of the pearly spot on the outside of the dorsal tubercles. [*N.B.*—The generic characters are mostly assumed in stage 3.]

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* This reduction of size and inconspicuousness of the dorsal abdominal tubercles is carried out to excess in *Eacles angulifera*, where they become obsolete, and the larva is simply a large green caterpillar with inconspicuous markings and simply protected by its green colour like the majority of lepidopterous larvæ, not being so strikingly marked as in the fully-fed *Samia cynthia*. It is not improbable that the reduction and atrophy of the dorsal tubercles in question are also accompanied by a great reduction, if not total abolition, of the poison-glands at the base of these spines. However, having lost the power of resisting or avoiding attack by this means, the larva, by the action of the law of correlation, also loses its bright markings or danger signals, and, having become harmless to its enemies, it is preserved from extinction by passively relying on its smooth, glaucous green body to escape the observation of its natural enemies. A tendency to the same end is seen in the larva of *S. cynthia*, which is paler, less gaily ornamented with bright markings, and also is much less heavily intercolored than the caterpillar of *S. cecropia*. It is evident that of the two species of *Callosamia*, *C. promethea* is the more primitive form and *C. angulifera* a derivation from it. Likewise the Asiatic genus, *Samia* (*S. cynthia* being an introduced form), with little doubt, is a form which has undergone more or less modification, &c., indeed, a slight degree of reduction or atrophy, and is thus a later form, the genus *Platysamia* being an earlier type, since it has been evolved from *Saturnia*, which is the most primitive genus of the family (Packard).

† The life-histories of the colossal moths, *Telea polyphemus* and *Actias luna* are of much interest in connection with the subject under review. It must be premised that the shape of the tubercles and the glandular setæ they bear differ greatly in the freshly-hatched larvæ from their appearance after the first moult (see *Proc. Amer. Acad. Arts Sci.*, xxviii., p. 80).

ACTIAS (LUNA).—A. *Congenital characters:* (1) Setæ tapering to a point, not bulbous, and finely barbed (stage 1), most of them 3 or 4 times as long as the tubercles. (2) Some larvæ in stage 1 with a very broad lateral dark band along the side of the body, some without it; no transverse stripes present, but the head in front banded with dark brown. (3) The second and third dorsal thoracic tubercles differentiated in stage 1, being slightly larger than the abdominal ones. (4) On the suranal plate are two rudimentary tubercles, each bearing a tuft of bristles. (5) The dorsal median tubercle on uromere 8 does not show such marked traces of its double origin as stage 1 of *C. promethea* or *T. polyphemus*, but it is more duplex than in *P. cecropia.* B. *Evolution of later adaptational features*: (1) Dorsal tubercles in stage 2 higher than before. (2) The lateral dark band disappears in stage 2. (3) In stage 3 the dorsal thoracic tubercles become nearly twice as long and thick as the abdominal ones. (4) The head is not banded in stage 4. (5) The tubercles brightest (pink or dark carmine) and most conspicuous in the last stage. (6) A distinct infraspiracular yellow line in stage 4, and the suranal plates and anal prolegs lined with yellow, the surface of the suranal plate and sides of anal prolegs amber-coloured.

We cannot further follow this interesting branch of our subject, and can only deal with some of the more marked peculiarities presented by the early stages of a few Attacid species. The Attacid egg is what we have already described technically as a flat egg. There is considerable difference in detail exhibited both in structure and in the mode of egg-laying, but it may be here noted that the mode of laying around a stem is common to as divergent forms as *Hemileuca maia (Ent.*, vi., p. 558) and *Saturnia pavonia.* Packard gives *(Proc. Am. Acad. Arts Sci.*, 1893, pp. 58 *et seq.)* the following interesting notes on the eggs of various species belonging to the three best-known groups:

1. ATTACIDÆ *.—*Platysamia cecropia:* The egg dull chalky-white, pitted in close irregular wavy parallel rows, the pits themselves showing a tendency to be grouped into twos or threes. *Samia cynthia:* The surface dull, finely pitted (but not arranged in wavy rows as in *P. cecropia*), the pits near together, slightly polygonal, their walls projecting as little bosses on the inside of the shell. *Callosamia promethea:* The surface pure white, shining, looks (under a half-inch objective) smooth, with only faint, irregular, moderately large, polygonal areas, with faintly raised edges or boundaries. *C. angulifera:* Same shape and colour as those of *C. promethea*, but rather smaller and the polygonal markings even fainter. *Actias luna:* Dirty-white in colour; the surface closely granulated, the pits between the granulations often confluent, rarely the raised bosses appear to be polygonal. *Telea polyphemus:* Chalky-white, with a very broad conspicuous dark brown band, the surface covered with round shallow depressions, bordered with a well-marked rim; these orbicular areas do not touch each other, there being quite wide spaces between them.

2. CITHERONIIDÆ.—*Dryocampa rubicunda:* Thin, parchment-like, smooth, and polished, shows (under ½ in. objective) no trace of pits or polygonal areas. *Sphingicampa bicolor:* Smooth, like parchment, shows (under ½ in. objective) very faint polygonal impressed areas, much fainter than in egg of *E. imperialis. Eacles imperialis* †: White, with a smooth distinct equatorial ridge, shows (under ½ in. objective) shallow pits, not closely crowded, nor with a definite raised edge, often with a boss or bead in centre; arising from the spaces between the

* In the *Attacinae* (*sens. strict.*) the eggs present generic, specific, and probably varietal, characters (Packard).

† It is interesting to compare the sculpturing of the eggs of this group, for that of *Eacles* (*imperialis*) appears to be intermediate between that of *Citheronia* (*regalis*) and *Sphingicampa* (*bicolor*), the shell of *Eacles* being more distinctly sculptured with irregular polygonal imprints, which are not so closely crowded as in *Citheronia* (*regalis*) in the egg of which the cell imprints are much more distinct and more crowded than in the two other genera (Packard). Bacot describes the egg of *Eacles imperialis* as being "pale yellow in colour, pearly in hue, semitransparent in appearance, like those of the Sphingids and Dimorphids, and not opaque like those of the Saturniids *(sens. strict., e.g., Saturnia pavonia).*"

bosses are slender, short, very minute hairs, originating from a swollen base. *Citheronia regalis:* The polygonal impressed cells readily recognised under microscope; much more distinct and crowded than in two preceding.

3. Hemileucidæ.—*Hyperchiria io:* Finely granulated, not smooth and shining; shows (under $\frac{1}{2}$ in. objective) the surface divided into closely-set, very small, slightly raised but flattened areas, separated by narrow valleys; the areas very irregular, but somewhat polygonal in outline.

The typical Attacid larva tends to have the tubercles arranged in circular form around each segment, this arrangement being brought about by the atrophy of ii, leaving i, iii, iv + v, and vii as raised warts on either side of each segment, bearing, in many cases, powerful spines or remarkable hairs. But it is in this stage that the superfamily appears to attain its highest form of specialisation, and the modifications are so extreme, that one finds within its limits perfectly smooth larvæ, as well as some of the most hugely spined of all lepidopterous larvæ. The suranal plate is, in some larvæ, exceedingly developed, *e.g.*, in *Aglia tau* it forms a long, permanent, sharp spine. In the Citheroniids—*Anisota*, *Dryocampa*, *Eacles* and *Citheronia*—it is very large, the surface and edges being rough and tuberculated. It appears to attain its maximum in *Sphingicampa*, being triangular and ending in a bifid point. The 9th abdominal segment is occasionally well developed in the Attacids and Citheroniids, sometimes bearing a true caudal horn, which replaces that more frequently developed on the 8th abdominal segment (Packard).

One finds that when the young larvæ of some of the spined forms leave the egg, the spines are flaccid and soft. Packard observes (*Proc. Am. Acad. Arts Science*, 1893, p. 59) that, when the young larva of *Platysamia cecropia* hatches, the yellowish-green tubercles are flattened close to the body and the hairs or setæ in each verticil or pencil are united in one pencil-like mass and bent to one side of the body. In ten minutes the tubercles become erect, higher and longer (probably swelled out by the pressure of the blood), and, by this time, the hairs have assumed their radiate arrangement, and in one or two minutes more (*viz.*, 11—12 minutes after leaving the egg), the tubercles have all become of full length and erect and the black setæ spread out in the normal verticillate way. He further notes (*loc. cit.*, p. 87) that when the larva of *Actias luna* is leaving the egg and before entirely breaking out of the eggshell the tubercles on the anterior segments become erect, and the hairs radiate from them, but, behind, the 3rd thoracic and abdominal segments are seen to be soft and flattened or appressed to the body, and adhering in flaccid bundles. In *P. cecropia* on the other hand, all the tubercles and bristles are flabby for perhaps half-an-hour after the creature frees itself from the egg; ten minutes after hatching all the tubercles of one were seen to have become filled out and erect with stiff radiating bristles. It is evident that before, and at the point of, hatching the setæ or bristles are filled with blood which distends them. While thus distended the fluid may ooze out of the ends and thus they may be called glandular hairs. In those which are full and bulbous at the end, the fluid may be retained through stage 1, and, in rare cases, through the second or even the third stage. See also Soule, *Psyche*, ix., pp. 299—300, on the development of the spiny tubercles in newly-hatched larvæ of *Eacles imperialis*.

Many Attacid larvæ, *e.g.*, *Citheronia regalis*, *Automeris janus*, &c., are no doubt protected by their spines, others, *e.g.*, *Telea polyphemus*, *Actias* *luna*, &c., adopt a *Sphinx*-like attitude more marked in some stadia than others, whilst the development of the double tubercle (i) on the 8th abdominal segment suggests strongly the Sphingid caudal horn. This is more distinctly divided in *Telea polyphemus* than in any other American Attacid, whilst it shows no such distinct trace of its double origin in the 1st stadium of *Actias luna*, as in the 1st stadium of *Callosamia promethea* or *Telea polyphemus*, yet in *A. luna* it is more duplex than in *Platysamia cecropia*. Packard distinctly states (*Proc. Am. Ac. Arts Sci.*, 1893, p. 57) that, in his opinion, this single median tubercle of the 8th abdominal in the more specialised Attacids is the homologue of the caudal horn of the Sphingids, of *Bombyx mori*, and of the Notodont genus *Pheosia*, and believes it to result from the fusion, before the end of embryonic lite, of what were originally two separate tubercles, like the two separate ones of *Saturnia*. Packard's opinion, therefore, confirms that of Müller (*Südamerikanische Nymphaliden-raupen*, 1886, pp. 249, 250). [See also Poulton (*Trans. Ent. Soc. London*, 1885, p. 30), Packard (*Proc. Bost. Soc. Nat. Hist.*, xxv., pp. 99, 103, footnotes 1, 2 and 3), and Grote (*North Amer. Lepidoptera*, 1886, pp. 16, 54).] It is difficult to form any definite opinion as to how far the caudal horn of the Sphingids is foreshadowed in the Attacids as an ancestral character, and how far it is a matter of convergence, but the similarity of structure certainly is entirely due to convergence in the case of those Notodonts that have developed this peculiar character.

The armature of certain of the spined larvæ of the Citheroniids and Hemileucids is figured by Packard (*Proc. Am. Phil. Soc.*, xxxi., pl. v—x). Some of the structures (enlarged) here exhibited are very remarkable. Barrett states (*Can. Ent.*, xxxii., p. 236) that the larva of *Copaxa multifenestrata* is most strikingly beautiful, and that in that of *Automeris janus* the spine defence system is carried to an extreme; the length of the profusely branching spines is 15mm.—25mm., or twice the diameter of the body, and so abundant are they that the larva looks like a bunch of moss a few yards away, while the quantity of poison contained in these spines is so great that during the process of inflating, the fumes which are driven off with the vapour are positively dangerous to the operator. The fullgrown larva of *Sphingicampa bicolor* is remarkable, not only on account of the two dorsal rows of acutely conical spines, with three or four blunt spinules, on abdominal segments 1—7, which are recurved and directed backwards, but also because the spines themselves are externally coloured with a pearly, silvery-white hue, which gives off all the colours of the rainbow during the movements of the larva, the corresponding spines on the other segments being similarly but less brilliantly coloured. Packard says: "The general colour of the body is of nearly the same hue as the undersides of the leaves of the honey-locust, and, thus coloured, it is partly assimilated and protected by its colour, whilst the horns are in general like the spines of its foodplants; on the other hand the gleaming silvery spines certainly render the creature conspicuous, as well as the lateral parti-coloured band. It would appear probable that the formidable spines of the grown-up caterpillar save it not infrequently from being swallowed by birds, though the horns are probably of greater use in the earlier stages, when they are much longer and much more movable in frightening away ichneumons and *Tachinae*, *e.g.*, even when 20mm.

in length, a larva was seen when teased to spread apart its great arm-like horns, while the fullfed ones did not notice such stimulus. . . . . The horns and the six silvery opalescent shining tubercles probably become terrifying by the movements of the larva. The tubercles are turned on and throw out their light suddenly like flashes, and may thus have a deterrent effect on their enemies" (*Proc. Am. Phil. Soc.*, xxxi., p. 156). It may be well to note here that the rapid jerking movements of some Attacid larvæ when disturbed must be of great protective value, *e.g.*, the larva of *Citheronia regalis*, if touched, jerks its head and thorax vigorously sideways. The larva of this species, and also those of *Eacles imperialis*, *Sphingicampa bicolor*, etc., assume a *Sphinx*-like attitude. The thoracic and caudal spines of the larva of *C. regalis* are also somewhat sensitive to touch. The Automerid larva (as represented by *Hyperchiria io*) has a pair of eversible glands developed on the 1st thoracic, and another pair on the 7th abdominal segment, placed behind the spiracles and between the subdorsal and spiracular row of spines. These persist throughout larval life. They are figured by Packard (*loc. cit.*, pl. ix., fig. 11). Similar eversible glands are present (or their position indicated) in the larvæ of *Hemileuca maia* and *H. artemis*, that in *H. maia*, by an irregular oval liver-coloured patch behind the first thoracic and 8th abdominal spiracles (*loc. cit.*, p. 173). Hinkley notes the larvæ of *Hyperchiria io* as "processionaries," and says that, although gregarious when young, they become solitary later. Bacot, however, notes larvæ of various sizes living together. They are also said to have* on each segment "five or six tufts of green prickles, terminated by minute black points which prick the hand, if touched, and cause severe smarting." The larvæ of *Hemileuca maia*, also gregarious when young, are reported to have hairs which possess the power of stinging sharply. But just as many Sphingid larvæ, in addition to the advantage gained by their peculiar attitude, also rely much for their safety on their resemblance to their environment (see *antea*, vol. i., pp. 80 *et seq.*), so Packard notes that he once saw a fine large larva of *Telea polyphemus* at Providence on chestnut, and was much struck with the resemblance of the outline of the creature's back—the segments being angular so as to render the body serrate, each tooth-like form of the segment surrounded by a tubercle and long hair—to the serrated edge of the leaf, each of the teeth ending in a long hair. Packard considers that it is not improbable that the ancestors of *Telea*, *Actias*, and other species whose larvæ have angular segments, may originally have fed on trees with serrated leaves, and that later they adopted as their more usual foodplants such trees as the oak, on which the edges of the leaves are either smooth or simply lobed (*Proc. Am. Acad. Arts and Sciences*, 1893, p. 86). The fullgrown larva of *Callosamia angulifera* has the dorsal abdominal tubercles reduced in size to such an extent that they may be said to be obsolete, the larva being simply a large green caterpillar with inconspicuous markings, protected by its green colour like the majority of lepidopterous larvæ, and not so strikingly marked as is the fullfed

* Bacot notes: "This is correct; it is certainly a poison; the effect very much like nettle-stings but it goes off in an hour or so, having none of the lasting effects exhibited by the urtication due to the hairs of Lachneid or Liparid larvæ" (*in litt.*).

larva of *Samia cynthia*, whilst Packard considers *Callosamia* to be, in its larval characters, the last and most specialised genus of a series beginning with *Saturnia* (*carpini*) and including *Platysamia* and *Samia*." Packard thinks that the absence of the tubercles in *Callosamia* may be a case of arboreal selection, the tulip-tree, its only known foodplant, having but few species of larvæ feeding on it.

Mention may be made that certain Attacid larvæ, *Philosomia lunula*, &c., become covered with a white waxy-powder when half-grown. No suggestion has yet been made as to the use of this powder.

The Citheroniid larvæ, *Citheronia*, *Eacles*, &c., are said to change their hue when fullfed, and wander restlessly when seeking for a pupation-place, peculiarities which they share in common with certain Sphingid, Dimorphid, and other larvæ. As bearing on this point, it may be observed further that the green, freshly-formed pupa of *Aglia tau* exhibits very distinctly all the markings of the larva, including the subspiracular line, a prominent larval feature, the line being continued along each side of the anal flap to its extreme apex. Poulton utilised these markings for the purpose of homologising the pupal segments and structures, the positions of the markings affording valuable confirmatory evidence of the identification of the anal flap of the larva with the terminal spine of the pupa, a subject which is treated by this author at considerable length (*Morph. Lep. Pupa*, p. 196).

The process of exuviation of the Attacid larvæ is very similar to that obtaining in other larvæ. Most, if not all, of the larvæ spin a silken cushion, into which they fix the crochets of the prolegs before moulting begins. That spun by *Telea polyphemus* has been described as a thin carpet of silk, and that of *Platysamia cecropia* is somewhat similar. The larva usually rests immovably for several hours before exuviation begins; the membrane of the prothorax swollen, the head appearing very small in comparison. In moulting, the larva leaves behind it only a small mass of crumpled skin, the whole of the cast skin being collected together into a very small space. In many Attacids the cast skin is eaten by the larva. See also *anteà*, vol ii., p. 6.

The cocoons of the Attacids (*sens. strict.*) are possibly among the most interesting of those made by any lepidopterous larvæ. Many of them are used commercially for their silk, and for this purpose the larvæ are kept in a domesticated or semidomesticated state, but the silk is almost always coarser than that of *Bombyx mori*, and cannot be wound, so that it is usually carded or spun like cotton. Gentry notes a variation in the colour of the cocoons spun by larvæ of *S. cecropia* that have fed upon various trees, *e.g.* (1) on red currant, the silk is said to be reddish-brown, (2) light-brown tending to grey on cherry, plum and rose, (3) grey-brown on *Spiraea*, *Symphoricarpos* and *Prunus serotina*. We doubt whether this would stand the test of careful experiment. The cocoons of the Hemileucids are usually spun on or under the surface of the ground, and the Citheroniids are satisfied with an earthen cocoon. Barrett notes (*Can. Ent.*, xxxii., p. 235) that the cocoons of several species of *Automeris* have a quasi-hinged grating in the front portion which only opens outwardly; the front is closed, but with very weak (brittle) silk. This strongly suggests *Saturnia*. Grote writes (*Can. Ent.*, 1895, pp. 263—266) of the cocoons of the Attacids as follows: "The *Saturniidae* (*Attacidae*) weave large and dense cocoons attached to objects free from and elevated above the surface of the earth; the *Hemileucidae* spin cocoons of slighter texture on or near the ground, and granules of earthy matter are mixed with the web (*Automeris*), or in a surface cell among *débris* with no or little silk (*Hemileuca*); the *Citheroniidae* enter the ground to form a cell beneath the surface, in which the naked pupa reposes, showing an analogy of habit with the *Sphingina*. In *Attacus*, *Philosamia* and *Callosamia*, the larva attaches the deciduous leaf, which forms the basis and natural attachment for its web, firmly to the branchlet by a pedicel of silk. Evidently this habit has been found more useful to the species, the cocoon being thus prevented from falling to the ground with the fall of the leaf. *Telea* and *Actias* have not this habit, and the cocoon falls in the autumn with the leaf which was used in the spinning. The Attacid group (*sens. strict.*) has generally this habit of attaching the cocoon, and in *Callosamia* the habit is strongly developed, although *Samia* has it not at all, but spins a thick double cocoon attached to the branches themselves often near the ground, and much after the fashion * of the European *Saturnia*. I, therefore, place the genera with the pedicel habit at the commencement of the family, *Samia* and *Saturnia* following, and closing with *Actias* and *Telea*, in which the thinner cocoon falls with the leaf to the ground." Sharp says: "The cocoons are very various, ranging from a slight open network to a dense elaborate structure arranged as in *Saturnia pavonia*, and in this latter case an opening is left by the larva for its exit after it has become a moth, but, by an ingenious *chevaux de frise* work, this opening is closed against external enemies, though the structure offers no resistance at all to the escape of the moth. Fabre has recorded some observations and experiments which seem to show that the instinct predominating over the formation of the cocoon is not cognoscent. The insect, if interfered with, displays a profound stupidity; its method is blind perseverance in the customary (*Souvenirs entomologiques*, 4th series, 1891, pp. 39—46)." The cocoon of the Attacids is, however, more often entirely closed, and, although Packard and others have asserted that the "cocoon-cutter," with which *Actias luna* and other species are provided, is used to cut its way out of the cocoon, Chapman long since described how *Platysamia cecropia* softened its cocoon with an abundance of fluid (*anteà*, vol. ii., pp. 64—65), and has recently (*Ent. Rec.*, xiii., p. 300) shown, as we have already stated, that the "cocoon-cutter" of *Actias luna* is not used to cut the silk at all, but to tease it out when it has been sufficiently softened by a fluid excreted by the imago. Sharp further notes that the cocoons of the species of *Ceranchia* have a beautiful appearance, like masses of filagree-work in silver. [The pupa in *Ceranchia*, too, is very peculiar, being terminated by a long spine-like process.] In *Loepa newara* the cocoon is of a green colour, and suspended by a stalk, looking like the pod or pitcher of a plant."

The Attacid pupa is very fairly specialised and distinctive, although, if the Citheroniids be considered, a considerable range of variation exists.

* Bacot notes the attachment as being often very similar to that of *Eutricha quercifolia*.

For the structure of a fairly easily-obtained Attacid pupa reference should be made to our description of that of *Saturnia pavonia* (*posted*). Chapman writes: "The Attacid pupa is one that in its more obvious characters is extremely varied, owing to the variety of its environment, some pupating underground, others forming cocoons. In its more essential characters, it is an obtect pupa, very difficult to differentiate from *Smerinthus* or *Dimorpha*, and, at times, from certain Lachneids. It is a thick robust pupa, essentially very round (circular in section) and very straight—*Saturnia pavonia* and others are obvious exceptions to this, being both flattened from back to front, and with the hinder segments bent well forward. The wings meet in the middle line. In those with well-developed antennæ, the greater part of the 2nd legs and a portion of the first are covered by them. This occurs also in the Cochlidids and elsewhere. There is no femoral piece between the maxilla and first leg. This is wanting also in Smerinthids, but appears in nearly all other Sphingids. Callosities on the metathoracic dorsum are marked in some Citheroniids, as in Acherontias and other Sphinges, but not so markedly in Smerinthids, they exist in Saturnians, but usually very obscurely. The surface is free from any hairs, such as form a pile on some Lachneids, and is generally smooth and polished; the dorsum, however, in some, *e.g.*, *Antheraea*, etc., possesses patches of brown hairs or rather bristles. In *Antheraea* the pupa is very short and thick, almost spherical, this modification is due to the form of cocoon, and similar modifications go with similar cocoons, in Lachneids, Cochlidids, etc., but it appears to reach its extreme in *Antheraea*. The anal armature in Citheroniids generally ends in a double point, and is without bristles. In Saturnians, it is a transverse ridge with, on either side, a row of bristles along its anterior and posterior edge, and somewhat curved over to face each other, the extent to which these are developed varies much, the anterior or posterior row is generally nearly wanting, the bristles are curved, but apparently never actually hooked. In species with cocoons, the segmental armature is rarely more than a little wrinkling, in subterranean species, there is usually a raised row of points along the posterior margin of segments, and a row of pits, or even a raised ridge along the anterior border; there is no lateral flange as in *Eumorpha* and higher Sphingids. In *Cricula trifenestrata* there is a strong set of cremastral hooks clothing a conical projection and not easily interpreted in the terms given above as usually covering the anal armature of Saturnians. In a large African form, very like *Ceratocampa*, there are callosities or great warts on the pro- and mesothorax as well as on the metathorax, and similar ear-like projections protect the 1st spiracles, whilst on the dorsum of the last abdominal segment are two holes leading into large spherical cavities, that look like two peas when seen from within the pupa. The hind-wing is always (?) visible as far as the middle of the hind-margin of forewing. The texture is very hard and thick in subterranean forms and the colour is usually black, whilst it may be delicate and the colour pale brown in forms with solid cocoons, *e.g.*, *Cricula*, which has a fairly solid texture. It may be a question whether any absolute characters can be given for the pupæ of any of the families of larger moths with obtect pupæ, many of which are closely related, and others closely approximated by convergence, whilst in each family there is much variation of an adaptive character. This difficulty is, perhaps, as great in the Attacids, as anywhere, though the thickness, straightness and circular section, as though turned in a lathe, are usually characters at once recognisable in many genera both of Citheroniids and Saturnians, the large antennæ being also very obvious facts. *Dimorpha* is a generalised Attacid in many respects. Its relations are nearer to Citheroniids than to Saturnians, but its pupa is curved, whilst those of Citheroniids are straight, and its armature everywhere it spiculate, whilst that of Citheroniids possesses pits. The arrangement of face-, wing- and mouthparts is very much the same. There are certain resemblances but it is impossible to say whether they do or do not indicate alliance" (*in litt.*). Attention has already been drawn to the sexual differences exhibited by the pupal antennæ of the Attacids (*anteà*, vol. ii., pp. 46, 47), and Poulton gives (*Morph. Lep. Pupa*, pl. xxvi., figs. 1—13) an excellent series of drawings of the pupal antennæ of *Saturnia pavonia*, *Aglia tau*, etc., comparing them with the corresponding imaginal antennæ. Mosley, in 1871, made some investigations into the relationship, observing that, in *Saturnia pavonia*, the sheaths of the antennæ in the female pupa are large and inflated, with traces of pectination, resembling in this respect those of the male pupa, but in a reduced degree, although the antennæ of the female imago are as is well-known merely filiform. Mosley concluded from this that "in the ancestral Saturniids the imagines of both sexes must have had large pectinated antennæ, and that they had not been developed as such only in the male for sexual purposes, but must have been retained in the male and degenerated in the female." He considers that "the pupal integument, requiring for purposes of protection to be hard and rigid, when once it had assumed a particular shape, suited to the contours of the body of the original ancestral insect, would retain that form indefinitely, although the shape of the several parts of the imago formed within it might, by the action of natural selection on it when in the free moving condition, alter considerably. It appears to be of no detriment to the development of the legs and the antennæ of the imago that their pupa-cases are far too big and do not fit." He concluded from these observations that probably members of the Saturniids existed with well-marked pectinated antennæ in both sexes, and soon found on looking at Westwood's drawers of insects that this was the case. Keeping to the Attacids, Poulton finds that there is an immense difference between the imaginal antennæ of the two sexes of *Aglia tau*, while the corresponding pupal organs are not widely different. Although the antennæ of the female imago are extremely degenerate, a careful examination, he says, reveals traces of the structure, which is so elaborately developed in the male (*loc. cit.*, p. 247). Poulton thinks that Mosley's conclusions require some modification, and he believes that "the particular size and shape of a pupal organ, which, at any one time, fits an imaginal organ developed within it, will not be retained indefinitely upon the shrinkage of the latter. . . but the pupal organ will also eventually become smaller." Poulton further considers it probable that "the male imaginal antennæ have increased as the female organs have diminished, so that the pupal organs of the former must have undergone recent increase, while the female pupal antennæ may indicate the size of these organs in both sexes, before degeneration of the one and concomitant development of the other commenced, or, considering how very common it is among moths for the male antennæ to be more developed than those of the ♀, only part of the sexual difference between pupal antennæ may date from the beginning of the rapid degeneration and development which certain species have undergone in the two sexes respectively; but it is most likely that the general and wide-spread difference between these imaginal organs in the two sexes is due to precisely similar causes acting slowly and only up to a certain point—due, in fact, to the competition among the males being keener than that among the females," etc. (*loc. cit.*, pp. 230—231). Chapman points out that, in his opinion, the explanation seems rather to be that the male and female antennæ tend to be alike, especially in the pupa. Wherever sexual dimorphism (or, *mutatis mutandis*, any dimorphism) occurs, it is as if we had two species mingled, which are separately responding to the effects of natural selection, and each tending to vary in a different direction, and yet unable to avoid a certain amount of crossing, making each to a certain extent follow the other. So if the male moth gets a large antenna by selection, the female tends to do so by inheritance from the male. Selection, however, keeps action on the female antenna to prevent its further development, but does not act so strongly on the pupal antenna, which is a quiescent and unimportant structure, and so the pupal antenna outstrips the imaginal one" (*Proc. Sth. Lond. Ent. Soc.*, 1899, p. 2). Considerable difference in the sexual organs is to be observed in the Attacid pupæ, and Poulton figures and describes (*Ext. Morph. Lep. Pupa*, p. 209, pl. xxi., figs. 15, 16) the terminal segments of the ♀ pupa of *Aglia tau*, as follows:

1. Fig. 15×7.—The surface sculpture is represented; the generative openings are unusually distinct and separate from each other. The anterior (bursa copulatrix) occupies the entire breadth of the 8th abdominal; its margin is very prominent, and much resembles the appearance of the male organ. The posterior opening (oviduct) similarly occupies the entire breadth of the 9th abdominal; its margin is not so distinct as that of the anterior opening. The median prolongation of the 10th abdominal is short and broad. The anus is placed on an oval convex area. Behind this area the base of the terminal spine is separated from the anal part of the 10th abdominal by a distinct furrow. The spine is rough and bristles with irregularly twisted thread-like processes. Its ventral surface (seen in the figure) is characterised by a large oval concavity, marked by concentric lines.

2. Fig. 16 × 7.—The last four segments seen from the right side. The functional spiracle on the 7th abdominal differs from the rudimentary one upon the 8th in its oblique position. All the visible functional spiracles are oblique like that shown in the figure. The 1st abdominal* is the only concealed spiracle in the pupa, for even the prothoracic is clearly exposed to view. The 10th abdominal is distinctly divided into a dorsal and ventral part. The terminal spine is not, however, uninterruptedly continuous with the dorsal part, but is separated from the latter by a furrow which extends dorsally from that which was shown in the last figure (15) and surrounds the base of the spine. [This tendency towards the separation of the terminal spine from the 10th abdominal is carried further in certain Geometrids.]

The Attacid imagines are, in many instances, the giant lepidoptera of the world, and the various families have an almost world-wide distribution, and considerable variation exists in many species, *e.g.*, *Samia cecropia* is said (*Can. Ent.*, 1876, p. 166) to vary

* Poulton says "thoracic" an evident *lapsus calami*.

in wing-expanse from 4⅛ins.—7¼ins. Sharp says (*Insects*, ii., pp. 372—373): "*Coscinocera hercules*, inhabiting North Australia, is a huge moth which, with its expanded wings and the long tails thereof, covers a space of about 70 square inches. One of the striking features of the family is the occurrence in numerous forms of remarkable transparent spaces on the wings; these window-like areas usually occur in the middle of the wing, and form a most remarkable contrast to the rest of the surface, which is very densely scaled. In *Attacus* these attain a large size; in other species such as the South African *Ludia delegorguei*, there is a small letter-like, or symboliform, transparent mark towards the tip of each front wing; in the genus *Automeris*, and in other forms, instead of transparent spaces, there are large and staring ocellate marks or eyes, which are concealed when the insect is reposing; in *Arceina*, *Copiopteryx*, *Eudaemonia* and others, the hindwings are prolonged into very long tails, perhaps exceeding in length those of any other moths." The sexes are usually very distinct and differentiated, the secondary sexual characters often strongly marked, especially in the direction of size, shape of the wings, and antennal structure. These differences are, in some families at least, possibly to be explained by the difference of the habits of the sexes of the same species, the males, usually seeking actively for the females, often flying swiftly by day, whilst the females fly slowly by night, and then only for the purposes of oviposition. We find usually in the males of such species well pectinated antennæ and smaller but strong wings, the wings of the female are usually larger in order to carry the heavy abdomen full of eggs, but there are strong indications of (?) degeneration in the antennæ. They usually fly slowly (compared with the rapid flight of the male), and frequently their powers of flight are still more reduced when, as is the habit of some species, they lay their eggs all in one or at most two or three batches, *e.g.*, *Saturnia pavonia*. Weismann states (*Essays on Heredity*, 1889, pp. 17, 18) that the females of *Aglia tau* deposit all their eggs in one spot, being unable to fly owing to the weight of the abdomen; the males on the other hand fly swiftly seeking the females. Poulton, however, points out (*Ext. Morph. Lep. Pupa*, p. 252) that flight, although sluggish, is still necessary, except under certain conditions, since there would be a two-fold danger in depositing all the eggs in one place—that of insufficiency of food and easy detection by enemies—and the latter applies to small as well as large moths, but while further degeneration is thus rigidly prevented in most cases, there are certain moths (in other groups—*Notolophus*, &c.) which escape from the limiting conditions.

Sharp draws attention (*Insects*, ii., p. 372) to the ocellated spots on the hindwings of the species of the genus *Automeris*, and Barrett notes (*Can. Ent.*, xxxii., p. 235) that these markings would appear to have a protective value, as all the species with which he is acquainted have the habit, when disturbed, of raising their primaries, so as to expose the large glaring eyes, and holding the secondaries at "present arms" until the fright is over. Kellogg states (*Taxonomic value of scales of Lepidoptera*, p. 68) that the sharpness of colour markings depends largely on the specialisation of the scales, and observes that, when sharply separated colour markings do occur in lower forms, there is a specialisation of the scales within the limits of the colour spots or lines much beyond the general condition of the wing-covering. Thus in *Actias luna* the general wing-covering is said to be rather generalised, but the brilliant eye-spots are composed entirely, except for the clear pupil, of rather short, broad, short-pointed scales, with no intermixture of scale-hairs, offering a striking contrast to the general, loose, hairy covering of the wings. In *Hyperchiria io*, which possesses a covering of lowly scales, there is a conspicuous eye-spot at the centre of each hindwing. The eye-spot has a brown iris composed of scales about like the general covering, but the white pupil is composed of highly specialised scales. The eye-spot on the hindwings of *Smerinthus cerisyi* is characterised by a more highly specialised condition of scale covering within its borders, than is shown on the rest of the wing. As to the colouring matter itself, reference should be made to Mayer's papers: "The development of the wing-scales and their pigment in butterflies and moths," and "On the colour and colour-patterns of moths and butterflies," in which the pigments of *Callosamia promethea*, *Philosamia cynthia*, and their development, is exceptionally well treated. Bacot has made the following interesting notes on the habits of the imagines of a few well-known Attacids :

1. *Telea polyphemus.*—♀. Rests with its wings hanging over its back, Geometrid-like, and "calls" in this position. If startled it drops, shortens its abdomen, draws up its legs, spreads its wings fully, and adopts a most peculiar attitude with its head down, the costa of forewings almost, or quite, touching the ground, the hindwings considerably raised (reminding one somewhat of the display attitude of the Argus pheasant), throwing the conspicuous ocellated spots on hindwings into startling prominence. The suddenness with which it changes from its resting-position, with its motionless, half-decayed-leaf-like appearance, to its remarkable display posture, would almost certainly affright any bird that attacked it.

2. *Platysamia cecropia.*—♂ and ♀ paired about 9 p.m., on June 27th, 1901. Both moths hung from the top of the cage, one sex did not carry the other. They separated at 9.30 p.m. the next evening. In a second pairing on June 28th, the ♀ carried the ♂, *i.e.*, the latter hung from the abdomen of ♀; these also remained paired almost 24 hours. The imagines rest much like *T. polyphemus*, and also resemble this species somewhat in their startled attitude, but the legs are not drawn up nor the abdomen shortened and swelled out, or if so to a much less extent; it falls to the ground in the same way to display, and gently waves its wings meanwhile.

3. *Actias luna.*—The imago rests with its wings spread, but the forewings are dropped somewhat in order to cover the hind ones.

4. *Hyperchiria io.*—The imago rests with its wings sloping and the forewings dropped to cover the hindwings much as does *Saturnia pavonia*. In copulating the ♂ and ♀ hang face to face. They pair from 9 p.m.—9.30 p.m. and separate during the early hours of the morning. When startled, this species also exposes its ocellated spots, and sometimes drops to do so. There is an ocellated spot on the upper side of hindwings and a less developed one (black with white centre) on underside of forewings, so that by raising the forewings both are exposed.

Sharp observes that about seventy genera and several hundred species of this interesting superfamily are already known; they are widely distributed on the globe, though there are but few species in Australia.

Family: ATTACIDÆ.

Following Dyar's grouping (based on larval structure), we have three subfamilies in the *Attacidae*, *viz.*, *Agliinae*, *Attacinae* and *Saturniinae*. Following Grote's grouping (based on neuration), we also have three subfamilies in the *Attacidae*, *viz.*, *Attacinae*, *Saturniinae* and *Hemileucinae**. Both are agreed that the *Attacinae* and *Saturniinae* are closely allied, and when we examine these carefully we find that the larvæ of these agree in having "no single tubercle on the 9th abdominal segment, in having a tubercular anal plate, and no primitive first stage," whilst the larvæ of the *Agliinae* and *Hemileucinae* (as well as the *Citheroniinae* and *Automerinae*†) are said to have a primitive first stage (see Dyar, *Ent. Rec.*, x., p. 37)‡. It is quite clear, on larval characters, that the *Attacidae* (limited to *Attacinae* and *Saturniinae*) is the most specialised family, whilst the other subfamilies, that have a primitive first larval stage, belong to more generalised families. Of the two subfamilies thus retained, the *Attacinae* would appear to be the more specialised, for, as we have before noticed, Packard remarks (*Proc. Am. Acad. Arts and Sci.*, 1893, p. 58) that, "as regards the larval tubercles, the species of *Saturnia* are on the same plane with the embryo, just before exclusion, of the more highly specialised forms of the group *Attacinae*," and adds further that "an interesting series of parallelisms may be observed in comparing the early and later stages of the larvæ of the family, *e.g.*, while the late embryos of the *Attacinae* are, perhaps, paralleled by the fully-grown larva of *Saturnia*, the fully-grown larva of the most, or one of the most, generalised *Attacinae*, *Platysamia*, is on the same plane of specialisation as the larva of *Callosamia* in its third stage." He also considers that the great size of the *Attacinae* (particularly *Attacus atlas*) appears to be a sign of recent specialisation, and the small size of *Saturnia*, apart from its other features, suggests that it is a generalised form not departing greatly from the normal size of the superfamily Bombyces. Dyar considers that, of the more generalised families, the *Agliidae* is most closely allied to the *Attacidae* (*Saturniidae*), resembling it in that the larvæ have "no single dorsal tubercle on the 9th segment, but have the anal plate tubercular," and differing from it in that there is a primitive first larval stage‡, and that nervure IV_2 in the forewing of the imago is less intimately related to IV_1 than in *Saturnia*.

It will be gathered from our remarks that we are inclined to limit the *Attacidae* to the subfamilies *Attacinae* and *Saturniinae*, excluding *Agliidae* as of family rank. Meyrick appears to base his diagnosis (*Handbook*, &c., p. 313) of the superfamily largely on these two subfamilies, for he observes under his genus *Saturnia*: "Characters those of the family." These family characters read as follows:

IMAGO: Head densely rough-haired. Ocelli absent. Eyes glabrous. Tongue rudimentary. Antennæ (under $\frac{1}{2}$) in ♂ strongly bipectinated to apex. Labial palpi very short, hairy. Thorax densely hairy above and beneath. Abdomen hairy. Femora and tibiæ densely hairy, posterior tibiæ without middle spurs. Forewings: 1b furcate, 5 and 6 closely approximated from upper angle, 7 absent, 8 and 9 out

* We are quite unable, on larval characters, to accept Grote's statement (*Ent. Rec.*, x., p. 146) that *Hemileuca* is a generalised Saturnian in the sense of including it as a subfamily of our *Attacidae*. The presence of two anal nervures in the hindwing suggests at least a separate family, even if it be not, as suggested by Dyar, a subfamily of the *Citheroniidae*. Grote's own opinion now (see *anteà*, p. 273) is that the Hemileucids should be treated as a distinct family.

† It may be well to note here that Bodine places (*Antennae of Lepidoptera*, p. 43) the subfamily *Automerinae*, in which the antennæ of the ♀ have a single pair of pectinations to each joint in the *Saturniidae*, with the *Attacinae*, which latter have, in both sexes, two pairs of pectinations to a segment. He does not know the antennal structure of the *Saturniinae* (*sens. strict.*).

‡ We do not agree that *Aglia* has a primitive first stage (see, footnote, *anteà*, p. 272).

of 10, 11 absent. Hindwings without frenulum, *1a* absent, 5 and 6 approximated from upper angle, 7 from ⅔ of upper margin, 8 out of cell at base rapidly diverging, a præcostal spur faintly indicated. OVUM: Flattened-spherical, smooth. LARVA: Stout, with tubercles bearing tufts of scanty hairs. PUPA: In a dense firm oval cocoon.

These characters would, in many cases, fail entirely if applied to any group greater than our family *Attacidae*. Packard characterises four families in the superfamily — *Ceratocampidae*, *Hemileucidae*, *Agliidae* and *Saturniidae* (=*Attacidae*). These we accept with the addition of *Automeridae*. The *Attacidae*, he subdivides (*Proc. Amer. Acad. Arts Sciences*, 1893, p. 58) into two subfamilies as follows:

1. Six tubercles on the 8th abdominal segment, the tubercles in general over the body, all of the same size. Generalised forms. Subfam. SATURNIINÆ.

2. Five tubercles on the 8th abdominal segment, the median one double; the tubercles in general more or less differentiated or specialised in size and colour. Specialised forms. Subfam. ATTACINÆ.

Although based on the characters presented by the number and arrangement of the larval tubercles, the same subdivision can be made on other characters, and it appears to us to be a very natural one, but Packard's remark, "generalised forms," is quite inexplicable to us. The family, as here restricted, contains the large silkworm moths, whose silk is used for commercial purposes, *e.g.*, *Antheraea mylitta* and its allies (India), *A. pernyi* (China), *A. yamamai* (Japan), *Callosamia promethea*, *Samia cecropia* (North America), *Philosamia lunula* (East Indies), and their allies. The family contains some of the largest moths in the world; the largest, *Attacus atlas*, sometimes reaching a foot in expanse.

Dealing with the origin of the family, Packard states (*Proc. Am. Acad. Arts and Sci.*, 1893, p. 55): "The larval characters, especially those features that are congenital, tend to show that the family has originated from some spiny group, and most probably, when we take into account the transformations of *Aglia tau*, from the *Ceratocampidae (Citheroniidae)*, although none of the latter spin a cocoon. During the evolution of the group they underwent a change in shape, from a rather long and slender form to a thick heavy body, with a thin integument, the result perhaps of an unusually stationary mode of life. The imagines also underwent a process of degeneration, as seen in the atrophy, total or partial, of the maxillæ, and in the loss of veins, in their large but weak wings*; though the loss of strength of flight is somewhat compensated by the remarkable development of the olfactory organs or antennæ. The family appears to be a closed type, none of the higher or more specialised Bombyces having descended from it, the type representing a side branch of the Bombycine tree which, late in geological history, grew apart, and reached a marked degree of modification, resulting in the possession of adaptive characters which were not transmitted to later forms. It seems probable that the type was a Miocene-Tertiary one, which has lingered on in eastern America (north and south), and in eastern Asia, as well as in Africa, while it has become nearly extinct on the Pacific shores of North and South America, and in Europe." Packard further notes (*Bombycine Moths*, etc., p. 45) that "the *Saturniidae* (*Attacidae*) is a tropical group, only a single

* Bacot notes: "The movement of the wings of *Attacus atlas* is slow and bat-like, but hardly weak, and the wing-membraue must be very strong, as it stands well a considerable amount of knocking about in a confined space."

genus occurring in Europe, while in North America, north of Mexico, there are six. In tropical America, Africa, and south-eastern Asia, including China, the species and genera are far more numerous, and form a characteristic feature of the fauna. Upon the whole the allied *Ceratocampidae (Citheroniidae)* are also tropical, many more species occurring in Brazil and Central America than in North America, and this may be said of the family *Hemileucidae*. Meyrick also notes (*Handbook*, p. 313) that the *Saturniidae* (*Attacidae*) is a small family, occurring mainly within the tropics, but with a few stragglers in temperate climates. The species are all large, and sometimes gigantic, the Indian *Attacus atlas* measuring ten inches in expanse of wing, and their decoration is often correspondingly magnificent. The single British species is one of the smallest.

Weniger, writing of the larvæ of the *Attacinae*, states (*Ent.*, xx., pp. 87-89) that after the second or third moult of the larva of *Attacus yama-mai*, *A. pernyi*, *A. selene* and *A. cecropia*, a coloured mark on the sternal region of the 8th abdominal somite affords a certain test of sex. The mark in the ♀ is a "black blotch" in the middle, of a yellowish tint, which, in natural size, is not larger than a large pin's head. The male differs from the female in the fact that the black blotch has in its centre a dark green spot. In both sexes the mark disappears when they are killed and the skin emptied." Jackson thinks (*Studies Morph. Lepidoptera*, p. 147) it may be due to a peculiarity of the larval cuticle, but emptying does not alter the cuticle, and the mark disappears when the skin is emptied. At any rate he points out that there is no structure belonging to the reproductive organs in both sexes alike which has the position assigned by Weniger.

Semper observes that, in the development of the antennal hairs of a male *Saturnia pavonia*, the hairs arise just as do the scales, from a layer of cylindrical cells. The hairs push out between the cells of the epidermis as do the scales, and the only difference, in fact, between the scales and these hairs is merely in the outer form, and this is no real difference, for there may be found between both forms numerous gradatory ones. So long as no cuticle is developed by the epidermis the forming scale consists of a fine membrane which is a direct continuation of the parent cell, and which contains a transparent finely-granular content, which is darkened and contracted by acetic acid. But as soon as the cuticle appears, one sees also developed on the scales and hairs—it was especially apparent on the antennal hairs of *Saturnia pavonia* (*carpini*)—a thickened layer which, where the hair or scale meets the cuticle of the epidermis of the antenna or wing, fuses with it; the thin stalk of the scale which unites the scale with its parent cell secretes for a short distance between the cells of the epidermis such a thickened layer as renders the joining of the scale with its supporting membrane much more secure. At first one sees on the scales only a simple membrane, but soon longitudinal striæ develop; these arise at certain places where a further thickening takes place on the secreting membrane, and proceeds till, finally, further depositing is limited to cross-striæ which develop between the separate longitudinal striæ. The scale is now complete except for the pigment, which, in many species, is deposited in the scale before its extrusion. After the scale is fully developed, the parent-cell disappears, the granular content of the scale becomes absorbed, the primitive cell membrane dies out, and there remains only the chitinised cuticle of the scale, with its root fast in a pouch in the membrane. The striking analogies between the course of development of scales and the varying conditions of the scales on the fully developed wing cannot escape attention. It is to be noted that Semper's description of the formation of the insertion cups differs from that given by Landois.

Bodine notes (*Antennae of Lepidoptera*, p. 43) that the family *Saturniidae* (*Attacidae*) is interesting in the series of forms the antennæ present. The genera *Coloradia*, *Automeris*, *Calosaturnia*, *Tropaea*, *Telea*, *Callosamia*, *Philosamia* and *Samia* present a regular and progressive series. The following table will serve to separate the antennæ of the members of this family *:

A. Antennæ of female with single pair of pectinations to a segment.
- B. Antennæ of male with distal pair of pectinations shorter than the proximal.
  - C. Distal pair not more than half the length of the proximal .. .. *Coloradia.*
  - CC. Distal pair but little shorter .. .. *Automeris.*
- BB. Antennæ of male with distal and proximal pairs of pectinations subequal .. .. *Calosaturnia.*

AA. Antennæ of both sexes with two pairs of pectinations to a segment.
- B. Proximal and distal pairs subequal in male, distal pair shorter in the female.
  - C. Distal pair of female very short, without hairs of the second type .. .. *Telea.*
  - CC. Distal pair of moderate length with hairs of second type .. .. *Tropaea.*
- BB. Proximal and distal pairs subequal in both sexes.
  - C. Distal pair of pectinations of female shorter than, or only equal to, the proximal on the proximal segments.
    - D. Distal pair wanting in a few distal segments .. .. *Callosamia.*
    - DD. Distal pair present, at least in rudiments, to the distal end . .. . *Samia.*
  - CC. Distal pair of pectinations of female longer than the proximal on the proximal segments .. *Philosamia.*

There is a gradual progression in complexity of development from *Coloradia* on the one hand, to *Samia* or *Philosamia* on the other. The females of *Coloradia*, *Automeris* and *Calosaturnia*, have a single pair of pectinations to a segment, while those of the other genera have two pairs. The males of the first two genera have the distal pair shorter, whilst those of the others have the two pairs subequal. There is also a gradual increase in both sexes from one end of the series to the other in the number and position of the cones. In *Samia* there is not only an abundance on the shaft, but many are on the pectinations of the distal portion of the clavola. There is some doubt as to whether *Samia* or *Philosamia* should be considered the higher form. The male *Samia* is more highly developed than the male *Philosamia*, but, on the other hand, the female *Samia* is less developed than the female *Philosamia*. I believe that now *Samia* is the higher form, and that it has outstripped *Philosamia* in specialisation in comparatively recent times. If the females lag behind the males, as seems most probable, the condition we find in the two genera would indicate that the male *Philosamia* has been long enough fixed to allow the female to

* Reference should be made here to Chapman's note on the antennæ of African forms (*anteà*, p. 270).

approach it in specialisation; while in *Samia* the male is even now progressing in complexity, and the female has not had time to approach it in development. There are many indications in the antennæ of *Samia* which point to its recent or even present progress. The pectinations are not well established in form and position; the cones are variable in position; even the segmentation is more or less indefinite in portions of the clavola. This appears to bear out Chapman's view (*antea*, p. 283).

The sexes repeatedly pair more than once. A male will pair with more than one female (see *Psyche*, vii., p. 167). No less than seven males of *Callosamia promethea* are recorded as pairing with a single female (*loc. cit.*). Moffat gives (*Can. Ent.*, 1894, p. 240) an interesting account of the assembling of males of *C. promethea* to a female hanging from the cocoon from which she had emerged, about 3 p.m. on June 11th, 1894. The ♀ was quite still, not a movement of wing or foot, during the time that the males flew around, before pairing took place. Mayer describes (*Psyche*, ix., pp. 15—20) a most interesting series of experiments "on the mating instinct in moths," especially as exemplified in *C. promethea*. They are much too long even to summarise, but his conclusions may be stated as follows:

1. The male is positively chemotactic toward some substance which emanates from the abdomen of the female, and which he perceives through olfactory organs situated upon his antennæ.

2. Females 30—60 hours old are much more attractive to males than are young females 5—10 hours old. Virgin females are somewhat more attractive than are fertilised ones of the same age.

3. The male will mate at least four times, either with the same or with different females.

4. Neither males nor females pay any attention to the appearance of their partners. The melanic colours of the ♂ have not been brought about through sexual selection on the part of the female.

Gynandromorphism is marvellously frequent in our European Attacids, more particularly in *Saturnia pavonia*. Schultz mentions (*Illus. Woch. für Ent.*, i., pp. 385, 416, 445; ii., pp. 462, 474, 494) no fewer than 74 specimens belonging to 5 species, *viz.*, *Saturnia pyri*, 4 examples, *S. spini* 2, *S. pavonia* 48, *S.* hybr. *emiliae* 3, *S.* hybr. *risii* 3, *S. caecigena* 1, *Aglia tau* 7, *A.* ab. *fere-nigra* 4, *A.* ab. *nigerrima* 2. Later (*loc. cit.*, iii., pp. 184, 294, 311), he supplements this by the addition of the following: *S. pavonia* 3, *S.* hybr. *emiliae* 1, *S.* hybr. *risii* 2, *S.* hybr. *schaufussi* 10, *S.* hybr. *standfussi* 12, *Aglia tau* 1. [For details, see *postea*, pp. 302 *et seq.*] Several unrecorded examples of *S. pavonia* are in various collections, and no doubt these numbers, large as they are, could be materially increased. Gynandromorphism is also recorded in a specimen of *Platysamia cecropia* (*Soc. Ent.*, xii., p. 9) bred by Frings.

Possibly, however, the most interesting phenomenon presented by the Attacids is the ease with which many of the species hybridise. So extensive have been the recent experiments of Standfuss and others that it is difficult to deal with them at length. One may pass by Hagen's remarks (cited *Can. Ent.*, viii., pp. 77 *et seq.*) that *Platysamia columbia* might be a hybrid between *P. cecropia* and *promethea*, as being a matter of speculation, not warranted by later facts. As to positive evidence—Bigot, a French sericulturist, obtained *Antheraea* hybr. *pernyi* × *yamamai*, and *A.* hybr. *yamamai* × *pernyi*, eggs from which produced in due course magnificent moths, the hybrid hybernating in the pupal stage and maintaining itself as a distinct form for some time. Berce also obtained hybrids of *A. yamamai* × *pernyi*, and 19 of these cocoons came into the possession of Wailly in 1875 (*Entom.*, xiii., pp. 155 *et seq.*). From these cocoons only 1 imago, a ♀, emerged, and this paired with a male *A. pernyi*, the larva, when hatched, being entirely black like those of *A. pernyi*, and bearing no resemblance to those of *A. yamamai*. Wailly does not tell us what special characters were developed later; one suspects that some signs must have remained of the *yamamai* ancestry. About 1878, the Bombay silk-spinners are said to have hybridised the Indian Tusser silkworm (*Antheraea mylitta*) with *A. yamamai*, whilst Bourdier, in 1878, evidently obtained fruitful hybrids between *A. pernyi* and *yamamai*, which he called *A.* hybr. *perny-yama* and says: "This fruitful hybrid has the immense advantage over the parents of being perfectly hardy; it will resist a temperature of 0° C., and will eat even dried leaves if they are not brittle; a second brood may be obtained each year, if the breeder, by artificial means, hastens the emergence of the moths from the hybernating cocoons." Wailly further notes that for several years he has obtained crossings as follows: *pernyi* ♂ × *polyphemus* ♀; *cecropia* ♂ × *cynthia* ♀, several times; *cecropia* ♂ × *gloveri* ♀; *cecropia* ♂ × *polyphemus* ♀, several times; *pyri* × *cecropia*, but that in every case the eggs have proved infertile. Wallace cites (*Darwinism*, 1889, p. 163) from Quatrefages, a case of fertility *inter se* in *Attacus* hybr. *cynthia* × *arrindia*. Watson notes (*Ent.*, xxvi., p. 174) a reputed fertile hybrid between *Attacus cynthia* and *A. ricini*, but questions whether it be, indeed, a hybrid, asserting that it is "now conclusively proved that *ricini* is merely the Burmese local polyvoltine or many-brooded variety of the common *cynthia*," and concludes that even if crossings of *cynthia* and *ricini* are perfectly fertile, it is only a cross between a species and its variety. He further records (*loc. cit.*, p. 176) *Antheraea mylitta* crossed with *A. yamamai*, and *A. pernyi* with *A. mylitta*. Heyer notes (*Soc. Ent.*, xiii., pp. 137—138) pairings as follows:

(1) *Platysamia cecropia* ♂ × *Saturnia pyri* ♀. (2) *Platysamia cecropia* ♂ × *P. californica* (*ceanothi*) ♀. (3) *Platysamia californica* (*ceanothi*) ♂ × *P. cecropia* ♀. (4) *Platysamia watsoni* ♂ × *P. cecropia* ♀. (5) *Platysamia heyeri* ♂ × *P. cecropia* ♀. (6) *Platysamia cecropia* ♂ × *P. watsoni* ♀. (7) *Platysamia cecropia* ♂ × *P. heyeri* ♀. (8) *Platysamia watsoni* ♂ × *P. heyeri* ♀. (9) *Platysamia heyeri* ♂ × *P. watsoni* ♀. (10) *Telea polyphemus* ♂ × *Antheraea pernyi* ♀. (11) *Antheraea pernyi* ♂ × *A. yamamai* ♀.

Combination 1 succeeded in only two cases, with sacrifice of considerable material, 4-11 each in one case, 2-3 in several. All the eggs from the crosses *polyphemus* × *pernyi* and *cecropia* × *pyri* were infertile. The *pernyi* laid a normal number, one of the *pyri* perhaps half the normal number the other only one egg. Both the fresh and vigorous *pyri* ♀s died within an hour after ovipositing, a thing which Heyer never observed in normal pairings among *pyri*.

At the meeting of the Entomological Society of London, July 7th, 1886, Wailly exhibited some remarkable hybrids between *Platysamia cecropia* and *P. californica (ceanothi)*, but one finds a much fuller account of the hybridisation of some of the American species (*Ent.*, xxvi., pp. 176—

177) and a description of some of the hybrids by Miss Morton (*Proc. Ent. Soc. Lond.*, 1895, pp. xxxiv—xxxv). The pairings obtained were *Platysamia cecropia* ♂ × *gloveri* ♀ (in 1891), *P. columbia* ♂ × *cecropia* ♀ (in 1893), *P. cecropia* ♂ × *californica (ceanothi)** ♀ (in 1893), *Actias luna* ♂ × *selene* ♀ (in 1892). Of these only short comparative notes, however, were published, and no detailed descriptions of the imagines or larvæ. Among the details noted are:

1. *Platysamia* hybr. *griffithsi*†, Tutt (*cecropia* × *gloveri*).—The hybrids are slightly paler than *P. cecropia*, and the white bar between the ocelli and the margin is with only the faintest trace of the red outer edge so noticeable in *P. cecropia*. These bars, in the latter, are indented and curved, but in the hybrids are much less indented, and those on the primaries are not nearly so bent as in *P. cecropia*, and on both wings are broader than in the latter; outer margin of secondaries of same shade as primaries, not darker as in *P. cecropia*, the whole insect being slightly below the size of *P. cecropia* (Watson, *Ent.*, xxvi., pp. 176–177). Miss Morton adds: "The hybrid larvæ take equally after both parents—the large size of that of *P. cecropia*, the bird's-egg blue of that of *P. gloveri* intensified with lemon-yellow tubercles, most beautiful objects. The largest of the *cecropia* × *gloveri* larvæ are larger than those of any *cecropia* I ever saw."

2. *Platysamia* hybr. *watsoni*, Tutt (*cecropia* × *californica* (*ceanothi*)).—Nearer to *P. cecropia* than *P. ceanothi* in size and shape of wings, though intermediate in markings, but of a lighter colour than either parent. The costa of primaries of *P. ceanothi* is straight for three-fourths of its distance from the base, in the hybrids it is arched all the way as in *P. cecropia*; the outer margin of the secondaries of *P. ceanothi* is not rounded as we find in *P. cecropia*, and in this again the hybrids distinctly take after *P. cecropia*. The costa of secondaries of *P. ceanothi* has a dip in them, in *P. cecropia* the costa is arched; the costa of the hybrids, as in their primaries, is arched also. The white bar on the wings of the hybrids, however, conforms much more nearly to *P. ceanothi*, and the ocelli of both primaries and secondaries are intermediate in shape between those of their parents, having the width of that of *P. cecropia* and the length of that of *P. ceanothi*, in which species, as in the hybrids, the outer point merges into the white bar on the secondaries. The underside of secondaries of *P. cecropia* has a whitish band, commencing at the base, where it is slightly wider, running round the costa and meeting the white band of the outer margin. In *P. ceanothi* this band is nearly obsolete, but on the costa and a little from the base is a pinkish spot. In the hybrids this spot is dilated into an elliptic or spindle-shaped spot, running to the base of the wing on the one side, and on the other side narrowed out into a mere streak along the costa till it meets the marginal band of white, into which it merges (Watson, *Ent.*, xxvi., p. 177). Miss Morton notes: "The hybrid larva is not nearly so handsome as that of *P.* hybr. *cecropia* × *gloveri*, and was readily distinguishable from the larva of *P. cecropia*; the larvæ grew to an immense size, though none attained the size of a few ♀ larvæ of the *P.* hybr. *cecropia* × *gloveri*."

The imagines of both the above hybrids differ so greatly from either of the parents, that they have the facies in each case of a quite distinct species; but the most remarkable thing about them (and the other hybrids here mentioned) is their total barrenness. I have never known a hybrid to lay an egg, nor the ♂ to fertilise, though both sexes pair freely with each other and with *P. cecropia* (Morton). This experience differs from that of Heyer (*posted*, p. 293), and that of Standfuss (*posted*, p. 300).

3. *Platysamia* hybr. *americana*, Tutt (*columbia* × *cecropia*).—This hybrid varies more than any other here noted, some examples being deep red-grey, others pinkish-grey, and yet others have the ordinary grey colour of *P. cecropia* (Watson).

4. *Actias* hybr. *mortoni*, Tutt (*luna* × *selene*).—The moths are intermediate between their respective parents, in colour, shape, and markings, though there is a variation towards either of their parents. The hybrids do not show (in those examined)

* Grote himself (*Can. Ent.*, xxvii., p. 267) calls this *rubra*, Behr. (1855)=*californica*, Grt. (1865)=*ceanothi*, Behr. (1868).

† Griffiths notes (*in litt.*): "One prominent distinction of this hybrid is the brilliant whiteness of the indented marginal line of the forewings—the number and shape of the indentations being as in *cecropia*."

any trace of the small oblique dash of red which runs from the costal nervure on primaries to the ocellus as is seen in *A. luna**, though not in *A. selene*, nor is there anything like an intermediate amount of the beautiful white down on the bases of the wings found so plentifully in *A. selene*. The ♂ hybrid leans towards *A. selene*, and the ♀ towards *A. luna* (Watson, *Ent.*, xxvi., p. 176). The larvæ were very like those of *A. luna*, only more richly coloured, and most of them considerably larger than *A. luna*; the cocoons were very different from either those of *A. luna* or *A. selene*, pale-coloured and silky, thinner even than those of *A. luna*, and the hybrids are very beautiful, the ♂ s a great deal handsomer than ♂ *A. luna*, with very pointed primaries (like *A. selene*), but the eyespots a bright pink; a few have the pink streaks on the anal angles like *A. selene*, but most of them are whitish with only the faintest blush. The ♀ s are more like ♀ *A. luna*, only considerably larger, with the eyespots all pink instead of yellow (Morton, *loc. cit.*). Miss Morton further adds: "It was remarkable that, in all the specimens bred, the ♀ hybrids followed *A. luna*, and the ♂ s followed *A. selene*, yet *A. selene* was the mother of the brood. All emerged from August 30th to November of the same season; of course the later stages were passed in the house. *A. luna*, it may be added, goes over the winter as a pupa."

Miss Morton notes that the only trouble in pairing is that one must have a ♀ of the species one wishes to attract to the ♀ which one wants to hybridise, *e.g.*, a ♂ *P. cecropia* was wanted to pair with a ♀ *P. californica (ceanothi)*. The ♀ *P. ceanothi* was left in cage with door open, a ♀ *P. cecropia* being in a cage above her with the door shut. The attracted ♂ s of *P. cecropia*, being unable to reach the ♀ *P. cecropia*, paired with the female *P. californica* (*ceanothi*). To get the crossing with the ♀ *P. gloveri*, two males of *P. cecropia* were placed with her in the cage, and the strongest paired with her. With the *A. luna* and *A. selene* cross a ♀ *A. selene* was tied at night on a hickory-tree; a ♀ *A. luna* was placed in a closed cage at foot of tree; in the morning the ♀ *A. selene* was paired with a wild ♂ *A. luna*. The hybrids frequently remain two years in the pupal stage; 25 emerged the second year from one brood of larvæ, yet all the *A. luna* and *A. selene* emerged the same autumn without even going over one winter.

4. *P.* hybr. *heyeri*, Tutt [*californica* (*ceanothi*) ♂ × *cecropia* ♀].—This is the reciprocal cross to *P.* hybr. *watsoni*, and has been bred by Heyer (see *Soc. Entom.*, xiii., p. 137).

Heyer notes that attempts to pair hybrid *cecropia* × *californica* (*ceanothi*) (=*watsoni*) and *californica* (*ceanothi*) × *cecropia* (=*heyeri*) among themselves failed to produce a single egg, and the body of a ♀ which was opened showed no trace of any. On the other hand ♀ s of *P. cecropia* which were paired with ♂ s of both these hybrids produced a very high percentage of fertile eggs.

Wailly records (*Ent.*, xxix., pp. 235 *et seq.*) the rearing of hybrids between the two allied species *Antheraea roylei* and *A. pernyi*, the moths pairing together as if they were the same species, and he adds that this "is the same with all closely allied species. The hybrid was robust, the specimens perfectly fertile *inter se*, and at the end of three years showed no sign of degeneracy. The hybrid *A. pernyi* × *roylei* was described by Kirby (*Proc. Ent. Soc. London*, 1882, p. vii), and that of *A. roylei* × *pernyi* by Moore (*Ent.*, xxix., p. 237). These descriptions read as follows:

(1) *Antheraea* hybr. *kirbyi*, Tutt (*pernyi* × *roylei*).—The hybrid before us expands just 6″ across the wings, which is about the size of large ♀ examples of the two parent species. It is of a greenish-buff colour, nearly as in the ♀ of *A. roylei*, but much clearer and with a distinct tawny shade, especially within the common band;

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* Griffiths notes (*in litt.*): "My hybrid *mortoni*, a ♀, has this red dash well-developed, though narrower than in *luna*; it also has the hindwings deeply scalloped."

the body and base of the wings are also suffused with a distinct vinous shade more resembling *A. pernyi* than *A. roylei*; the shape of the wings also agrees better with that of *A. pernyi*. On the other hand, the ocellated spots resemble those of *A. roylei*, but are considerably larger, the pupil especially being as large as in *A. pernyi*, but the projection of the black outer rim, so conspicuous in *A. pernyi*, is scarcely indicated. The other markings of the wings are well defined and resemble those of *A. roylei*. On the under surface the insect agrees in colour and markings with typical *A. roylei*, but the basal band is less distinct and perhaps less waved, and the submarginal spots, dusted with white and pink, are larger and more distinct. Just inside these is a very faint dark stripe, more distinct on the right wing. In *A. roylei* this is still more indistinct, whereas in *A. pernyi* it is well-marked, but closer to the spots. The antennæ and the body of the hybrid are more like those of *A. pernyi* than of *A. roylei*. The cocoon is fully as large as that of *A. roylei*, but, instead of there being a considerable space between the outer and inner cocoons, there is scarcely any interval between them. *A pernyi* has a similar but much smaller cocoon, and hence it would appear that that of the hybrid would be of greater commercial value than either (Kirby).

(2) *A.* hybr. *moorei*, Tutt (*roylei* × *pernyi*).—The imago, in point of coloration, is intermediate between the two species. Both sexes of the hybrid show the mealy olivaceous colour of the pure *A. roylei*, dominated by a tinge of the ochraceous colours of *A. pernyi*; the ochraceous tinge, however, is brightest across the discal area of both wings within the transverse band, and more especially so in the ♀. The bands on both wings are more strongly developed than in *A. roylei*, and more so even than in *A. pernyi*, the ocellated spots in both sexes are larger than in either *A. roylei* or *A. pernyi*, the talcose central spot being much larger than in *A. roylei*, but about the same size as in *A. pernyi*. The ocellated spot on the hindwings differs from that of *A. roylei*, in having the upper curve somewhat extended upwards, thus giving it a slightly lobate form as in some ♀ specimens of *A. pernyi*. Both sexes of the hybrid are comparatively larger than the general size of *A. roylei*, and are much larger than *A. pernyi* (Moore).

Standfuss records in his *Handbuch* (pp. 99—100) the pairing of *Saturnia pavonia* ♂ with *Actias luna* ♀, nine apparently normal pairings taking place, and over 1000 eggs being laid, but none hatched. A crossing of *S. pavonia* ♂ with *A. isabellae* ♀ also took place (*loc. cit.*), the ♀ laying 98 eggs, of which 7 hatched; the larvæ did not, however, long survive their first change of skin. Details of the hybridism of *Saturnia pavonia*, *spini* and *pyri* will be found in our account of the genus *Saturnia* (*posted*, pp. 296 *et seq.*).

Subfam.: SATURNIINÆ.
Tribe: SATURNIIDI.
Genus: SATURNIA, Schrank.

SYNONYMY.—Genus: *Saturnia*, Schrank, "Fauna Boica," ii., p. 149 (1802); Ochs., "Die Schmett.," iii., p. 6 (1810); iv., p. 46 (1816); Leach, "Edin. Ency.," ix., p. 132 (1815); Oken, "Lehrb. Zool.," i., p. 714 (1815); Samouelle, "Ent Comp.," p. 246 (1819); Stphs., "Ill.," ii., p. 37 (1828); "Cat. Br. Ins.," pt. 2, p. 45 (1829); "List Br. An. Br. Mus.," v., p. 45 (1850); Meig., "Eur. Schmett.," ii., p. 156 (1830); Bdv., "Eur. Lep. Ind. Meth.," p. 49 (1829); "Icon. Chen.," pl. ii., figs. 1—3 (*circ.* 1840); "Gen. et Ind. Meth.," p. 73 (1840); Wood, "Ind. Ent.," p. 21, fig. 39 (1839); Dup., "Icon. Chen.," pl. ii., figs. *a*—*h* (*circ.* 1840); Zett., "Ins. Lapp.," p. 921 (1840); Humph. and Westd., "Brit. Moths," p. 51 (1841); Evers., "Faun. Volg.-Ural.," p. 116 (1844); H.-Sch., "Sys. Bearb.," ii., p. 96 (1846); Bohem., "Vet. Ak. Hand.," 1848, pp. 146—147 (1850); Heydnr., "Lep. Eur. Cat. Meth.," p. 28 (1851); Sta., "Man.," i., p. 160 (1857); Speyer, "Geog. Verbr.," i., p. 417 (1858); ii., p. 288 (1862); Hein., "Schmett. Deutsch.," p. 196 (1859); Humph., "Gen. Brit. Moths," p. 20 (1860); Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 70 (1871); 3rd ed., p. 127 (1901); Snell., "De Vlind.," p. 196 (1867); Berce, "Faun. Franç.," p. 207 (1868); Nolck., "Lep. Fn. Estl.," i., p. 131 (1868); Newm., "Brit. Moths," p. 48 (1869); Wllgrn., "Skand. Het.," ii., p. 130 (1869); Mill., "Cat. Lép. Alpes-Mar.," i., p. 146 (1872); Bang-Haas, "Nat. Tids.," ix., p. 410 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 71 (1874); "Curò, "Bull. Soc. Ent. It.," viii., p. 153 (1876); Frey, "Lep. Schweiz," p. 99 (1880); Kirby, "Eur. Butts. and Moths," p. 126 (1880); "Cat.,"

p. 773 (1892); "Handbook," &c., iv., p. 105 (1897); Buckl., "Larvæ," &c., iii., pl. lii., fig. 1 (1889); Auriv., "Nord. Fjär.," p. 66 (1889); Meyr., "Handbook," p. 313 (1895); Tutt, "Brit. Moths," p 42 (1896); Barr., "Lep. Brit.," iii., p. 57 (1896); Grote, "Die Saturniiden," p. 3 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 59 (1899). *Phalaena-Bombyx*, Linn., "Sys. Nat.," ed. x., p. 496 (1758); "Faun. Suec.," ed. 2, p. 291 (1761); Müll., "Fn Frid.," p. 38 (1764); "Zool. Dan.," p. 117 (1776); Bkh., "Eur. Schmett.," iii., p 34 (1790); Brahm, "Ins. Kal.," ii., 1, pp. 173, 450 (1791); [F. J. A. D.,] "Rhein. Mag.," p. 328 (1793); Cuv., "Tabl. Elem.," p. 594 (? 1798). *Phalaena-Attacus*, Linn., "Sys. Nat.," ed. xii., p. 810 (1767); Lang, "Verz.," ed. 2, p. 81 (1789); Schwarz, "Raup.-Kal.," p. 234 (1791); Esp., "Schmett. Eur.," iii., pl. iv., p. 35 (1782). *Phalaena*, Scop., "Ent. Carn.," p. 192 (1763); Fuess., "Schw. Ins.," p. 33 (1775); "Neu. Mag.," ii., p. 268 (1785); iii., 2, p. 149 (1787); Hfn., "Berl. Mag.," ii., pp. 394, 428 (1766); Sulzer, "Kenn. d. Ins.," p. 38 (1761); Retz., "Gen. Spec. Ins.," p. 25 (1783). *Bombyx*, Fab., "Sys. Ent.," p. 539 (1775); "Spec. Ins.," ii., p. 171 (1781); "Mant. Ins.," ii., p. 110 (1787); "Ent. Sys.," iii., pt. 1, p. 416 (1793); [Schiff.,] "Schmett. Wien.," ed. i., p. 50 (1775); ed. ii., p. 66 (1801); Hb., "Eur. Schmett.," figs. 53, 54, 255 (*circ.* 1800); text p. 116 (1805); Schrk., "Faun. Boica," ii., 1, p. 249 (1801); View., "Tab. Verz.," p. 29 (1789); Rossi, "Faun. Etr.," ii., p. 168 (1790); Haw., "Lep. Brit.," i., p. 78 (1803); Latr., "Hist. Nat.," xiv., p. 176 (1805); "Gen. Crust.," iv., p. 218 (1809); "Consid.," &c., p. 441 (1810); Godt., "Hist. Nat.," iv., p. 68 (1822). *Heraea*, Hb., "Tent.," p. 1 (1806); "Franck Cat.," p. 88 (1825). *Attacus*, Germ., "Bomb Spec.," i., p. 10 (1811); Dup., "Cat. Méth.," p. 79 (1844); Rambur, "Cat. Lép Andal.," p. 378 (1869). *Pavonia*, Hb., "Verz.," p. 157 (*circ.* 1822).

Schrank's original description of the genus reads as follows:

Fühlhörner: zweyreihig gekämmt; beyde Reihen fast in einerley Fläche verbreitet. *Zunge:* fehlt. *Schnauzen:* zwo, behaart. *Flügel:* dicht beschuppet, in der Ruhe anfliegend, ziemlich verbreitet: die obern breit. *Raupe:* nackt, walzenförmig, mit borstig gestirnten Warzen. [Hieher rechne ich die Familie B. des *Wiener Verzeichnisses* nebst dem *Bombyx* T. aus der vorhergehenden Familie. Also]—*Saturnia pyri, S. spini, S. carpini, S. tau.*

The genus as constituted by Schrank is heterotypical, *tau* being quite distinct generically from the other three species. In 1806, Hübner, neglecting Schrank's genus, created (*Tentamen*, p. 1) two new stirpes (with genera)—(1) *Echidnae—Echidna* with *tau* as type. (2) *Heraeae—Heraea*, with *carpini* as type. The question, therefore, arises, as the original genus *Saturnia* was split by Hübner into two moieties with a new name for each, as to which shall retain the original generic title. Both names were published simultaneously although *Echidna* has priority of position on the page. In 1809, Latreille (*Consid.*, iv., p. 218) restricted *Saturnia* (as a subgenus of *Bombyx*) to "*pavonia*, Fb." (*i.e.*, *carpini*, *pyri* and *spini*); in 1810, Ochsenheimer (*Die Schmett.*, iii., pp. 1 and 11) not knowing of Hübner's subdivision, but recognising, as the latter had done, the heterotypical nature of *Saturnia*, Schrk., restricted the latter to *carpini*, *pyri* and *spini*, but created the genus *Aglia* for *tau*. These being the first real limitations of Schrank's genus *Saturnia*, the latter name must be retained for *pavonia* (*carpini*), *spini* and *pyri*, whilst *Aglia* would fall as a synonym of *Echidna* had not the latter been preoccupied. In 1816, Ochsenheimer had obtained the *Tentamen* and writes (*Die Schmett.*, iv., p. 46): (1) *Saturnia*, Schrk.=*Heraea*, Hb. (2) *Aglia*, Ochs.=*Echidna*, Hb. About 1822, Hübner (*Verz.*, p. 152) accepted Ochsenheimer's name *Aglia* (sinking the preoccupied *Echidna* as a genus) and also sinks his own genus *Heraea*, but creates (*loc. cit.*, p. 157) the genus *Pavonia*, for *pyri*, *spini* and *pavonia*, restricting *Saturnia* to *maja*, Drury (=*proserpina*, Fab.), a species not even mentioned in Schrank's original genus. At the same time he retains *Heraeae* and *Echidnae* as stirpes (*antea*, pp. 266—267). Hübner's action, therefore, must be considered as altogether *ultra vires*, as affecting *Saturnia*, although his restriction of *Heraea* to *carpini* as type, in 1806, may be held to have settled this to the exclusion of *pyri* and *spini*, *tau* already being eliminated as the type of *Aglia*.

Packard considers (*Proc. Amer. Acad. Arts Sci.*, 1893, p. 57) that, "in the European *Saturnia carpini* and its allies, and the Pacific coast species, *Saturnia mendocino** and *S. galbina*, we have perhaps the most generalised and primitive members of the family. In the larva of *S. carpini* the setiferous tubercles are of the same size and shape on the abdominal as on the thoracic segments, there being no differentiation in shape, and size, or colour †, such as occurs in all the other genera, except that the second and third thoracic dorsal tubercles bear one or two bristles much longer than those on abdominal segments 1-7, and about as long as those on the 8th abdominal segment. There are six tubercles on the 8th segment, being the same number as on the seven segments in front; on abdominal segment 9 there are four tubercles, and two on the 10th, *i.e.*, the suranal plate. The same number of tubercles on the 8th abdominal segment also occurs in *Saturnia mendocino* of California." Packard further considers that the generalised form of *Saturnia* larva is clearly shown by the fact that, in *Platysamia cecropia* and all the other more specialised and later genera, there are only 5 tubercles on the 8th abdominal segment, those corresponding to the middle ones of *Saturnia* having, probably during embryonic growth, coalesced . . . . . . Meanwhile it is not unreasonable to suppose that all the more specialised genera must have been derived from a *Saturnia*-like ancestral form, *i.e.*, a larva of cylindrical shape, with all the tubercles, whether thoracic or abdominal, of the same size, shape, and colour on all the segments; those on the 8th abdominal segment being of the same number (six) as on the segments in front."

Standfuss has carried out elaborate crossings of the species of *Saturnia*, his earliest results being detailed (*Handbuch der palaeark. Gross-Schmett.*, pp. 66 *et seq.*) in 1896. The experiments on which these results were based were carried over some ten years, the parent species dealt with being *Saturnia pavonia*, *S. spini* and *S. pyri*. The various primary hybrid forms are described in detail in this work as follows:

1. *S.* hybr. *bornemanni*, Stdfss. (*pavonia* ♂ × *spini* ♀).—The eggs first laid were regularly deposited, and were fertile to the extent of from 60 to 85 per cent. The larvæ in all five stages bore a much closer resemblance to those of *S. spini* than to those of *S. pavonia*, though this became less pronounced after the second stage was passed. The cocoon and pupa were both intermediate in structure, but the perfect insect was nearer to *S. spini* than to *S. pavonia*. This applies to both sexes, but is more easily seen in the male, the males of the two parent species differing (as is usual) more than the females (*loc. cit.*, pp. 66—74, figs. 1—3, pl. ii., figs. 3—5, pl. iii., figs. 9—10).

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* Smith erects for this the genus *Calosaturnia*, see *Proc. U.S. Nat. Mus.*, ix., p. 432 (1886).

† We are inclined to disagree entirely with this. Our own impression is that this represents extreme specialisation.

2. *S.* hybr. *hybrida**, Ochs. (*spini* ♂ × *pavonia* ♀).—The reciprocal cross of above, not yet produced in captivity, stated by Standfuss to be repeatedly found in the wild state, generally as larva. Standfuss asserts (*Handbuch*, etc., p. 74) that the parentage is undoubted, that the larva, though intermediate in character, shows constant differences from that of *S. bornemanni*, and that the conditions in nature for the pairing of *S. spini* ♂ and *S. pavonia* ♀ are favourable, whereas those for the converse cross are difficult or impossible. The males of both species emerge before the females, and in regions where both occur *S. pavonia* is out first. Hence, though the females of *S. pavonia* are out with the males of *S. spini*, the converse does not take place. It must be allowed that it would be well to test this conclusion as to the parentage of *S. hybrida* by experiment. The larva of *S. hybrida* resembles *S. pavonia* somewhat more than does that of *S. bornemanni*; it possesses, however, the greasy polish of *S. spini* to a greater extent than the latter. The cocoon and pupa both show a nearer approach to *S. spini* than do those of *S. bornemanni*, and the same applies to the perfect insect; in fact, the resemblance of both sexes to the male parent is remarkably close (*loc. cit.*, pp. 74—76, pl. ii., figs. 1—2).

3. *S.* hybr. *emiliae*, Stdfss. (*pavonia* ♂ × *pyri* ♀) and *S.* hybr. *emiliae* ab. *daubii*, Stdfss. (dark aberration).—The crossing of *S. pavonia* ♂ × *pyri* ♀ produced hybrids which fell into two classes, a dark form called by Standfuss, *S. daubii*, and a paler form to which he gives the name *S. emiliae.* The latter is by far the commoner. As in former cases, if the laying be much deferred after pairing, the eggs are apt to prove infertile. The larva in its early stages is very like that of *S. pyri*; as it grows it becomes more and more like that of *S. pavonia*, and finally bears a close resemblance to the latter species. The cocoon is intermediate; the pupa is nearer to *S. pavonia* than to *S. pyri.* The perfect insect, except for a reduction in the sexual disparity of size, is more like an enlarged *S. pavonia* than a diminished *S. pyri.* In a majority of specimens some of the nervures were forked terminally at a greater or less distance from the margin of the wings (*loc. cit.*, pp. 77—83, p. 81, figs. 3–5; pl. i., figs. 1—4; pl. iii., figs. 13—14).

4. *S.* hybr. *hybrida-major*, Staud. (*nec* Ochs.) (*pyri* ♂ × *spini* ♀).—Said by Staudinger to have been described by Ochsenheimer (*Die Schmett.*, iv., p. 192). There is no evidence whatever that the cross is *pyri* × *spini* (see footnote below). Standfuss refers to it as *spini* ♂ × *pyri* ♀ (*loc. cit.*, p. 57).

5. *S.* hybr. *hybrida-media*, Staud. "Cat.," 2nd ed., p. 70 (*pyri* ♂ × *pavonia* ♀).

The males of *S.* hybr. *emiliae* paired readily with the females of *S. pavonia*; they were also attracted by the female hybrids, though in a less degree. The latter were, as already stated, infertile, the

* The original description (*Die Schmett.*, iii., pp. 9, 10) reads as follows: "As a result of the pairing of *S. spini* and *carpini* a hybrid has been produced which is found in some of the Vienna collections under the name of *Pavonia hybrida.* I have already mentioned it in the introduction to vol. ii., p. viii, and give here a further description from a perfect pair which I received from the late H. Radda. The ♂ resembles *S. carpini* in colour and form, but is somewhat larger, the ground-colour grey-brown, mixed with reddish, the first transverse line only slightly inclined inwards towards the costa, the second undulated stripe terminates above the eyespot of the hindwings, which are coloured yellow-grey in the middle. The underside of the forewings is yellow-grey, that of the hindwings tinged with reddish, with a white central spot, in which the eye [-spot] stands. The white spot at its outer angle shows distinctly. The ♀ has the antennæ like *S. spini*, the undulated line of the forewings as in the ♂, the first transverse stripe towards the base meets that of the hindwing, and the whitish central area thereof, in which the eyespot stands, is broader, especially towards the inner margin. The larva also is said to be intermediate between *S. spini* and *S. carpini.*" Ochsenheimer says (id. ii., p. viii): "I possess a perfect hybrid, in both sexes, which arises from the crossing of *B. spini* with *B. carpini*, forms an unmistakable intermediate, and is found also in some collections in Vienna under the name *Pavonia hybrida.*" In vol. iv., pp. 191—193, Ocshenheimer appears to have described another form of this same hybrid (*spini* × *pavonia*), for he there writes that, on taking over Radda's collection, he found not only three examples of the hybrid described in vol. iii as *Pavonia hybrida-major*, but also a second *Pavonia hybrida-minor*, which is as essentially different from *carpini* as is the former from *spini.* He then describes the two forms as *Pavonia hybrida-major* and *P. hybrida-minor* at length, the former in both sexes, which resemble most those of *S. spini*, the latter also in both sexes, which resemble most *S. carpini.* There is no reference to *S. pyri* in either description.

oviducts containing no ripened eggs. Pairing also took place, though with much less readiness than in either of the preceding cases, between the hybrid males and some females of *S. pyri*. The number of fertile eggs produced in the latter case was far smaller than in the cross with *S. pavonia*. The secondary hybrids are described at length as follows:

1. *S.* hybr. *schaufussi*, Stdfss. (*bornemanni* ♂ × *pavonia* ♀).—The larvæ at first closely resembled those of *S. pavonia*, but, in subsequent stages, the influence of *S. spini* began to assert itself. They presented a very variable appearance on reaching the fourth stage, which period, unfortunately, they did not survive (*loc. cit.*, pp. 86—87). [Fresh batches, however, have since been raised to maturity by Dixey, from ova supplied by Standfuss in 1895, as well as by Standfuss himself (*Ent.*, xxxiii, pp. 344 *et seq.*, pl. iii., figs. 6-8).]

This hybrid is important as one of the only ones that have produced fertile progeny of both sexes (*Ent.*, xxxiii., p. 345). Standfuss has inbred ♂ s and ♀ s of *schaufussi*, and succeeded in rearing two males of the same brood of this crossing, *i.e.*, *schaufussi* ♂ × *schaufussi* ♀, the only pairing between true hybrid forms that he has yet obtained. One of these is figured (*Ent.*, xxxiii., pl. iv., fig. 3) and gives a very curious impression. At first sight it appears to be an old and well-known form, and the next moment an entire stranger. The creature seems familiar when one simply regards the coloration which first forces itself upon one's attention, as it agrees so entirely with a lightly coloured *S. pavonia* ♀ that it could easily be mistaken for such; but the creature gives quite a different idea when one notices that it is without doubt a well-developed ♂. In fact, this creature agrees entirely in structure with that of a *S. pavonia* ♂, but possesses the exact coloration of *S. pavonia* ♀. By this crossing experiment the bright phylogenetically younger male coloration is thrown back to the phylogenetically older, less brightly coloured, ♀ type. The second ♂ is similar to this ♂ in structure and size, but on the upperside, on the outer border of the hindwings and in the centre of the forewings, beneath the eye-spot, towards the hind border, it possesses numerous rosy scales, and resembles the rare, somewhat-red form of *S. pavonia* ♀.

2. *S.* hybr. *standfussi*, Wiskott (*emiliae* ♂ × *pavonia* ♀).—The larvæ of this hybrid are very variable. Their general appearance is that of a large *S. pavonia*. The cocoon and pupa are also near the same parent species. The perfect insect, like the larva, is variable; it always, however, shows much resemblance to *S. pavonia*, and the sexes are dissimilar as in that species. The margins of the wings are apt to be scalloped. The oviducts of the single female that emerged contained mature eggs, but only about twenty, or one-tenth of the normal number in *S. pavonia* or *S. pyri*. It is possible that these hybrids may be fertile *inter se* (*Handbuch*, &c., pp. 87—91, pl. ii., figs. 6-7). [See also *Ent.*, xxxiii., p. 344.]

3. *S.* hybr. *risii*, Stdfss. (*emiliae* ♂ × *pyri* ♀).—This pairing was only obtained with great difficulty, and, in four cases out of nine, the eggs, though laid in normal numbers, did not hatch. In the remaining five broods only one per cent. produced caterpillars. These at first closely resembled *S. pyri*, and in the second stage still showed more likeness to *S. pyri* than to the male parent form. In the third stage the *S. pyri* characters began to be lost, and in the fourth those of *S. pyri* and *S. pavonia* were fairly balanced. After changing its last skin the larva resembled a large *S. pavonia*, though its parentage was three parts *S. pyri*. The perfect insects, of which only six were reared, were in many respects remarkable. Unlike *S. pyri*, they were sexually dimorphic, the females differing little from those of *S. emiliae*, while the males showed a nearer approach to *S. pyri*. The females were not dissected, but were probably sterile. Of the six specimens, one was hermaphrodite, and three others showed a tendency in that direction. These four were the produce of three separate females out of the five that laid living ova. Standfuss draws attention to the fact that the normal occur-

rence of hermaphrodites in lepidoptera is given by Speyer as about 1 in 30000. The latter number he considers rather too low than too high. There was no hermaphroditism in any known members of the families of the progenitors of these hybrids, and its appearance in this proportion must be, he thinks, a consequence of their exceptional origin. On the other hand, he has bred more than 1000 genuine hybrids without one such case occurring, nor was any such tendency shown by a single one of the sixteen specimens of *S. standfussi**—a form whose origin is analogous with that of the present cross-product. In the well-marked hermaphrodite mentioned above, the distribution of sexual characters is remarkable. The shape of the forewings is rather female than male, the colouring on the upperside of both is male; on the underside, the right is mostly male and the left female. In both hindwings, the upper surface has the costal portion male, the remainder female; the right, which is about one-fifth larger than the left, has the female area more extensive. The under surface of the right or larger hindwing is female, of the left, mostly male. The right antenna is male in form; the left partly male and partly female. The external genital organs on the right side are of a malformed male type; on the left side absent. The want of vigour in this cross is shown by the fact that out of nine pairings, each resulting in an average of 200 eggs, only ten larvæ were produced, and of these, only six, as we have seen, attained the perfect condition (*loc. cit.*, pp. 91—98; pl. iv., figs. 1—3).

4. hybr. *schlumbergeri*, Stdfss. (*bornemanni* ♂ × *pyri* ♀).—As *S. bornemanni* is the cross product of *S. pavonia* ♂ × *S. spini* ♀, this hybrid is descended from all three species. Only one pairing was obtained and 92 per cent. of the eggs hatched, whilst of the resulting progeny a pair is figured (*Ent.*, xxxiii., pl. iv., figs. 1—2). The ♀ gives one the impression of a very large, gigantic *S. spini*. The ♂ also inclines mostly to a large ♂ of this type, without, however, entirely discarding its connection with *S. pavonia* and *S. pyri*. Two male pupæ of this rarity have already gone over three winters without developing and will probably go over a fourth winter without emerging (*loc. cit.*, xxxiii., p. 345).

Further experiments were carried out by Standfuss in the years 1895, 1896, 1897 (*Ent.*, xxxiii., pp. 343 *et seq.*). As has been already noted above, the hybrid males of *S.* hybr. *pavonia* × *spini* and *S. pavonia* × *pyri* can be crossed back with the ♀ s of either of the parent species, and imagines from all these four crossings have been obtained, whilst the three Saturnias—*pavonia*, *pyri* and *spini*—have also been combined into a hybrid form, and still more complicated hybrids obtained, which only reached, however, the larval stage. These are detailed at length in tabular form (*Entom.*, xxxiii., p. 344) and figured [*loc. cit.*, pl. iii—iv (vii—viii)]. These crossings gave besides those already enumerated:

1. *S.* hybr. *dixeyi*, Tutt (*bornemanni* ♂ × *spini* ♀).—The hybrid figured (*Ent.*, xxxiii., pl. iii., figs. 4 and 5) resembles *S. spini* in structure and coloration. The ♂ differs from *S. spini*, however, in the single coloured dark grey-brown hairs of the upper side of the abdomen, while the ♀ possesses the broken transverse band at the base of the forewings, which is a peculiarity of *S. pavonia*.

2. *S.* hybr. *complexa*, Tutt (*standfussi* ♂ × *pavonia* ♀).—Of this also very complicated hybrid, three males of the same brood were successfully reared. The largest is figured (*Ent.*, xxxiii., pl. iv., fig. 4) the others measure respectively 71mm. and 73mm. The mother and grandmother of these hybrids were both very large ♀ s of the Dalmatian type of *S. pavonia*. The great size of these insects is certainly chiefly due to this origin, as only one-eighth of the *S. pyri* blood of the great-grandmother remains. In general all the specimens have the appearance of large light-coloured *S. pavonia* ♂ s of the Dalmatian form.

Three other crossings were obtained, fertile ova and larvæ resulting, but the larvæ died of an infectious disease when nearly fullgrown. These were: (1) *S.* hybr. *pavonia* ♂ × *schaufussi* ♀. (2) *S.* hybr. *schaufussi* ♂ × *pavonia* ♀. (3) *S.* hybr. *bornemanni* ♂ × *schaufussi* ♀

It might be supposed from these results that these crossings were abundantly fertile *inter se*, but this is not so, for Standfuss has found the ♀ s almost entirely incapable of egg-production, and has discovered as yet in the ♀ s only a very few degenerate egg-germs or

* Obtained in some numbers later, see *posteà*, pp. 302—304.

eggs, whilst the latter, as yet, have never shown themselves capable of development, except in the case of *S.* hybr. *schaufussi*, yet the males of the hybrids will readily pair with, and easily fertilise, the females of either parent stock. The experiments further brought out many incidental points; among others, they show that the male *S. pavonia* had very little influence on the progeny of a ♀ *S. spini*, with which it paired, whereas a male *S. pavonia* influenced greatly the progeny of a ♀ *S. pyri*. Comparison of certain characters, exhibited by the larvæ and pupæ of the three species—*spini*, *pavonia* and *pyri*—always resulted in placing *spini* in the lowest position genealogically, and *pyri* in the highest, so that pylogenetically the species always arranged themselves—*spini*, *pavonia*, *pyri*—*spini* being the oldest form. In the crossings, the oldest species, *spini*, was able to cling to its characters more strongly than the younger *pavonia*, and this latter again more strongly than the still younger *pyri*. Standfuss further notes that in the reciprocal crosses between *S. pavonia* and *S. spini*, the male element had more influence on the resulting form of the hybrid than the female. He further states that the experimental test of the reproductive capabilities of male hybrids, when crossed back with females of both parent forms, showed that the fertility of these primary hybrids was greater when paired with the phylogenetically older form than with the phylogenetically younger, so that the physiological characters of the primary hybrid were nearer to the phylogenetically older form than the younger." The chief points relating to the development of these hybrids are formulated (*Ent.*, xxxiii., pp. 346—347) as follows:

1. The secondary hybrids were not only produced by pairing primary male hybrids with females of the parent species, but also with the females of a third species.

2. A larger percentage of the broods of crossings of these primary hybrids with females of the phylogenetically oldest of its parents developed, than with the females of the younger.

3. The resulting brood shows in general the same characters as in the primary hybrids, in biological and physiognomical respects, but with a larger individual variability. A tendency was shown to follow the line of development of the phylogenetically older form of the two, and in the three species the phylogenetically oldest form.

4. In a less degree there is to be found in some male individuals a capability and inclination to individual development in new directions within a narrow limit.

5. Besides males capable of limited and individually varying degrees of reproduction and females mostly sterile, or only fertile to a slight degree, there appeared among certain secondary hybrids a relatively large number of gynandromorphous specimens in various crosses and in varying proportions.

6. The physiological affinity of the secondary hybrid males, and also of the somewhat fertile females, to the related types, has not yet been ascertained, so that nothing definite can be said about it. An increase of fertility, compared with that of the male parent, could not be ascertained in any of the numerous cases investigated, but, on the contrary, generally a decrease.

7. The broods of secondary hybrids, whether from an inpairing of these forms or from crossing with a true *Saturnia* ♀ has produced up to the present only males, which were certainly capable of reproduction.

Standfuss gives (*Handbuch*, &c., pp. 100—107) some most interesting suggestions as to the relative age of the three European species of *Saturnia*, as suggested by the oval, larval, pupal and imaginal structure, and details at length reasons for considering *S. spini* to be the oldest form and *S. pyri* the most recent. The chief of these are as follows:

1. The larva of *S. spini* maintains its original black colour throughout its life. *S. pavonia* loses this sometimes in the 3rd stage, always in the 4th or 5th. *S.*

pyri abandons it almost completely in the 3rd stage and onwards. The succeeding green colour, which is no doubt adaptive, is acquired by *S. pyri* at an earlier stage and more completely than by *S. pavonia*.

2. In the larva of *S. spini*, the tubercles are not very prominent even in the adult, and the knobs at their summit are not distinctively coloured until the last stage. In *S. pavonia* the tubercles are conspicuous and the knobs acquire an appearance distinct from the general surface of the body in the 3rd and 4th stages. In *S. pyri*, on emergence from the egg, the knobs are already coloured and indications exist of the extreme prominence of the tubercles.

3. The tactile bristles are least developed in *S. spini*, most in *S. pyri*.

4. The cocoon of *S. spini* is simpler than that of *S. pavonia*. That of *S. pyri* is the best defended of the three.

5. *S. spini* is almost sexually monomorphic though the male is somewhat the smaller. The female is very sluggish, and the antennæ of the male are pectinate to a high degree. In *S. pavonia* there is well-marked sexual dimorphism, as regards both size and colouring. The female resembles that of *S. spini* in aspect; it is less sluggish though not very active. The antennæ of the male are less strongly pectinate. *S. pyri* again is sexually monomorphic; the female is a tolerably good flier, and the antennæ in the male are less strongly pectinate than in many other species of *Saturnia*.

Standfuss further concludes from the larval and pupal characters that the three species form a progressive series in protective adaptation, *S. spini* always taking the lowest, and *S. pyri* the highest, step in the scale, so that *S. spini* must be considered on this ground also as the phylogenetically oldest, and *S. pyri* as the phylogenetically youngest, of the three forms. Other interesting details as bearing on the phylogeny are collected from observations on the larvæ and imagines of the hybrid forms. These are given at length *(loc. cit.*, pp. 110 *et seq.)*, and, summarised, read as follows:

1. The freshly-hatched hybrid larva closely resembles the larval form of the female parent.

2. With the process of growth a resemblance to the male parent gradually increases.

3. The final extent of approximation towards the male parent depends on the relative phylogenetic age of the two species, the older being able to transmit its properties, whether of structure or habit, better than the younger.

Thus the crossing of *S. pavonia* ♂ with the phylogenetically younger *S. pyri* ♀ gives rise to a larva in which at first the maternal and afterwards the paternal characters predominate. The resulting perfect insect is by more than two-thirds of its external appearance *S. pavonia*, and by less than one-third *S. pyri*. Its habits and functions correspond with its external aspect. It prefers to fly by day, like *S. pavonia* ♂, and pairs easily with the ♀ of that species, from 43 to 62 per cent. of the eggs being fertile. On the other hand, it does not pair readily with *S. pyri*, and the resulting eggs on an average of nine cases gave only one larva in 180. Similarly *S. pavonia* ♂, when paired with the phylogenetically older *S. spini* ♀, gives a form of which in the perfect state about two-thirds of the external aspect belong to the type of *S. spini*. The male flies by night. After crossing with *S. pavonia* ♀, the resulting eggs were only fertile to the extent of 16 to 22 per cent., while the crossing with *S. spini* ♀, though not easily brought about in consequence of their diverse times of appearance, yielded eggs of which from 94 to 98 per cent. were fertile. Thus the male *S. pavonia* is able to influence the issue of the relatively gigantic *S. pyri* ♀ much more than that of *S. spini* ♀. Again, the issue of *S. spini* ♂ × *S. pavonia* ♀ is much nearer *S. spini* than is that of *S. pavonia* ♂ × *S. spini* ♀. Hence—

4. In reciprocal pairing the male is able to transmit the characters of the species in a higher degree than the female.

The above cases show that the former influence, *viz.*, that of the older-established species, is the more effective of the two. The sexual prepotency of the male *S. pavonia* counts for less than the specific prepotency of the female *S. spini*. The highest effect, of course, is produced when the two influences concur, as in the hybrid of *S. spini* ♂ and *S. pavonia* ♀. A further result of the experiments is that, while no female* hybrid was proved to be fertile, there are undoubted cases of fertility in male hybrids. This has been shown by crossing with the females of both parent species, and in one case with a female of a third species (*S. bornemanni* ♂ and *S. pyri* ♀).

Standfuss has further proved a close connection between hybridism and a tendency to gynandromorphism, at least among these closely allied Saturnias—*spini*, *pavonia* and *pyri*. Not only were the females sterile or with only the slightest traces of fertility, but a very large percentage of the apparent females of some crosses showed distinct traces of male characters. Strange to say, the cross obtained from *S.* ♂ (*pavonia* × *spini*) × *spini* ♀ (= *S.* hybr. *dixeyi*), and that obtained from *S.* ♂ (*pavonia* × *spini*) × *pyri* ♀ (= *S.* hybr. *schlumbergeri*), gave no gynandromorphous examples. Some of the gynandromorphous examples obtained from the other crossings were as follows (*Ent.*, xxxiii., pp. 347 *et seq.*):

1. *S.* hybr. *standfussi.*—Of fifty-four imagines bred, twelve are gynandromorphous. Nine broods produced one gynandromorphous example each, and the tenth brood three. One of these is described as: "A large powerful insect (figured *Entom.*, xxxiii., pl. iii., fig. 3); on the upper side the right forewing, the left fore- and hindwings, and the abdomen are entirely of the female coloration, the right hindwing male; the antennæ both nearly male, but with somewhat shorter feathering than usual. The male genital claspers are present in a rudimentary form at the end of the abdomen. The underside of the wings and body show male and female characters mixed up with one another, except the right hindwing, which here again is entirely male" (*loc. cit.*, p. 347).

2. *S.* hybr. *risii.*—Of eight imagines bred, five were gynandromorphous, probably resulting from four different broods (*loc. cit.*, p. 347).

3. *S.* hybr. *schaufussi.*—Of this cross every attempt (9) was successful in producing fertile ova, 207 imagines resulted, and there were ten gynandromorphous specimens, one of which is figured (*Entom.*, xxxiii., pl. iii., fig. 8). It is not known exactly to how many broods these belong nor how they were distributed among the broods. The gynandromorphous example figured is described as being "on the upper side of wings and body predominatingly female, only on the right hindwing, outside the ocellated spot, is a bright orange-coloured patch. . . The antennæ are almost entirely ♂, and the male genital claspers are well-developed. Beneath male and female characters are indefinitely mixed, only the right hindwing is entirely ♀" (*loc. cit.*, p. 348).

Of some 4000 hybrids that Standfuss has bred, he notes (*Ent.*, xxxiv., p. 11) having had only two gynandromorphous primary hybrids. One of these was an example of *S.* hybr. *emiliae* (bred in 1897), the other a *S.* hybr. *bornemanni* (bred in 1898). On the other hand, he obtained 27 gynandromorphic secondary hybrids out of a total of 282. He, therefore, concludes that "the percentage of gynandromorphic specimens among primary hybrids is infinitesimal compared with the occurrence among secondary hybrids. It is, however, higher among primary hybrids than among individuals of pure specific origin." Discussing the matter further, he concludes (*loc. cit.*, p. 13) that "the degree of fertility of a form stands in direct connection with the percentage of gynandromorphic individuals in its offspring; the greater the fertility the smaller the percentage of

* This has not held altogether. A ♀ *schaufussi* has since been mated with a ♂ *schaufussi*, the union producing fertile ova, and, in due course, imagines (see, *anteà*, p. 298).

gynandromorphic forms, and *vice versa*;" and again, that "the degeneration and malformation of the egg germs which these gynandromorphic forms have been shown by anatomical investigation to possess is directly connected with the appearance of secondary female sexual characters in male individuals, and *vice versa;* the occurrence of secondary male characters in female individuals has long been known to be a fact." Most of the hybrid Saturnian gynandromorphs at present known have been described at length by Schultz (*Illus. Woch. für Ent.*, vols. i., p. 447; iii., pp. 294-296) as follows:

1. *S.* hybr. *emiliae.**—*a*—*c.* Perfectly gynandromorphic. Left purely ♀, right purely ♂. Right antenna ♂, with strong pectinations, left purely ♀. Wings sexually the same. Thorax above to the right brownish, to the left more grey-haired. Left legs stronger than right. The sexual aperture not quite as in the female, the male clasps indicated. The ovarian sac in the living example quite distinct. Body not so stout as that of a female, though stouter than in the male, somewhat distorted towards the right side. The other hybrid-gynandromorphs are almost similar, only the male side in both of them is not so brightly coloured, the female side not so sharply marked; in one of them the left side is likewise female, the right male: in the other all is reversed; the latter is also distinctly different in the colouring of the thick, short abdomen, which as to the rest is female. Bred by W. Caspari, Wiesbaden (*Jahrb. d. Nass. Ver. Naturk.*, xlviii., pp. 176—177) [*Ill Woch. für Ent.*, i., p. 447].

2. *S.* hybr, *risii.*—*a.* A pronounced gynandromorphous example. Both fore wings on the upper side ♂, though the shape of the wings is less produced than usual in the male. Of the hindwings the left one is male-coloured from the costal margin to behind the eye-spot, the remaining part to the anal angle entirely female. The right hindwing, doubtless a fifth larger, exhibits from the costal margin to only the front margin of the eye-spot male coloration, the whole of the remaining part is of ♀ character. On the underside the left forewing and the right hindwing throughout female, the left hindwing has a narrow female-coloured strip on the costal and dorsal margins, but the whole median area is male-coloured. Right forewing preponderantly male, except a female wedge-shaped spot widening out towards the outer margin, and situated between the upper portion of the eye-marking and the outer margin. Right antenna shortly pectinated, male; the left one above likewise, though still more shortly pectinated, below toothed as in the female. Thorax and base of abdomen on the upper side preponderantly red-brown, male; the rest of the abdomen and the whole belly below grey-brown. Of the male copulatory organs only the right half (crippled), present, the left wanting. In the Daub collection, Carlsruhe [Bred by Standfuss, see *Handbk. d. pal. Grossschm.*, 1896, pp. 97, 98]. *b.* ♀ with gynandromorphous characters. Antennæ irregularly toothed and partly ciliated. On the right side, on the underside of the forewing and on the upperside of the hindwing, small stripes of a ♂ character. Bred by Standfuss of Zürich (*loc. cit.*) [*Ill. Woch. für Ent.*, i., p. 447]. *c.* ♂ with female coloration in places. The upper side of the abdomen, besides the underside of the forewing and the upper- and underside of the hindwing, female-coloured. All the rest purely male. Bred by Standfuss of Zürich (*loc. cit.*). *d.* A thoroughly normal ♀, although with one ♂ antenna. Bred at Zürich by Standfuss. *e*—*f.* Two further examples of this derived hybrid, which Standfuss bred, exhibited likewise the phenomenon of gynandromorphism [*Ill. Zeits. für Ent.*, iii., p. 294.].

3. *S.* hybr. *schaufussi* †.—*a.* The ♂ characters greatly preponderant, 64mm. in expanse. On the right side, both wings smaller than left and absolutely ♂ in shape; right forewing above and below purely ♂; right hindwing with coloration of a ♀ character in the area at the end of the discoidal cell above and below; the eye here of abnormal size. Left side: the shape of both wings more ♀, here the eye of the forewing is abnormally large; left forewing above from the end of discoidal cell to the outer margin with many grey, that is ♀, scales; otherwise this wing on both sides, as regards the coloration, of ♂ character. Left hindwing above on the whole of the costa up to the middle of the discoidal cell ♀-, the rest of the wing ♂-, coloured; the eye-marking is also small, corresponding with the right forewing. Below the whole left wing is ♀-coloured; only before the

* Neither the gynandromorphous example of *emiliae* bred by Standfuss (*Ent.*, xxxiv., p. 11) nor that of *bornemanni* (*loc. cit.*, footnote p. 11) appears to have been described.

† For this and the following descriptions, see Standfuss, *Experimentelle-zoologische Studien mit Lepidopteren*, separat., pp. 54 *et seq.*

outer margin towards the anal angle there is a larger group of ♂-coloured scales. Antennæ, head, thorax and legs of ♂ type. The abdomen more of a grey coloration, with crippled anal clasps. [This and the following gynandromorphous examples (*b*—*j*) bred by Standfuss in Zürich.] *b.* Much more preponderantly of ♀ type (78 mm. in expanse). Both antennæ above densely ciliated, with strongly produced pectinations which attain half the length of normal ♂ teeth. Both sides of the sexual aperture with crippled ♂ anal clasps. Left hindwing on the dorsal margin above with red-brown ♂ scales, left forewing below likewise furnished towards the dorsal margin with a larger portion of ♂ scales; all the wings otherwise ♀-coloured. *c.* ♀ form, crippled. Both antennæ of almost purely ♂ character. On the upperside of the left forewing rather extended ♂ coloration—otherwise all the wings above and below ♀-coloured. Two crippled, almost perfectly symmetrical, anal clasps are present. [N.B. The anatomical dissection yielded: Bursa copulatrix, receptaculum seminis, as well as oviduct with its eight ovarian tubes, present, the latter however, absolutely empty. On the other hand there is only one cement gland present nearly double the normal size; the second is entirely wanting.] *d.* ♀ type, crippled. Both antennæ approaching to ♂ form. Left forewing in shape and coloration ♂. All the other wings of entirely ♀ coloration. Crippled anal clasps present on both sides of the sexual aperture. [N.B. This individual was also dissected; the oviduct with its eight ovarian tubes is normally developed and contains 22 ova irregularly distributed, partly of normal and partly of very reduced size. Further there are present the bursa copulatrix, the receptaculum seminis and the connecting passage between them both. Instead of two cement glands there are three of them, all three of nearly normal size. It is remarkable that, beside these female organs, the penis sheath and penis are also developed.] *e*—*j.* Six more individuals exhibited likewise the phenomenon of gynandromorphism (Standfuss) [*Ill. Zeits. für Ent.*, iii., pp. 294—295].

4. *S.* hybr. *standfussi.*—*a.* General appearance that of a ♂; expanse 86mm. On the upperside, the coloration ♂ throughout with the exception of the costal margin of the left hindwing. On the underside: the right forewing almost entirely ♀-coloured; the right hindwing from the dorsal margin for two-thirds of the wing area likewise ♀-coloured, otherwise ♂-coloured. Both the left fore- and hindwing ♀-coloured only along the costal margin as far as the ocellated spot, the other two-thirds of both wings of ♂ coloration. Outline of the wings: with the exception of the right, ♀-shaped forewing, all the wings of ♂ shape. Antennæ, head, thorax and legs male. The abdomen partly grey-haired, with crippled anal clasps. [This and the following eleven gynandromorphous examples of this hybrid (*b*—*l*) were also bred by Herr Standfuss in Zürich.] *b.* Predominantly ♀ type (76mm. in expanse). Left antenna above and below—right antenna above only — strongly pectinated and ciliated on about two-thirds of the normal ♂ scale. On the genital aperture, rudiments of the ♂ clasps, left larger, right smaller. The whole of the underside of both pairs of wings, as well as the upperside of both hindwings of purely ♀ coloration. Upperside, the right forewing from the base to the middle of the dorsal margin with rich male coloration, the left forewing only about the middle of the dorsal margin sparingly ♂-scaled, otherwise also ♀-coloured. *c.* Preponderantly ♀, 96mm. in expanse. Both antennæ below with long, ciliated teeth of two-thirds the length of the ♂ type. Rudiments of anal clasps and penis present. Coloration above purely ♀, the same beneath only on both hindwings below, between the eye-marking and the outer margin, there are rays of ♂-coloured scales. *d.* Of ♀ type; 87mm. in expanse. Both antennæ almost purely ♂ in character. Rudiments of anal clasps and penis present. Left forewing of ♂, the remaining wings of ♀, shape. The whole of the upperside purely ♀-coloured. Underside: left forewing on the costa as far as the margin of the eye of ♀ coloration, the whole of the remaining part ♂-coloured. Right hindwing with wedge-shaped male marking between the eyespot and the dorsal margin, but not attaining the latter. There are besides ♂-coloured scales on the outer margin below the apex of the right forewing and left hindwing. All the rest of the underside of ♀ type. *e.* Preponderantly ♀. Bred by Standfuss. In the collection of His Imperial Highness the Grand Duke Nicholas Mikhailovich, in St. Petersburg. *f.* Preponderantly female individual. Bred by Standfuss [In the Zoological Museum of the University of Tübingen]. *g.* An individual of similar character. Bred by Standfuss [Passed into the possession of Dr. Kerschensteiner, Ratisbon]. *h*—*l.* Five further individuals, likewise bred by Standfuss, showing signs of gynandromorphism (Standfuss) [*Ill. Zeits. für Ent.*, iii., pp. 295—296].

The Saturnian egg is opaque, possibly a more specialised form than the Citheronian, which is transparent and much more nearly allied to the existent form in Dimorphids and Sphingids. [For a comparison of the eggs of the three European Saturnias see Standfuss, *Handbuch*, &c., pp. 100-101.]

The Saturnian larva is a very specialised product, but its line of specialisation appears very simple, and is well exhibited in series, in newly-hatched larvæ of *S. spini*, *S. pavonia* and *S. pyri*. In the first stadium (of *S. pavonia*) tubercle ii is, on most of the segments, single-haired, i and iii have already assumed a wart-like form, and iv and v united form a subspiracular wart, vi and vii are also more or less wart-like. With the first moult ii disappears, i, iii, iv + v (and to a less extent vi and vii) become large characteristic warts forming a ring round each segment. The newly-hatched larva of *S. pyri* has the warts already highly developed and coloured, whilst the adult larva of this species is a fine creature, of a lovely pea-green colour, ornamented on each segment with a series of large, beautiful, turquoise-blue, coronal warts, representing i, iii, iv + v, vi and vii, surrounding each segment, each carrying long spathulate hairs, whilst the 10th abdominal segment is very distinct, flat, and bears a dark, red-brown, saddle-shaped, chitinous patch, the rounded edge of the saddle forming the posterior edge of the flap. The dorsal warts on the meso- and metathorax are especially well-developed, whilst the 9th abdominal bears only a dorsal and supraspiracular wart on either side, the others being atrophied; it is worth while, perhaps, to notice that the warts on the 8th abdominal segment are paired, and similar to those on the preceding segments (*Ent. Rec.*, ix., pp. 112—114). Standfuss gives many interesting comparative notes on the larvæ of the three European species (*Handbuch*, &c., pp. 101-103, see also *antea*, pp. 300—301). Gauckler notes (*Ill. Woch. für Ent.*, ii., p. 143) that the larvæ of *Saturnia pyri* sometimes reach an immense size. Some sent by Locke from Vienna were 135mm. long and 20mm. in thickness. The latter also notes that, from larvæ collected in the same district, he bred, in 1889 and 1891, examples that measured in both sexes from 190—220mm. in expanse. As in the Dimorphids, Citheroniids and Sphingids, the adult larva changes colour just before pupation.

The Saturnian pupa is somewhat different from the very round and straight pupa which may be looked upon as that which is more typical of the superfamily, being flattened from back to front, and with the hinder segments bent well forward (see *antea*, pp. 280—282); that of *S. pavonia* is described at length (*postea* p. 331), and that of *S. pyri* (*Ent. Rec.*, ix., pp. 144—146). The pupa of *S. pyri* is almost cylindrical, tapers only very slightly to the base of wings and then abruptly to the head. The frontal area is, therefore, blunt, as is also the anal area, and the latter does not curve up ventrally as does the pupa of *S. pavonia*. Standfuss compares the pupæ of the three European Saturnias and gives comparative figures of them (*Handbuch*, &c., pp. 72, 81, 104).

The Saturnian cocoon is oval in outline, extended into a neck at one end, with a very remarkable lobster-trap arrangement, so arranged, however, as to allow egress and not ingress, less developed, however, in that of *S. spini* than in those of the other two species (see, Standfuss, *Handbuch*, &c., pp. 72, 81, figs. 1-5).

In the cocoon of *S. pyri* the trap is double; that of *S. pavonia* has the commencement of a double trap, but the outer is little more than an opening with ragged edges. [Réaumur's account is given at length, *posteà* pp. 327—328.] The tough silk is felted throughout with a hardening material, that of *S. pyri* cutting like thin horn; this cement appears to consist of a dark fluid which is poured on the silk, at first rather pale in colour, by the larva, after the cocoon has been largely spun. Details of the variation of the colouring of the coçoons of *S. pavonia* are given later at length (*posteà*, pp. 329—330).

The exceedingly interesting comparison of the early stages and imaginal habits of the three European species of this genus, made by Standfuss (*Handbuch*, &c., pp. 104-107), has been already referred to (*anteà*, pp. 300—301).

Sharp observes (*Insects*, ii., p. 310) that in some lepidoptera, *e.g.*, *Saturnia*, there appears to be no buccal orifice whatever, and further (p. 313) that a stigma believed to be an imperfect mesothoracic spiracle exists behind the anterior wing of *Saturnia pavonia*. Chapman objects to the doubt implied in this statement, and asserts that the mesothoracic spiracle is always present. Sharp also states (p. 307) that, in *Saturnia*, on each side of the clypeus, there is a deep pocket projecting into the head cavity. One may here note that the imago of *Saturnia pyri* has well developed anterior tibial spines, whilst that of *S. pavonia* has none.

Packard asks (*Proc. Amer. Acad. Arts and Sciences*, 1893, p. 58): "Are the species of *Saturnia (sens. strict.)*—three in Europe and two in the Southwest and Pacific coast of North America, occurring where the *Attacinae* do not exist at all, or only rarely—the relics of a Saturnian fauna from which the group *Attacinae* has been eliminated by geological extinction, as the sequoia, cypress, magnolia and other Tertiary plants have been rendered extinct in Europe, or may the view be taken that the *Attacinae* have never had a foothold in western Eurasia and North America?" Meyrick notes *Saturnia* as "a somewhat limited Asiatic genus, extending into Europe and North Africa."

Saturnia pavonia, Linné.

Synonymy.—Species: *Pavonia*, var. *a*, Linn., "Sys. Nat.," xth ed., p. 496 (1758); xiith ed., p. 810 (1767). *Pavonia*, Linn., "Faun. Suec.," 2nd ed., p. 291 (1761); Sulz., "Kennz. d. Ins.," p. 38, pl. xvi., fig. 92 (1761); Müll., "Faun. Frid.," p. 38 (1764); "Zool. Dan.," p. 117 (1776); Fuess, "Neu. Mag.," iii., 2, p. 149 (1786); Cuv., "Tabl. Elem.," p. 594, in part (1798); Latr., "Gen. Crust.," iv., p. 218 (1809); "Consid.," p. 441 (1810); Stphs., "Illus. Haust.," ii., p. 317 (1828); Zett., "Ins. Lapp.," p. 921 (1840); Boh., "Vet. Ak. Handl.," 1848, pp. 146—147 (1850); Staud., "Cat.," 1st ed., p. 30 (1861); 2nd ed., p. 70 (1871); 3rd ed., p. 127 (1901); Snell., "De Vlind.," p. 196 (1867); Berce, "Faun. Franç.," ii., p. 207 (1868); Nolck., "Fn. Estl.," i., p. 131 (1868); Wallgrn., "Skand. Het.," ii., p. 130 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 410 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 71 (1874); Curò, "Bull. Soc. Ent. Ital.," viii., p. 153 (1876); Speyer, "Stett. Ent. Zeitg.," xl., p. 151 (1879); Minà-Pal. and Failla, "Nat. Sic.," vii., p. 232 (1888); Auriv., "Nord. Fjär.," p. 66 (1889); Meyr., "Handbook," p. 313 (1895). *Pavoniella*, Scop., "Ent. Carn.," p. 191 *bis* (*ex errore*) (1763); Fuess., "Schweiz. Ins.," p. 33 (1775). *Pavonia-minor*, Hufn., "Berl. Mag.," ii., pp. 394, 428 (1766); Fab., "Sys. Ent.," p. 539 (1775); "Spec. Ins.," ii., p. 171 (1781); "Mant.," ii., p. 110 (1787); "Ent. Sys.," iii., pl. i., p 416 (1793); Fuess., "Neu. Mag.," i., 2, p. 268 (1782); Esp., "Eur. Schmett.," iii., p. 25, pl. iv., figs. 1—6 (1782); Lang, "Verz.," 2nd ed., p. 81 (1789); Rossi, "Faun. Etr.," pl. ii., p. 168 (1790); Schwarz, "Raup.-Kal.," p. 234 (1791); "Beytr.," pl.

v., figs. 1—8, p. 42 (1793); Latr., "Hist. Nat.," xiv., p. 176 (1805); Leach, "Edin. Encycl.," ix., p. 132 (1815); Samouelle, "Ent. Comp.," p. 246 (1819); Godt., "Hist. Nat.," iv., p. 68 (1822); Stphs., "Cat. Br. Ins.," p 45 (1829); "List Br. An. Br. Mus.," v., p. 45 (1850); Wood, "Ind. Ent.," p. 21, fig. 39 (1839); Humph. and Westd., "Brit. Moths," p. 51 (*circ.* 1841); Sta., "Man.," i., p. 160 (1857); Humph., "Gen. Brit. Moths," p. 20 (1860); Kirby, "Cat.," p. 773 (1892); "Handbook, etc.," iv., p. 105 (1897). *Carpini*, [Schiff.,] "Schmett. Wien," ed. i., p. 50 (1775); ed. ii., p. 66 (1801); Bkh., "Eur. Schmett.," iii., p. 34 (1790); Brahm, "Ins. Kal.," ii., pp. 173, 450 (1791); View., "Tab. Verz.," i., p. 29 (1789); Hb., "Schmett. Eur.," figs. 53, 54, 255, 276 (*circ.* 1800); text p. 116 (?1805); "Larvæ Lep.," iii., Veræ A, 1, *a—c* (*circ.* 1800); "Tent.," p. 1 (1806); Verz., p. 157 (*circ.* 1822); "Franck Cat.," p. 88 (1825); Schrank, "Faun. Boica," ii., 1, p. 249 (1801); ii., 2, p. 149 (1802); Ochs., "Die Schmett.," iii., p. 6 (1810); iv., p. 46 (1816); Germ., "Bomb. Spec.," i., p. 10 (1811); Oken, "Lehrb. Zool.," i., p. 714 (1815); Meig., "Eur. Schmett.," ii., p. 156 (1830); Bdv., "Eur. Lep. Ind. Meth.," p. 49 (1829); "Icon. Chen.," pl. ii., figs. 1—3 (*circ.* 1840); "Gen. et Ind. Meth.," p. 73 (1840); Dup., "Icon. Chen.," pl. ii., figs. *a—h* (*circ.* 1840); "Cat. Méth.," p. 79 (1844); Evers., "Faun. Volg.-Ural.," p. 116 (1844); H.-Sch., "Sys. Bearb.," ii., p. 96 (1846); Heydenr., "Lep. Eur. Cat. Meth.," 3rd ed., p. 28 (1851); Speyer, "Geog. Verb.," i., p. 417 (1858); ii., p. 288 (1862); Hein., "Schmett. Deutsch.," p. 196 (1859); Mill., "Cat. Lép. Alp.-Mar.," i., p. 146 (1874); Newm., "Brit. Moths," p. 48 (1869); Frey, "Lep. der Schweiz," p. 99 (1880); Kirby, "Eur. Butts. and Moths," p. 126, pl. xxvii., figs. 3 *a—e* (1880); Buckl., "Larvæ," etc., iii., pl. lii., fig. 1 (1889); Tutt, "British Moths," p. 42 (1895); Barr., "Lep. Brit.," iii., p. 57 (1896); Grote, "Die Saturniiden," pp. 3, 25 (1896). *Pavunculus*, Retz., "Gen. Spec. Ins.," p. 25 (1783). *Pavoniellus*, Ramb., "Cat. Lép. And.," p. 178 (1866).

ORIGINAL DESCRIPTION*.—*Phalaena Bombyx pavonia*, elinguis, alis patulis rotundatis griseonebulosis subfasciatis: ocello nictitante subfenestrato.

a. Minor, *Fn. Suec.*, 835. Mouff., *Ins.*, 20. Jonst., *Ins.*, t. 8, f. 7. Rai., *Ins.*, 146, no. 1. Pet., *Gaz.*, t. 33, f. 12. Alb., *Ins.*, t. 37. Merian, *Eur.*, t. 13, 23. Reaum., *Ins.*, i., t. 50, 49. De Geer, *Ins.*, i., t. 19, f. 7, 8. Roes., *Ins.*, i., phal. 2, t. 5. Wilk., *Pap.*, 15, t. 2, *a.* 3.

β. Major, Goed., *Ins.*, 3, t. 2. List., *Goed. Act. Paris.*,

* For comparison we give the following: "*Phalaena* (*Attacus*), pectinicornis elinguis, alis rotundatis griseo-nebulosis subfasciatis; ocello nictitante subfenestrato" (*Faun. Suec.*, no. 835). Also the following: (1) "*a. Minor.*—'Faun. Suec.,' i., p. 835. (2) *β. Major.*—Goed., 'Ins.,' 3, t. 2." . . . "*Major* et *minor* adeo inter se affines ac *Sphinx elpenor* (*sic*) et *porcellus* seu *Phalaena antiqua* et *recens*, confirmante Larva et Pupa, sed altera duplo *Major* alis albido-cinerascentibus; *Minor* vero ferrugineis. Sic una ex altera orta, constanter se multiplicans, nec miscenda alterius cum altera in copula" (*Sys. Nat.*, xiith ed., pp. 810—811) Speyer points out (*Stett. Ent. Zeit.*, vol. xl., p. 151) that Linné evidently considered *pavonia-minor* and *pavonia-major* as distinct species, since he writes: "*Major* et *minor* adeo inter se affines ac *Sphinx elpenor* et *porcellus* seu *Phalaena antiqua* et *recens* (*gonostigma*), confirmante larva et pupa, sed altera duplo *major* alis albido-cinerascentibus; *minor* vero ferrugineis. Sic una ex altera orta, constanter se multiplicans, nec miscenda alterius cum altera in copula" (*Syst. Nat.*, ed. xii., p. 811). He also shows that Linné did not consider such double names as inadmissible and that *pavonia-minor* and *pavonia-major* could be paralleled in repeated instances. He, however, doubts whether *pavonia-major* = *pyri*, for, although Linné's citations point in this direction, yet his description suggests simply that Linné's *pavonia-major* was merely the female of the same species of which *pavonia-minor* was the male. He observes that no one would diagnose *pyri* and *carpini* in the terms used by Linné, that the latter knows no difference in the early stages, nor does he note that only one of the two inhabits Northern Europe. He further notes that in the *Fauna Suecica*, ed. 2, p. 291, only the ♂ of *pavonia* is described, and infers (being unacquainted with the 10th ed. of the *Systema Naturae*) that, at that time, Linné did not know the insect afterwards described as *pavonia-major.* Speyer concludes that *pavonia* is, therefore, the correct name for the species, the suffixes *-minor* and *-major* simply referring to the sexes of the same insect.

1692. Reaum., *Ins.*, i., t. 47, 48. Roes., *Ins.*, 4, t. 15, 16. Knorr, *Delic.*, t. C. 2, f. 2.

Habitat in *Rosa*, *Rubo*, *Ulmo*, *Corylo*, *Salice*. Larva nuda, verticillata verrucis pilosis ut *P. atlantis*. Ocellus alarum margine superiore nictitat lunula fenestrata vix conspicua. Varietates α et β adeo similes, ut vix differant, nisi magnitudine. An specie distinguendæ? (Linné, *Sys. Nat.*, xth ed., pp. 496—497).

Imago.—50mm.—91·5mm. ♂. Head brown, collar white, thorax and abdomen brown. Anterior wings blackish-grey, with three transverse lines, one basal, pale, not reaching costa, edged on either side with rosy and then with black, the second beyond the ocellated spot, sinuate, pale, tinged with rosy, and edged on either side with black; the third forms a whitish subterminal shade, edged externally with grey, with dark nervures crossing it; discal area whitish, with conspicuous ocellated spot; apex with pale lunular mark, edged strongly externally with crimson, a short black costal mark near apex. Posterior wings orange, basal and inner marginal areas darker; dark, irregular, transverse lines on either side of a conspicuous ocellated spot; subterminal band blackish, narrow towards apex, broadest at anal angle, outer marginal area grey, faintly tinged with reddish, the marginal line dark, blackish-grey. ♀. Larger, paler; anterior wings pale grey, transverse lines white, the rosy tinge confined largely to basal line and apical area; posterior wings as in ♂, but with all orange parts white and the transverse lines more strongly marked. Thorax brown, basal part of costa of wing and collar white, abdomen white-ringed.

Sexual dimorphism.—The male is smaller than the female, the antennæ more strongly pectinated, and the colours brighter and browner, the female having quite a soft pearly-grey ground colour. The female has a large heavy abdomen, is of quiet and lethargic habits, whilst the male is exceedingly active. The extremes of measurement of the examples in our collection are—♂s, 50mm.–68mm., ♀s, 75mm.–91·5mm. Standfuss notes that, in breeding this species, there was a very close approach between the numbers of the sexes. Thus he notes: in 1881—162 ♂s, 157 ♀s; 1882—230 ♂s, 205 ♀s; 1884—110 ♂s, 117 ♀s; 1889—87 ♂s, 83 ♀s; 1890—116 ♂s, 111 ♀s; 1891—361 ♂s, 349 ♀s; 1892—412 ♂s, 385 ♀s; 1893—442 ♂s, 411 ♀s. Total, 1920 ♂s, 1818 ♀s. Chapman describes the antennæ as follows: ♂, 8mm.—10mm. long, of about 24 joints; plumules in a nearly flat plane, making the antenna a plane of about 3mm. across, narrowing to each end; each joint carries 4 plumules and these arise almost from the dorsum, leaving a large part of the circumference ventral and free from any pectinations, etc.; this portion would almost certainly be taken for the dorsum and not the venter on a casual examination; there are three basal joints, unpectinated, the first large and globular, the second somewhat conical, the third somewhat less so and rather shorter, about 19 (17—20 or even a wider range) of quadripectinated joints, and three short, unpectinated terminal ones. The origin of the pectinations on the joints are dorsal rather than lateral, and though viewed dorsally or ventrally they appear regularly placed, nevertheless the alternate branches differ, the distal branch bends more dorsally and the basal more ventrally, and the bare dorsal surfaces of the two are not absolutely dorsal, but on the basal branch it is rather more basal, on the distal one more distal; the basal ones are also a little darker in colour, and terminate more bluntly. Both are fairly cylindrical, the basal a little thickened at the end, and terminating in a point. Nowhere on the antenna are there any definite bristles, but each branch carries 200, or rather more (on full length ones), black, sensory hairs, about 0·2mm. long. The shaft carries a few similar but shorter hairs. The colour of the shaft and branches is straw-colour. The black hairs make the antenna as a whole look darker. The ♀ antenna is about the same length as that of the male, and has the same (variable) number of joints; being without the sense-hairs of the ♂ antenna, it looks pale straw-colour. The pectinations of the male antennæ are represented by processes of which the basal is in length, where longest, about equal to the width of the antenna, basally and apically dwindling to nothing; the distal pectination is merely a slight thickening and projection of the lateral margin of the end of the joint, but where best developed, at the middle of the antenna, carries a bristle or two. The upper or outer processes, however, of both series are much smaller than the lower or inner, so that the outer basal are only half the length of the inner, and the outer distal can hardly be said to exist. The upper basal carry two short terminal bristles (not hairs), the lower basal also, but these also have another at their base. These structures are not represented on the ♂ antenna. They do not exceed 0·05mm. in length. Along the outer basal aspect of these basal processes or pectinations are a dozen or so of short hairs (0·04mm.—0·05mm.) representing apparently the hairs of the ♂ antenna. Towards the base of the antenna the inner pectination sometimes carries 2 basal and 3 terminal bristles; the terminal bristles are reduced to one on both pectinations towards the apex. In both sexes, the chitin of which the dermis of the joints (and in the ♂ the pectinations) consists, appears to be very minutely spiculated, that of the ♀ pectinations is not so.

Gynandromorphism.—There are very many gynandromorphous examples of this species recorded in the various entomological periodicals, and many others which have never yet been described undoubtedly exist in collections. Speyer gives (*Stett. Ent. Zeit.*, xlii., pp. 477—486) a very circumstantial account of a large number of gynandromorphs, including a brood of the larvæ of *S. pavonia* found by Maus near Wiesbaden, every one of which produced imagines which proved to be more or less gynandromorphous. The following are those which have come to our knowledge:

α. Perfect gynandromorph. Right ♂, left ♀. The ♀ wings a little larger than the ♂ ones; the halves of the abdomen in form and colour agreeing with the sex exhibited by the wings. Captured near Aschaffenburg in 1844 (Hagen, *Stett. Ent. Zeitg.*, 1864, p. 196).

β. Left ♂, right ♀. Smaller than usual, even the ♀ side scarcely attains the size of an ordinary ♂. Right antenna and wings ♀; left antenna and wings ♂. Body slender as in ♂, coloured as in ♀, the scaling intermediate between that of the two sexes. From the Hoffmannsegg coll. In Berlin Mus. (Klug, *Verh.*, p. 366; *Jahrb.*, p. 255; Rudolphi, p. 57; Burm., p. 340; Lefebvre, p. 150).

γ. Left ♂, right ♀. Body not divided, ♀; the ♂ wings rather smaller, from the back yellow hairs pass over their junction as in ♂; left antenna ♂, right ♀. Günther, Chemnitz (Capieux, *Naturforscher*, 1778, st. 12, p. 72, tab. iv., fig. 6).

δ. Left ♂, right ♀. Imperfect gynandromorph. ♀, with two ♂ antennæ and ♀ genitalia. Forewings in form ♂, in colour ♀, only the base of the left forewing and the first transverse line are coloured red-brown as in the ♂; on the underside the costa is orange. Hindwings ♀; in the middle of the left wing and on the outer margin of the right are orange spots. The right side of the thorax red-brown. In Ochsenheimer coll. (Ochsenheimer, iv., p. 188; Rudolphi, p. 52; Burm., p. 341).

ε. Right ♂, left ♀. Somewhat smaller than usual; on the right the wings somewhat smaller and completely ♂, right antenna likewise ♂; on the left the wings somewhat larger and completely ♀; body not hairy, without divisions, but doubtless more ♀ than ♂. In the Regiomont mus. (Hagen, *Stett. Ent. Zeitg.*, 1861, p. 274).

ζ. Left fore- and right hindwing ♀, the right fore- and left hindwing ♂. The right antenna ♂, the left the same so far as the outer pectinations are concerned, the inner, however, much shorter, with the coloration of the ♀. Body as in the ♀, but without eggs and shrunken; thorax and abdomen of ♀ coloration, the right patagia of ♂ coloration. Right forewing above almost entirely ♂, below almost entirely ♀; right hindwing above ♀, though darker, below as far as three-fourths to the marginal band yellow-scaled. Left forewing ♀, with a brownish dash; the left hindwing half ♂, half ♀. The underside purely ♀. The left forewing larger than right. Both hindwings of the same size, the apex of the right more pointed. Bred at Vienna, 1865, by [illegible]. In Vienna mus. (Rogenhofer, *Verh. zool.-bot. Ges. Wien*, 1865, p. 51[illegible]).

η. Preponderantly ♂. Right wing [illegible] ♂. Left antenna with shorter pectinations and lighter [illegible] and [illegible] ♀. Left forewing approaching the form of the ♀, but with the coloration of the ♂, and somewhat smaller than the right, more thinly-scaled; underside ♂, with less of the ♀ coloration. Left hindwing almost entirely ♀ with ♂ hair-covering; underside ♂, except the ♀-coloured central area. Body ♀, only on the thorax is the reddish-brown down of the ♂; the two last segments somewhat more slender; anal tuft longer-haired. Bred 1865. In the Dorfmeister coll. (Rogenhofer, *Verh. z.-b. Ges. Wien*, 1865, p. 515).

θ. Body, wings and size preponderantly ♀. Antennæ somewhat more shortly pectinated than in the ♂. Patagia brownish, abdomen ♀-coloured. Right forewing in coloration and shape ♂, although scaled with whitish-grey in the middle of cell 1 *b*; below ♀-coloured with ♂ scaling in isolated parts. Right hindwing above and below ♀. Left forewing in shape and coloration ♀, though brownish-scaled, especially on the costa and at the base. Left hindwing ♀ with a rather broad yellow stripe. Bred 1865 by Weppl (Rogenhofer, *Verh. z.-b. Ges. Wien*, 1865, pp. 515—516).

ι. Preponderantly ♂. Thorax and right antenna ♂; left antenna lighter, the upper pectinations scarcely any longer than in the ♀, the lower about half as long as in the ♂. Abdomen ♀, coloration grey mixed with yellowish. Forewings above ♂, the right one more rounded and bearing only on the inner margin a row of white hairs and scales; the underside of the right (forewing) coloured yellow in places. Right hindwing above quite ♂, below towards the base lighter grey. Left hindwing much larger than the right, in shape ♀, orange-coloured as far as the waved band with the exception of a narrow strip on the costa; this colour (orange) runs along nervure 5 as far as the fringes. Ocellated spot small as in the ♂. Underside as in the ♀, from the base to the first band on the costa a stripe of red-brown scaling. Bred by Weppl in 1835 (Rogenhofer, *Verh. z.-b. Ges. Wien*, 1865, p. 516).

κ. Quite preponderantly ♂. Antennæ, thorax, legs, colour and markings of the right hindwing ♂; all the rest mixed. 62mm. in expanse; shape of wings more ♀; left hindwing broad and regularly rounded, the right approaching that of the ♂ in shape. Abdomen not longer than in the ♂, but much thicker; the first segments covered with yellowish-brown hairs, intermingled on the anus with rusty-yellow hairs. Of the ♂ genital organs only irregularly-formed, slightly protruding rolls and clasps are discernible. Colour of forewings more grey than in normal males; ocellated spot of the left narrower; right hindwing in form and colour ♂, fainter coloured, its ocellated spot small; left hindwing ♀, with large ocellated spot, but orange on the costa and at the base. Underside of forewings grey, dusted with orange on the costa; the left has besides a large orange area, occupying the inner marginal half, nearly up to the marginal band. Hindwings below with costal stripe of ♂ colour without downy hair-covering. Bred by Maus, Wiesbaden (Speyer, *Stett. Ent. Zeitg.*, 1881, p. 482).

λ. Mixed gynandromorph. Abdomen in thickness, clothing and coloration ♀, sunken between segments 4 and 5 on left side; clasps distinctly discernible, more turned down, smaller and less regular than is usual in the ♂. Antennæ with densely-ciliated pectinations, though shorter than is usual in the ♂. The second of each joint is much shorter than the first (on the right on the outer row, on the left on the inner row, of the pectinations). Thorax and legs ♀, the latter more strongly hairy than in normal ♀. Wings more ♀ in shape, and with a greasy gloss, all the wings above grey, ♀; ocellated spot ♀, alike on both sides. Forewings partly red-brown; hindwings in places bright orange-red. On the right hindwing the red and grey equally divided, on the left the former less extended. Forewings below ♀-coloured, with bright orange-red areas: hindwings below ♂-coloured, in places ♀. Bred by Maus, Wiesbaden (Speyer, *Stett. Ent. Zeitg.*, 1881, p. 482).

μ. Characters of ♀ quite preponderant, although the build of the antennæ and some orange spots on the hindwing at once proclaim its gynandromorphous nature. 66mm. Body, shape and colour of ♀. Hair of the legs a little stronger than in the ♀. Sexual parts imperfect, ♀. Antennæ slighter than those of the ♂, in build more ♀. Outer row of the pectinations of the left antenna almost ♂, inner row altogether abnormal; the first process of every joint only half as long, but thicker than in the ♂; but instead of the second there are *two* present, one shorter, thicker, and more pointed, and above that a process twice as long, thinner, and spindle-shaped. The inner row of pectinations on the right antenna consists of rather shorter teeth than on the left, especially is the second of each joint strongly curtailed; of the processes of the outer row, the second is serrate, the first normal female (inner row). Wings ♀, hindwings less regularly rounded. The outer half of the first double stripe on the forewings is bordered with red towards the base; on the left forewing is a second purple-brown cuneiform spot. Hindwings on both sides sprinkled with orange-yellow in divers places. Underside of the wings ♀-coloured, with only a little ♂ admixture. Bred by Maus, Wiesbaden (Speyer, *Stett. Ent. Zeitg.*, 1881, pp. 484—485).

ν. Imperfect gynandromorph, preponderantly ♀ (only one-fourth ♂). The wings show above, in front of the dark outer-margin of the white border of the inner dark shade, a marking (not in the ♂) arcuated between the nervures running towards the base. Hindwings shot with red, the white border more brown. On the forewings at the apex the red mark in the fascia is, in a striking manner, twice as long as usual. Antennæ not quite ♀, browner, furnished also with longer teeth (Kretschmar, *Berl. Ent. Zeitschr.*, viii., 1864, p. 397).

ξ. Right antenna and right pair of wings in colour and size entirely ♀; left antenna ♂; left wings somewhat smaller. Left forewing in coloration and markings ♀ but for the rather darker costa. (Left) hindwing wholly ♂, yellow-brown coloured and normally marked. Body in shape and colour preponderantly ♀. Bred by H. Jammerath, of Melle, near Osnabrück (*Isis*, ix., 1884, no. 20).

ο. Forewings as well as hindwings show equally all over a transition to the ♀ colouring and markings, so that the ♀ scales appear as if pushed in among the ♂ scales. All the wings of normal and even size. Antennæ ♂. Body strongly ♀ in shape, but of brownish coloration. Genitalia crippled. In the Gleissner coll., Berlin (Schultz, *Illus. Woch. für Ent.*, i., p. 445).

π. Almost normal ♂ (58mm.). Wing coloration inclining to grey, and markings fainter (Speyer, *Stett. Ent. Zeitg.*, 1881, p. 481).

ρ. Both the left wings and the right forewing ♀, right hindwing ♂; left antenna ♀, right ♂. In coll. Poulin, Geneva (Corcelle, *Feuille des jeunes Nat.*, vi., p. 105).

σ. Left wings ♀; the right wings, structure of antennæ, etc., ♂ (Douglas, *Proc. Ent. Soc. Lond.*, 3rd ser., i , p. xi).

τ. Halved gynandromorph, left ♂, right ♀. In Budapest mus. (Mocsáry, *Rovart. Lapok*, i., p. 56).

υ. Crossed gynandromorph. Left forewing ♂, right ♀; right hindwing ♂, left ♀ (Lamprecht, *Ent. Nachr.*, ix., p. 134).

φ. Size of ♂; wing-markings on the right ♀, right antenna ♂; on the left the reverse. Bred from larva near Brünn (Dragoni, *Verh. d. Naturf. Ver. Brünn*, xxiv., p. 10).

χ. Right side ♂, left side ♀. Bred from Lincoln. In Mason coll. (Mason, *Proc. Ent. Soc. Lond.*, 1888, p. xv; *Ent.*, xxviii., p. 211).

ψ. ♀ in form; the antennæ more strongly pectinated than usual; the pectinations on the right antenna about half as long as those of normal male antenna, those of the left shorter than the right, but still longer than those of typical ♀. Bred from Wicken pupa. In Fletcher coll. *(in litt.)*.

ω. Mixed gynandromorph. Size and shape of ♀, markings sharper. Abdomen ♀, somewhat distorted, evenly brownish, with the segmental interruptions brighter. On the left an intimation of an anal clasp in the form of quite a small tuft of hairs apparently resting on a little plate of chitin. Left antenna ♂, right ♀, although rather more strongly developed than in the normal ♀. Wings in shape and form ♀, forewings brightly coloured as in the ♂, as regards the size and shape of the ocellated spots and other markings ♀. Hindwings deep dark orange, alike in size. On the underside the left forewing is brighter orange-coloured; on the right this colour is less marked, just as the waved marking on the left is far more weakly expressed than on the right side. The hindwings below are quite even in coloration, and correspond with those of a quite darkly coloured ♂. Bred in 1829 by Gross, Wiesbaden. In Mus. nat. hist. Wiesbaden (Pagenstecher, *Jahrb. Nass. Ver. Naturk.*, xxxv., pp. 89—90).

α′—ζ′. Frings notes (*Soc. Ent.*, ix., p. 182) that a ♀ *S. pavonia* found at Bonn, in 1889, laid many eggs, from which over 100 imagines were obtained in the spring of 1890; a few pupæ going over until 1891, when they emerged; among the latter no fewer than six gynandromorphous examples. Three of these are described as follows: (1) A perfect gynandromorph, the body exactly divided from the head to the anus into two halves, showing respectively male and female characters which include even the genitalia. The wings are very curiously divided in a diagonal manner, so that the right forewing and the left hindwing have male coloration, and the left forewing and right hindwing are coloured as in the female. The male and female wings, as well as being different in colour, have the usual disparity in size, giving the specimen, which is well developed and as large as a middle-sized female, a very curious and beautiful appearance. (2) An apparently faultless female, of medium size, but with both antennæ pectinated as in the male, and the costal border of the right fore- and hindwings decidedly male with orange coloration. (3) The upper surface of all four wings is of male coloration, but the right wings are considerably larger than is usual in the male. The right wings are greyish below as in the female, while the left wings have male coloration on the under surface. The abdomen and thorax are of the male form, though the former is swollen with eggs, which can clearly be seen through the spaces between the segments. The genitalia are completely divided into male and female, the male anal clasps being very strong and larger than usual. (4—5) Two others of this brood are noted by Caspari (*Jahrb. d. nass. Ver. Naturk.*, xlviii., pp. 172—173) as being "of predominant ♀ type with ♂ portions scattered over the wings."

η′—λ′. Five gynandromorphs were bred by Caspari, at Wiesbaden, 1895: (1) Completely divided; left antenna entirely ♂, right ♀. Left forewing and left hindwing wholly ♂, hindwing fiery orange; right side decidedly ♀. Underside as the upperside without a trace of ♂ and ♀ admixture, genitalia exactly divided, left ♂, right ♀. (2) The second gynandromorph similar, though smaller, with very dull coloration and faint orange on the ♂ hindwing. All the wing-scales poorly developed. (3) The body of the third gynandromorph is not divided into a ♂ and ♀ side, but exhibits hairs as in a normal ♂. Wings in shape and coloration more ♂, though with isolated places ♀-coloured, especially on the underside. Left antenna wholly ♂, the right half ♀. The upper side of this (right) antenna without pectinations, the underside with distinct ♂ pectinations. Abdomen ♂, with ♂ genitalia. (4) The fourth is a perfectly divided gynandromorph, except a slight blending. Left antenna strongly pectinated as in the ♂; right below ♂ pectinated, above as in the ♀, except a few small weak pectinations towards the apex of the antenna. Left wings above and below very fiery-coloured; right wings ♀, except a place on the forewing from the first lower vein to nervure 4. The abdomen above is ♂, more marked towards the left side, below ♀ more marked towards the right side. The body somewhat crooked, right side longer and stouter; full of eggs. (5) The fifth gynandromorph exhibits on the right a ♀, on the left a ♂, antenna. The body is only divided on the lower part of the thorax, while the abdomen is entirely ♀ and filled with eggs.

μ′. Imperfect. Right pair of wings ♀, as well as the left forewing; left hindwing ♂. Right antenna ♂, left ♀. Body in shape more ♀. External genital organs indistinct. Bred, Hartmann coll., Reichenbach (Schultz, *Illus. Woch. für Ent.*, ii., p. 463).

ν′. Right wings ♂, left ♀. A broad orange-coloured ♂ stripe on the inner margin of the left ♀ hindwing. Antennæ and body ♂. Sexual organs ♂, somewhat crippled. Daub coll., Carlsruhe (Gauckler *teste* Schultz, *Illus. Woch. für Ent.*, ii., p. 463).

ξ′. Imperfect. Preponderantly ♀ in colour; on the hindwings some ♂

orange rays and dashes. Antennæ intermediate between the two sexes ; the pectinations shorter than in the ♂. Abdomen ♀, although pointed and thin. Bred at Prague. In Wiskott coll. (Wiskott, *Festschrift Ver. Schles. Ins.*, 1897, p. 125).

ο′—ψ′. Nine gynandromorphous examples in the Staudinger collection (Schultz, *Illus. Woch. für Ent.*, ii., p. 463).

ω′. Antennæ wholly ♀ as well as abdomen and genitalia. Forewings ♀ except a ♂-coloured spot only on inner margin. Both hindwings of ♂ coloration. In size and shape of wings ♂. Emerged March 23rd, 1897, from a second-year pupa. Schultz coll. (Schultz, *Illus. Woch. für Ent.*, ii., p. 463).

α″. Both right wings ♂, both left wings ♀. Right antenna ♂, left ♀. The body in shape ♀, the right side with darker ♂ scaling, the left with lighter ♀ scaling. Bred by Hildebrand, Magdeburg (*Ent. Zeits. Guben*, xii., p. 56).

β″. Wings and antenna on one side ♂, the wings and antenna on other side ♀ ; bred March 29th, 1893, at Preston, near Brighton (Morris, *Ent.*, xxvi., p. 164).

γ″. The left primary that of a ♂, but the left secondary on the same side has only about one-fifth of the area with ♂ coloration, just reaching the eye-like markings. On the right side, both wings have the normal ♀ coloration. Antennæ, left and right, ♂ and ♀ respectively. Bred May, 1896, from parents twice inbred, the original larvæ having come from Wicken in 1893 (Mitchell, *Ent. Record*, viii., p. 184).

δ″. The forewings of the ♀ pattern, the hindwings ♂. Bristow coll. (Kane, *Ent.*, xxvii., p. 41).

ε″. Halved, left ♀, right ♂. Wings and antenna on left side completely ♀, in colour, markings and size ; on right side completely ♂. [Nothing is stated concerning body and genitalia.] (Schultz, *Ill. Zeit. für Ent.*, iii., p. 184).

ζ″. Incomplete, predominantly ♀. Upperside : both forewings entirely ♀ in markings and colour ; right hindwing ♀, yet with ♂ coloration on the costa of the wing, and also from the anal angle to the outer margin ; left hindwing ♀, with ♂ coloration at the inner angle, the latter colour occupies one-fifth of the surface of the wing. Underside : left forewings purely ♀ in colour, likewise the right hindwing ; right forewings ♀, yet with broad ♂ stripe along the costa as far as the apex ; left hingwing ♀, with strongly expressed ♂ coloration at its costa, occupying perhaps one-third of the wing. Shape : left fore- and right hindwing ♂, smaller, more contracted ; the other two wings ♀, more extended, larger. Thorax, palpi and legs of ♀ coloration. Antennæ in colour and structure intermediate between ♂ and ♀. Body ♀ in form and colour. Abdomen with distinct ♀ sexual organs on the left, and a ♂ anal clasp on the right side. Bred by Krieghoff, from a larva found at Oberspier (Schultz, *Berl. Ent. Zeit.*, 1897, pp. 158—159).

η″. Incomplete. Right wings ♂ in shape, markings, and colour ; underside, however, with a light ♀-marked streak, 2mm. in width, on the inner margin, reaching to the base. The shape of the left wings also ♂. Colour of the left forewing on the upper side irregularly mixed, ♂ and ♀. Ground colour of left hindwing on the upper side ♀, but interrupted at the costal and inner margins with red spots and rays. Left forewing on the underside with broad orange rays from the base to marginal band ; ♀, on the other hand, only on the costa, and in some places on the inner margin. Left hindwing, with the underside ♀ from the inner margin to the subterminal line only ; in its marginal band very bright red ♂ colouring. Size : left 38mm., right 37mm. Right antenna purely ♂ ; left intermediate between ♂ and ♀ form, the pectinations shortened, about half-way between those of the sexes. Abdomen very woolly, large, ♀ in appearance. Bred in Vienna. In the Wiskott coll., Breslau (Wiskott, *Iris*, 1897, p. 384, pl. xi., fig. 4).

θ″. Most abnormal specimen, the various secondary sexual characters of both sexes being curiously mixed with certain aberrational features that are not sexual ; 74mm. in expanse. The abdomen short, broad, and shrunken ; the left wings apparently smaller than right, due to their outline following that of ♂ more distinctly than do latter ; the ocellated spots, especially on forewings, unusually large. A small accessory circle at the upper outer corner of normal ocellated spot of right forewing. The white thoracic band is as pronounced as in normal ♀, but not extended along costa. The dash that represents the subcostal continuation of central white blotch surrounding ocellated spot is of ♂ character on right forewing and ♀ on left. Colour of forewings ♂ so far as depth of dark grey shading and absence of the three spots towards apex are concerned, but they show no trace of the orange scaling usually found in normal ♂s ; there is also more white in marginal band of right than in that of left forewing. The left hindwing shows a most peculiar blotching and streaking with typical bright orange of normal ♂s, the right hindwing is of normal ♀ coloration, except that the dark outer band of both hindwings is more speckled with white scales than usual. The underside differs in that both forewings show the orange colour of normal ♂s, that of left wing more developed than that of right; on the other hand the hindwings which differ so markedly on upperside do not differ so noticeably on underside, being both more nearly like a normal ♀ than ♂, although they show traces of colouring of latter sex in costal area above ocellated spot. The antennæ with long plumules compared with those of normal ♀s and with numerous dark hairs fringing them as in normal ♂s; the pectinations, however, are very slight compared with those of ♂s. Coll. Mera (Bacot, *in litt.*).

TERATOLOGICAL EXAMPLES OF S. PAVONIA.—(1) A male with narrow wings, the forewings with the basal half of costa strongly excised and concave, the left hindwing with the apical part of costa excised (Hampson, *E.M.M.*, xxxvii., p. 118). (2) A specimen with five wings bred at Tenby (*Proc. Ent. Soc. Lond.*, 1888, p. xv).

VARIATION.—This cannot be considered as at all a variable species. There are very few records of striking aberrations having fallen into the hands of collectors, nor is there any marked tendency to the development of local races. Allen notices that Irish examples are large compared with those from Lancashire; Norman observes that Morayshire specimens are smaller and less richly-coloured than those from York, whilst Gordon considers the Wigtownshire females to be darker and more richly-coloured than those from the New Forest. Warburg states that *S. pavonia* from Cannes are larger, brighter and more thickly scaled than any English specimens; and Calberla has named a bright form from southern Italy, var. *meridionalis*. There is aslight amount of variation in the intensity of the ground colour of both sexes, in the amount of crimson shading, in the clearness of the transverse lines on the forewings, and the intensity of the lines on the hindwings. The best ♂ aberration that we have has the forewings of a darker ground colour, less red than usual, the discal area very white, the ocellated spot unusually dark, the hindwings also yellow instead of orange (ab. *lutescens*, n. ab.); and the best ♀ has the forewings of a darker ground colour than usual, the hindwings much darker, a smoky hue suffusing all the paler areas (ab. *infumata*), evidently a ♀ form agreeing with the ♂ described by Newnham under this name (*posteà* p. 316). Two small ♂s, evidently resulting from bad feeding, have a very greasy appearance, the markings of the forewings all washed out, and the hindwings with the usual darker transverse lines almost obsolete (ab. *subobsoleta*, n. ab.). Whitaker mentions (*i.l.*) two ♂ aberrations, one 57mm., the other 63mm. in expanse, one with only one band between the hind margin and ocellated spot on hindwing, the other with a narrow, inner, secondary one nearer the ocellated spot; the smaller one, between this band and outer margin, is of a deep orange colour, shading into brown; in the larger the colour is wholly brown (except the pink band). Ellis records a ♂ from Bolton with the whole of the markings so suffused with the dark ground colour that the insect appears nearly black. Hodgkinson records (*Ent.*, xxv., p. 145) an aberration taken on the Scottish border with a black band and a jet-black patch about ⅜in. in width near shoulder. Gordon notes a ♀ with the normally pale markings quite red (ab. *rosacea*), taken at Corsemalzie in 1898; Hewett has a ♂ with the left hindwing very pale, and one very dark ♂ from Yorks. Mitchell notes a dark ♀ showing distinct melanochroic tendencies bred from a Wicken larva (*Ent. Record*, viii., p. 184). Wood bred a specimen at Baldock with semi-transparent wings, a large proportion of scales being apparently absent (*Ent. Rec.*, v., p. 105). Frings records (*Soc. Ent.*, xiii., p. 130) the breeding, in April, 1897, of a very pale albinistic ♂. Gauckler describes and figures (*Illus. Woch. für Ent.*, i., p. 211, fig. 3) an aberration of *S. pavonia* that emerged in February, and has the bands which border the ocellated spot of both forewings united (ab. *fasciata*, n. ab.), directly beneath the spot, into a single broad dark carmine-red band, whilst the white area surrounding the ocellated spot has almost disappeared. Dwarfs are not at all uncommon among bred specimens, and Davis notes some from Waltham Cross only about half the normal size. Our smallest ♂s are only 50mm. in expanse (ab. *minor*, n. ab.). Morton, on the other hand, notes ♀s from Rothiemurchus Forest that expand 73mm., and some of ours reach 91.5mm. It is difficult to know how far the development of the tint characteristic of one sex, by the other, is a mere matter of individual variation, or an external sign of an internal modification in the direction of gynandromorphism. Pearson notes (*i.l.*) that he has a bred ♂ with ♀ coloration from Wannock; Hewett has a ♀ from York, having hindwings approaching the ♂ coloration; Gregson observes (*Ent.*, iv., p. 13) a very dark ♂, and 3 barren ♀s approaching the colour of the ♂s. Newman records the breeding of a subdiaphanous specimen that had been three years in the pupal stage, and we have already noted (*anteà*, p. 234) that Standfuss has produced dull and ill-marked examples by exposing the pupæ to high temperatures and forcing them to emerge in autumn without a winter hybernation as pupæ. Frings has produced similar poorly scaled and ill-pigmented examples, by subjecting pupæ to a low temperature and lengthening the pupal period. Thus the latter observes (*Soc. Ent.*, xv., p. 35) that 1896 pupæ kept out of doors in winter and placed in a refrigerator during the summer, produced in the spring of 1899, crippled imagines, weakly marked, and very thinly scaled, and thus resembling those that emerged in the spring of 1898 under similar treatment from 1896 pupæ (*loc. cit.*, xiv., p. 59). He further notes (*Soc. Ent.*, xiv., p. 67) that fresh pupæ of *S. pavonia*, *S. spini* and *S. pyri*, were exposed in the summer of 1898, 10 to 15 times, 6 to 10 hours at a time to a temperature of -15° C. They were then placed till late autumn in a refrigerator, hybernated in the open, part only producing imagines in the spring of 1899; almost all the *S. pavonia* were normal, probably only those being aberrant that were exposed to the frost immediately after pupation. These latter are pale in colour with much widened, hardly dentated, subterminal line and with the red of apex often darkened to black; whilst one very aberrant ♂ has the wings strikingly small and narrow, the expanse when the specimen is normally set (inner margins of forewings forming together a straight line) being only 39mm.; its ocellated spots only consist of yellow rings in the black area; the double subterminal line not at all dentate, and so abnormally broad as to reach the eye-spots. Many of these pupæ of *S. pavonia* did not emerge till autumn, 1899, after spending the summer again in the refrigerator. Among these were an aberrant pair, agreeing with those described above and those bred in 1898. Frings considers that these experiments show that, through long-continued moderate cold, and through frost operating on fresh pupæ, the same change of colour is brought about which also tends to occur, though rarely, in high alpine specimens.

The following appear to be the more important aberrations and varieties that have been figured and described:

α. ab. *infumata*, Newnham, "Ent. Rec.," ii., p. 198 (1891); Tutt, *loc. cit.*, p. 223 (1891).—♂. Very dark; the dark colour of all the wings has so far invaded the whole colouring, that it has nearly expelled the ordinary orange colour from the hindwings. Reared 1891 from larvæ taken on the Longmynds in Shropshire (Newnham).

β. ab. *rosacea*, Newnham, "Ent. Rec.," ii., p. 198 (1891); Tutt, *loc. cit.*, p. 223 (1891).—♂ and ♀. A very diminutive pair, in which a brilliant rosy-crimson has suffused the principal markings, this colour so far predominating that the bluish part of the crescent of the eye is altogether wanting, and this crescent reduced to a broad rich crimson arc. The usually serrated line is scarcely indented at all, and broadly suffused with crimson. This charming aberration might well be styled *rosacea* (Newnham).

γ. ab. *obsoleta*, n. ab. *Carpini* var., Bond, "Ent.," x., p. 1, with fig. (1877).—In the colour and markings of the specimen there is, perhaps, nothing worth notice, excepting the absence of the ocellus in each wing, and also of one of the nervures in each of the anterior wings. The specimen was bred by Mr. F. Barlow, from a larva found feeding with many others on sallow in Sawston Fen, Cambridgeshire (Bond).

Bond further notes that from the same batch of larvæ he bred a curious ♀, quite destitute of scales, in fact diaphanous, and without markings, though perfect in other respects, and large in size. The specimen is now in the "Stephens' Collection" in the British Museum. The rest of the specimens bred were exceedingly fine, the largest, a ♀, nearly four inches in expanse, the ♂s also large, measuring nearly three inches; the markings in all these clear and bright, the ground colour rather light, and not nearly so dark as some specimens received from the north of England. This type specimen of ab. *obsoleta* is mentioned in the *Proceedings Entomological Society of London*, as having been exhibited at a meeting of that Society on August 4th, 1851. An exactly parallel aberration (ab. *obsoleta*) of *S. spini* ♀, without ocellated spots on fore- or hindwings, is described and figured by Gauckler (*Illus. Woch. für Ent.*, ii., p. 159).

δ. var. *meridionalis*, Calb., "Iris," i., p. 155 (1887); Staud., "Cat.," 3rd ed., p. 127 (1901).—In the ♂ the upper side of the forewings is thickly dusted with orange-yellow, the ground colour of the hindwings, as far as the dark submarginal band, a bright orange, but often the latter also is orange-dusted, and the light marginal band of an orange colour. On the underside of all the wings the colour is likewise brighter than in German specimens, the inner half of the outer marginal band white, sharply divided from the outer dark half, divided by the dark nervures into spots, so that in cell 6 of the hindwings as distinct a spot appears as in *S. spini*, Schiff. The ♀s vary much in colour, but are mostly darker brown-grey, and with a redder tinge than there is in German specimens (Calberla).

Staudinger diagnoses (*Cat.*, 3rd ed., p. 127) var. *meridionalis* as: "Major, dilutior, ♂ al. ant. aurantiaco-inspersis, al. post. saturatius aurantiacis. It. c. et m."

ε. var. *alpina*, Favre, "Mitt. Schw. Ent. Ges.," x., 1, p. 36 (1897); "Faun. Macr. Lép. Valais," p. 111 (1899).—Se distingue du type par sa taille d'un bon tiers plus petite, avec les ailes beaucoup moins écailleuses et presque transparentes. Pas rare dans l'alpe de Bovine et les environs du glacier de Trient, Mont Arpilles, &c. (Favre).

Egglaying.—The natural manner of egglaying appears to be to attach the eggs very closely together round and round the twigs of some dead or living plant, the micropylar axis vertical to the plane on which the eggs are deposited, the whole united solidly by a thick coating of dark gum. A batch thus laid around a heather stem May 17th, 1899, bore a most remarkable resemblance to a little bunch of dried *Calluna* flowers, a resemblance still more striking when seen among natural surroundings in spite of the dissimilarity of individual eggs to individual blossoms. The eggs of another batch from near Knutsford were similarly laid against each other around a needle of furze forming a compact little mass of about 20 in number; these were laid by a wild ♀, April 22nd, 1899, on the gorse, though there was much heather close by; a batch of 176 eggs (with ♀) received from Pitcaple, May 8th, 1899, was laid on the inside of a chip-box, upright, *i.e.*, micropylar axis vertical, the eggs placed closely against each other and thickly covered with gum. A few of the outside eggs were flat, some oblique, *i.e.*, partly on end, but so few that one would be inclined to think that the upright must be the normal position, were it not known that this was so. In some places they were arranged in two layers, one on the other, the upper being rather oblique. Chapman writes: "The eggs are laid in patches (in a pillbox) in regular rows, standing side by side on their smaller ends, the tops being rather wider they rather push one another over, and some are on their sides. They are very firmly glued together and to the surface of deposition by a brown gum or varnish which leaves a thick dark ring with a white centre at the point of contact when they are separated. The colour of the egg is therefore whitish and the brown clouding, of differing intensity on different parts of the egg, is due to differences in the thickness of the gum, and the surface seen is not the true surface of the egg but that of the gum" (May 13th, 1899). The eggs are not only laid more or less upright on end in a box, but more frequently round a twig on each other, *neustria*-like; moreover they are not unlike the eggs of *Malacosoma neustria* or those of *M. castrensis* in shape (Bacot); eggs laid around twigs of blackthorn and ground maple at Chelmsford (Miller); round a dried stem of bog-myrtle near Corsemalzie, hatched June 5th, 1898 (Gordon); a ♀ found on a hawthorn hedge on April 5th, 1893, at Molesworth, had already laid 52 eggs on the twig on which she was resting (Wood); eggs laid May 19th, 1856, hatched June 5th at Fordwich (Cox); eggs laid April 22nd, 1885, hatched May 25th, 1885, at Brentwood; another batch found April 27th, 1887, of which one part hatched at Brentwood on May 27th, 1887, the other part in Manitoba on May 24th, 1887 (Burrows); a ♀ paired May 20th, 1897, oviposition began same day before sunset, larvæ hatched June 12th (Newland); Newland also notes (*i.l.*) that a ♀, that he believed to have been unfertilised, laid eggs on May 7th, 1894, but these hatched May 30th—June 2nd; Bayne notes (*i.l.*) finding a ♀ on a street lamp-post at Enfield and by her side a number of eggs which she had evidently laid there, April 24th, 1895; eggs laid May 14th, 1896, at York, hatched June 6th, 1896; a complete batch laid round a stalk of heather on May 11th, 1901, consisted of 167 eggs (Hewett); Milton and others have noticed that only the first laid eggs of some batches hatch, and the suggestion arises whether the ♀ does not frequently pair more than once in order to fertilise her whole batch. Holland states that about a third of a batch appears to be laid in one place, Ovum.—The form differs from a regular ovoid; it has three different diameters — the micropylar axis 2·2mm., a longer secondary axis 1·53mm., and a shorter 1·36mm. Looking down on the micropylar end, the egg is elliptical, with the diameters, 1·53mm. and 1·36mm. This corresponds to a section one-third (·7mm.) distant from the micropylar end; the egg is, however, ovoid, and not elliptical in longitudinal section, *i.e.*, it tapers towards the micropylar nadir and one-fourth distance (·55mm.) from the end opposite to the micropyle, the elliptical section would have diameters 1·22 and 1·10mm.; this is not quite all as the egg is not quite straight but one side is slightly flattened, the opposite a little rounded (this form is one very common in Geometrids, also in Drepanids). The surface of the egg is so clouded with brown gum that its colour is thereby dominated. Really the egg is white but not quite densely enough to obscure the green contents. I succeeded in chipping and scraping off some of the gum revealing a smooth surface, with faint pentagonal and hexagonal netting, not definitely rising above the surface, this netting was a little finer just round the micropyle, but without any obvious rosette of very fine netting. The micropyle was in a slightly paler area of egg (or egg contents). Many of the eggs showed a definite dark spot at the micropyle, as this is not constant and did not appear in the cleaned egg, it must be some effect of the gummy coating at this spot (Chapman, May 13th, 1899). Greyish-green in colour (but thickly embedded in brown gum); rather over 2mm. long, and 1·3mm. × 1·1mm. along other axes; a very marked oval depression on upper surface (considering the eggs to be laid upon each other), the shell without an obviously distinct reticulation, exceedingly roughened by raised points; the micropylar area conspicuous as a minute black point placed at the rather broader end of egg, very slightly depressed (Tutt. Described May 5th, 1899, from eggs laid April 22nd, 1899, near Knutsford). Another batch was pale whitish-green in colour with scarcely any of the thick brown gum that characterises most of the batches; in these the micropyle was very distinctly made out even with a hand lens, the central black point being surrounded by a very clear white ring (From Mrs. Cowl, Bournemouth, May 17th, 1899; these hatched May 25th, 1899). Another batch, colour pale olive-brown, the micropylar area rather dark, the micropyle a very minute depression at the apex, paler than the surrounding area. The surface is practically smooth, a slight roughness under a fairly high power does not resolve into any definite reticulation (eggs from Pitcaple, May 8th, 1899). When first laid the eggs are of a paler and greener tint than they afterwards become, but after deposition they change colour in a few minutes (Reid). When first laid the eggs are covered with a sticky substance by which they are attached and which makes them appear dark green; they soon dry and are then bluish-white and opaque (Burraud). Réaumur describes the eggs as like "des grains d'un émail blanc un peu bleuâtre, ou d'une porcelaine dont le blanc peche pour être trop bleu" (*Mém.*, i., p. 631).

Habits of larva.—The young larvæ live gregariously, and do not separate to any extent until after the third moult. Poulton notes that, in the first stage, larvæ in his possession not only showed a distinctly gregarious habit, but also persistently sought the side of their cage which was turned towards the light. Kane obtained a batch of larvæ (about 6mm. long) at Leenane, Connemara, on July 3rd, feeding on *Myrica gale*; they were quite social, but spun no silk web on which to rest. Hoffmann states that the larvæ are gregarious until after the third moult in the Upper Hartz, and are fullfed there about the beginning of July, the adult coloration being very protective on *Calluna vulgaris*, and, in spite of their large size, their green tint and reddish or yellow bristle-bearing warts render them inconspicuous. Holland observes that, when young, the larvæ prefer thick cover, and are found low down in the willow-beds, where the long grass and herbage grow around the small willows, whilst the larger larvæ are found higher up on the large bushes, occasionally fully exposed, but usually even these are most abundant in the densest part of a bush. Bankes sweeps the larvæ from heather in Dorset and Hants, and has sometimes met with the fullfed larva on heaths wandering about in search of a suitable place in which to spin. Porritt observes that, in Yorkshire, the larvæ prefer the lower shoots of whitethorn bushes on or at the edges of heaths, and we have seen them in abundance on the plants of *Spiraea ulmaria* that abound everywhere in Wicken Fen. Occasionally they are very abundant—Christy notes them as being exceptionally so on the moors of south Argyllshire in August and September, 1894, with larvæ of *Lasiocampa quercûs* var. *callunae* and *Pharetra menyanthidis*. The following notes relating to the capture of larvæ have been collected: larvæ fullfed in mid-August in the valleys of the Upper Engadine (Bischoff); July 19th—23rd, 1890, at Tancarville, Normandy (Leech); June 29th, 1878, at Barmouth (Sheldon); July 22nd—August 3rd, 1878, June 14th—26th, 1880, at Wicken (Porritt); September 13th, 1879, fullfed larvæ at Chat Moss (Auld); larvæ from June 16th—August, 1880, at Eltham (A. H. Jones); larvæ June 24th, 1885, at Abbott's Wood (Hanes); larvæ feeding on elder, August 3rd, 1888, at Groombridge (Blaber); July 21st, 1889, 69 on sallow and willow, August 31st, 1890, at Southstoke, May 28th 1893, at Pamber Forest (Holland); larvæ August, 1889, at Felixstowe, August, 1889 and 1890, at Brantham (Buckell); larvæ July 12th—19th, 1890, at Brockenhurst (Ogden); May 1st, 1892, June 8th, 1896, at Benfleet (Whittle); June 9th, 1892, at Hartley Wintney (Claxton); June 6th, 1893, on oak, June 1st, 1896, at Chattenden (Bower); July 15th—24th, 1893, at Wicken (Mitchell); July 29th, 1894, at Haverthwaite, larvæ on heather (Arkle); July, 1894, at Abersoch (G. O. Day); August 1st—September 22nd, 1894, June 5th—August 31st, 1895, at Penrith (Varty); August 30th, 1894, September 8th, 1896, on a heath at Heswall (Freeman); June 7th, 1896, near King's Lynn, on birch (Glenny); larvæ June 8th, 1896, at Benfleet (Mera); July 18th, 1896, in North Devon (Cowl); fullfed larvæ August 4th, 1896, at Wicken (Kaye); August 1st, 1896, at Ringwood (Fowler); June 6th, 1897, at Denny Bog (Tremayne); larvæ June 22nd, 1897, also 37 young larvæ at Loch Chesnay, June 5th, 1898, fullfed larvæ on September 4th, 1898, &c. (Gordon); July 10th—24th, 1897, at Barmouth (Imms); larvæ July 31st, 1897, in Glen Mallon (Dalglish); larvæ fullfed on August 19th, 1897, very small, in web, June 17th, 1898, at Oxton (Studd); July 16th—27th, 1898, in New Forest (Carr); larvæ pupated from August 24th, 1898, in Norfolk Broads (Edelsten); August 6th, 1899, in Isle of Man, from heather and blackthorn (Clarke); larvæ July 31st, 1900, at Henny, August 8th, 1900, at Sudbury (Ransom).

LARVA.—*First instar.*—The newly-hatched larva is black at first: the large warts are pale, but soon become as black as the hairs on general surface; length 2mm.—3mm. according to amount of extension. On the abdominal segments 1—7 the tubercles are: i (anterior trapezoidals), a large boss or wart, terminating in a strong stiff spine 0·35mm. in length, apparently without barbs, but seen laterally with 3 transparent or pale points, the first just beyond the middle, the others a little beyond; in a circle round this are 6 long hairs about 0·9mm. in length, faintly barbed; the bases of the spine and these hairs form a circular top to the wart, below this it continues same width (cylindrical) and then swells out, forming a wider lower ledge or circle which, however, carries no hairs; ii (posterior trapezoidals) each represented by a single hair, without raised base, arising just behind and slightly outside centre of i; the hair is about 0·5mm. in length and has some variations in tint suggesting barbs, but these cannot be made out; iii (supraspiracular) a rounded boss or wart carrying 7 hairs, not apparently differentiated, about 0·9mm. in length; v, subspiracular, a wart similar to iii, carrying 8 hairs very similar to those on iii; behind this and rather beneath it, and on its slope differentiated by its not forming part of the group of 8 hairs noted, is a single hair (? iv)*, very fine, about 0·15mm. in length; vi, vii, viii (?) on abdominal segments 1, 2, 7, and 8 are three bristles on either side, in line across segment, on abdominal segments 3, 4, 5, 6 are three bristles on each proleg. The arrangement on segment 8 is hardly distinguishable from the above, on the 9th, ? iv is represented by one bristle, and ii seems to be internal to i, whilst on 10 there is an anal plate with a row of bristles along its hind margin, on either side, 4 towards the centre, length 0·3mm., then a solitary one and then a group of 8 massed together, length 0·6 mm., there are many short bristles at the base of the anal claspers, length 0·12mm. On thoracic segments 2 and 3, the tubercles are as on the abdominal segments, except that I do not detect ii, and between iv and v and the bases of the legs, is a small wart with two long hairs, one in front of the other. On the prothorax is a plate with 10 hairs on its anterior margin on each side, and one posteriorly, one near the middle line; below the plate is a lateral wart with 10 hairs. The true legs have the usual 3 joints and a claw, along with the claw are three identical spindle-shaped processes, as long as the claw, pale and transparent, they seem to be the same organs that, from their shape, I have called in other young larvæ "battledore palpi." The ventral prolegs have about 13 large hooks along the inner margin only of the circle, the anal prolegs

* In the Saturnian larva the subspiracular wart is usually considered to be formed of tubercles iv + v. Chapman gives his post-subspiracular tubercle in 1st stadium as possibly iv moved down, and the subspiracular as v alone and not v + iv. The tubercle mentioned here may be a supplementary one, since there is good evidence in some Saturnian larvæ that the subspiracular really is iv + v. It may of course really be iv, absorbed in v in 2nd stadium, or atrophied. This explanation appears necessary to make the references clear.

have 16 along the anterior and inner margin. The head is black, with a number of not very long bristles, 2-jointed antennæ, maxillary palpi, a well-developed labium, with a marginal row of minute organs (hairs ?) the largest being distinct palpi at the outer angles. *Second instar:* Colour black, with a dark buff lunar mark above subspiracular tubercle, almost continuous from segment to segment, but not quite, and, therefore, not a subspiracular line; since it varies a little from specimen to specimen, it may be a continuous line in some. It is usually present only on the eight spiracle-carrying abdominal segments. When first moulted, the segmental incisions and the bosses of the tubercles are pale. The tubercles are a subdorsal (i) carrying a central and 6 surrounding hairs, supraspiracular (iii) similarly armed, but not quite so large; the hairs are black and strong and of a length equalling about half the diameter of the newly-moulted larva; tubercle ii of the first instar is now quite lost, nor is the post-subspiracular, called above iv, present, or, if so, distinguishable from the secondary hairs; the subspiracular tubercle, v, carries 2 or 3 black hairs like those of the dorsal tubercles, but shorter, and 5 or 6 white hairs that are a good deal longer and hang downwards to the surface on which the larva is; below this are (on 1st and 2nd abdominal segments) 3 ventral (vii, viii, ix) tubercles, the outer carrying 2 or 3 white hairs, the two inner white ones; between these and the subspiracular are several hairs, one or other of which may represent vi. The hairs, at least the central one on each tubercle, are much longer on the 2nd and 3rd thoracic segments. The thoracic tubercles are (on meso- and metathorax) the same as on the other segments, except that vi seems to be present, with several white hairs. On the 1st thoracic the dorsal and supraspiracular i and iii seem to be fused together. There is often a spot of yellow (continuing the lateral line) at base of v on the pro- and mesothorax; the 8th abdominal segment as others; the 9th has 4 tubercles and the 10th has 2. There are also a number of hairs on the general surface; these are short and white, not rising much above the summits of the tubercles, and number ten to a dozen round each tubercle, being scattered freely over the whole surface, *i.e.*, not massed near the tubercle; several rather larger ones occur below the subspiracular and in front of it and behind it; there is also a supply in the region of vii and at the bases of prolegs. The normal colouring as already noted is black, with an orange-yellow lateral line, somewhat interrupted, on the first 8 abdominal segments. The only variations noticed are the frequent extension more or less of the orange to the thoracic segments, and, as a rarer phase, the presence of some orange colouring round the bases of the tubercles, the central abdominal segments being first affected, and the lower row (iii) before the upper (i). One specimen for example has a lunule round the front and lower aspect of iii on abdominal segments 2-8, which is a complete circle only on the 3rd and 4th segments; another has lunules round iii on 3-7 and no complete circles; in another iii has complete circles from 2-8, and on the thoracic segments and 9th abdominal are also marked yellow lunules, whilst yet another has a yellow lunule below the tubercle on abdominal segments 3-8. As this is an anticipation of later colouring it may probably be occasionally more extreme. *Third instar:* The tubercles as before, fine white secondary hairs numerous, hairs on tubercles not half width of segment in length. Colour black with orange lateral line. One or two have this only, most have further markings. The orange band has the subspiracular tubercle in its centre, the spiracle being immediately above it. The orange line extends to the thorax in all specimens. The variation in the others would require a description for each specimen, but the general line of progress seems to be an orange circle round each tubercle first occurring on iii and afterwards on i, first as a lunule round lower margin, then as a complete circle. Then the circle of iii unites with the lateral line, afterwards with that round i. At the same time the lateral line becomes broader, and orange marks appear at bases of prolegs. These changes are most advanced on abdominal segments 3—6, although the junction of the orange circles of i is very rare on the abdomen but usual on the thorax. The next step is the appearance of a spot which is greenish-yellow rather than orange at the posterior margin of segment, level with the spiracle, and another above it at the level of (the absent) ii. On one specimen these two spots have united into a vertical stripe at posterior margin of segment, of a quite green tint, and just touching the orange stripe enclosing i and iii. In this specimen the orange stripe is still discontinued across dorsum on abdominal segments 1—6. The spiracle is a black spot in this stripe. The lateral band extends downwards, uniting with the orange stripes at bases of prolegs, but includes two black islets on each segment. On abdominal segments 3 and 4 the lateral stripe has a greenish tendency. The tubercles are still black; looking directly down on one where the ground colour is still black, it shines with its 7 black spines (or hairs), then round it is a dull black circle, and the black round this shows up the white secondary hairs as a circle of white rays radiating from the tubercle. When the larva is fullfed in the 3rd instar the orange areas become rather green than orange; what is curious is that the median zone of the segment, surrounding the tubercles, is the first to become green, yet is the one that so often remains black in last instar. This anomaly to some extent remains, but is less difficult to understand when we more carefully examine the colours at this (the third) instar, and find that the black tubercles, apparently surrounded by a yellow ring, are not simply the tubercles, but that the black centre includes also a black circle round the tubercle proper. *Fourth instar:* In this instar we find a very definite change of coloration, we have not now a black larva with orange (latterly becoming greenish) markings, but a larva of very strong and vivid green, with black markings, and though there is still great variety in the relative amounts of green and black (and no orange) the tubercles are nearly black and the head is usually more green than black. The moult then from 3rd to 4th instar is critical in green appearing as the dominant colour. Using green in this instar as synonymous with orange in the 3rd, we may note that the lateral line persists but tubercle v usually has a black ring round it, which was previously wanting. The semilunar mark under iii actually, but not always, persists, that under i is wanting or pushed backwards; a continuous dorsal black stripe is common, and at its greatest reduction is a black line connecting the black circle round i on each side, at least on forward abdominal segments. Green is the most strongly developed on the posterior border of segments, usually to the extent of a broad continuous band round segment, that on the anterior border is usually reduced to two large spots in front of i and iii respectively. The tubercles themselves are usually pink, but may be green or may be black with a green or pink point. The whole of i may be black, or only those on front segments. The head may be entirely green except a black line round the clypeus, or it may be black with the centre of clypeus, a line on each side and a patch at hind margin green. The black persists in centre of face beside clypeus. It is obvious to conclude that, at this stage, the larva might be entirely black above lateral line, or entirely green with green or pink tubercles, were sufficient specimens at command. Of those in my possession the greenest has pink tubercles, all surrounded by very narrow black lines, a black triangle at anterior margin of each segment dorsally, and also above iii, a black dot mediodorsally on 3rd thoracic and 6th abdominal segments and a black bar across the dorsum between tubercles i on the intermediate segments, 3 or 4 black spots above v, one being the spiracle, a slender vertical line behind iii and a black dot behind that, and another above iii. When the larva is extended, the black triangles at anterior border of segments are seen to be connected by a black line round posterior margin of preceding segment. The head has a black line round clypeus—secondary hairs white, arising from minute black dots. The darkest specimen has black tubercles, i and iii only with coloured centres, tubercles v (subspiracular) have black circles, and there is a suspicion of orange tinting on the green of lateral line and beneath iii. The green patches of i are square, and right away in front of tubercle iii are irregular lunules below and in front of them. There is a large green patch on posterior border of segments, on either side, narrow below and wide where it reaches forwards, nearly to line of tubercles and just between them. The green invasion is a little stronger on the meso- and metathorax and on the 7th, 8th, and 9th abdominals, in that the posterior patch meets the patch before i between the tubercles i and iii. Head black, with green clypeus, a line on each side of it and posterior margin of epicranium. Though the subsegmentation is indistinct, there appear to be three ridges behind that carrying tubercles, and on these the secondary hairs are arranged with some regularity. There are about 9 hairs (subsegments?) along the length of a segment, and their distances from each other are about the same in the transverse direction. This 4th stage is then identical in colouring with the last stage, but the black is more dominant. In the last stage a wholly green larva is common, possibly to be called the type, here it is rare, and is only very closely approached by the greenest one in the specimens under observation. Whilst dark larvæ are more abundant than in last stage, a larva quite black (except lateral line) seems quite possible at this stage, but in last stage could only occur as an extremely rare variation (Chapman. June 1901). *Last stadium:* Head and body bright green, the skin covered with minute tubercular points, each giving rise to a stout white bristly hair. *Dorsally:* head green, edges of clypeus margined with black, covered with many white and a few longer black hairs ocelli on a dark patch, the antennæ pale, orange-brown, mouthparts also brown. Prothorax with two dorsal yellow tubercular warts, transversely linear on anterior edge (each consists of the united dorsal (i) and supraspiracular (iii) of the succeeding segments), 9 long black hairs and many white ones on each wart, the lateral tubercular wart (iv + v) normal in shape, prothoracic spiracle large, conspicuous, with a pinkish centre and black rim. The meso- and metathorax, and abdominal segments 1—8, all bear a dorsal (i), a supraspiracular (iii), and subspiracular (iv + v) wart on either side, yellow, edged with black at the base on upper side, and bearing, as a rule, 7 black hairs, of which the two central are the longest; on the 8th abdominal the subspiracular (iv + v) is pushed back a little, and on the 9th and 10th the dorsal (i) and small supraspiracular (iii) unite, having on the 10th the form of a single wart. The 10th abdominal segment is much flattened dorsally and the anal flap is edged with the same sort of hairs as those on the wart. The abdominal segments appear to be divided into an inconspicuous 1st subsegment, a 2nd wide one bearing the tubercular warts, followed by four very narrow and inconspicuous ones. *Laterally:* The subspiracular flange is very conspicuous and rendered more so by the segmental incisions and the position of the subspiracular series of tubercular warts (iv + v) on it; the spiracles are very conspicuous, large, open-mouthed ovals with a black edge. The prolegs are green, covered with numerous stout white hairs, each arising from a small shiny tuberculated base; the foot itself is duller green, the hooks black, the anal prolegs are particularly large and strong. *Ventrally:* The surface darker and duller green, the true legs reddish, each with a powerful hook, the legs themselves covered with many white hairs (Tutt. Described from a larva found feeding on *Potentilla* at Evolena, August 12th, 1899). Réaumur describes (*Mém.*, i., p. 91) the young larvæ as "entierement noires et très-veluës (pl. ii., fig. 12), des poils serrés les uns auprès des autres partoient de tous les endroits de leur peau, ils couvroient les tubercules sur lesquels des poils plus courts étoient implantés. . . . Quand elles furent parvenuës à une grandeur peu au dessous de celle que nous avons fixée pour la grandeur mediocre des chenilles (pl. ii., fig. 15), il parut tout du long de leurs côtes une raye jaune: en continuant de croître, ce ne fut plus ce jaune qui se fit remarquer. Au milieu du noir qui dominoit, parurent de petites taches du plus beau verd d'émeraude, distribuées sur tout leur corps. Elles changerent de peau. Les taches vertes n'en furent pas moins belles, mais elles furent plus grandes. Elles eurent beaucoup moins de poils, il y en avoit peu sur tout ce qui étoit en verd. Enfin, soit à mesure qu'elles croissoient, soit après des changements de peau, le nombre des poils diminua de plus en plus, et le noir continua de disparoître. Elles devinrent presque entierement vertes, n'ayant qu'une tache noire au bord posterieur de chaque anneau, et elles n'eurent plus de poils sensibles que sur leurs tubercules, qui d'abord furent jaunes, et ensuite rougeâtres. Il resulte de cette observation que ce n'est qu'après avoir suivi une chenille jusqu'à sa transformation qu'on peut la mettre dans le genre des veluës, ou des rases, et qu'il y en a qui vûës dans differents âges, seroient distribuées en des genres differents."

Variation of larva.—Chapman's detailed description of the larva (*antea*, pp. 320 *et seq.*) deals largely with this phase of the subject.

There are certain directions in which variation of the larva occurs, on which detailed information would be exceedingly useful, *e.g.*, the maintenance of characteristic features of any of the earlier stadia in individuals that have reached the adult stage, etc. Newnham says (*Ent. Rec.*, ii., p. 199) that some larvæ have broad velvety rings around each segment, in others, they are reduced to small rings around each tubercle; whilst the tubercles themselves offer many variations, bright yellow (the commonest form), orange, pink, white, black and purple, the three last-named forms being the rarest. Scharff notes an adult larva near Lough Bray, in the Wicklow mountains, in August, 1894, which was "entirely black, with the exception of the yellow tubercles, the green ground colour being reduced to a frontal triangular patch and two lateral streaks on the head, a pair of dorsal spots on the mesothorax and the two spots, on either side of each abdominal segment, which together form a broken spiracular line." Bacot observes (*Ent. Rec.*, iv., p. 199) that he "obtained a brood of young larvæ in June, 1892, on a whitethorn hedge, near Thundersley; from a ♂ and ♀ reared from these larvæ, a batch of ova was obtained in 1893, the larvæ hatching in about 20 days. After their first moult, the larvæ varied very widely, some of them being entirely green or pale yellow without any black, some remaining (until their third moult) quite black, with the exception of a reddish or brownish stripe along the side. The latter retained a large proportion of black in their coloration until nearly fullfed, while others, exhibiting nearly every grade between these two extremes, could be picked out of the brood. It seems strange that a brood of larvæ should vary so widely after their first moult, and yet be so alike (comparatively speaking) in their last stage. The following possible explanation has occurred to me: The larvæ until the first moult are quite black, and they feed gregariously until the third moult. When feeding on a hedge or bush they might easily be overlooked, as the effect of a brood of small black larvæ lying close together is to blot out the leaf or leaves on which they are feeding, leaving an apparent opening in the hedge, such as would be obtained if one or two leaves were picked off. If, however, the whole brood retained its black colour as the larvæ grew larger, the size of the apparent opening or hole in the hedge would become noticeable, but as they vary in colour, they match very well with the bright green leaves and dark spaces between, in fact, if they cleared a patch of leaves, the larvæ would themselves (to a certain extent) present the appearance of the missing foliage. No doubt after the third moult, when they scatter, the bright forms are, as regards colour, by far the best protected." Poulton notes (*Trans. Ent. Soc. Lond.*, 1887, pp. 310—312) that 80 larvæ received from Norfolk, July 25th, 1885, and found feeding on *Spiraea ulmaria*, varied in ground colour, in the last stadium, from light bright green to dusky green. The black markings were also very variable in the last stage, being, as a rule, especially small in the bright green larvæ; in some larvæ the black rings were incomplete, and were occasionally reduced to a mere black line round each tubercle. The longitudinal black marks, as a rule, only occurred in the dull green larvæ. In 76 larvæ the tubercles were yellow, varying from orange to lemon-yellow, and the lighter tubercles were generally found upon the bright green larvæ; in three larvæ the tubercles were pink, without a trace of yellow or orange; in one the tubercles were pure white. Of the three larvæ with pink tubercles, one was recognised from its size to be a ♀, and it was of a dull green colour, with the black markings largely developed; the other two were similarly recognised as males, and they were both of the brightest green colour, but with the black markings also well-developed (unusually so for so light a ground colour). The perfect insects emerged during the last few days of April, 1886, and 120 ova were obtained from the ♀ moth which was developed from the larva with pink tubercles, the male parent being derived from one of the other two pink-tubercled larvæ just described. The larvæ emerged May 23rd, 1886, and were fed upon hawthorn; 80 of these larvæ were reared by Poulton, the remainder by Dixey. Of Dixey's 40, 13 had yellow or orange tubercles in the last stadium, 27 having pink ones like the parents, the black segmental rings were not imperfect in any of the 40 larvæ, as was so often the case in the original batch of larvæ. In this they completely resembled their parents. The green ground colour varied, but was mostly bright like that of the larva of the ♂ parent. Of the 80 larvæ reared by Poulton, 48 were noted in the last stadium, and 37 had pink tubercles. The results, therefore, tabulate as follows: 1885.—80 larvæ, of which 3 (or 3·75 per cent.) possessed pink tubercles. 1886.—88 larvæ, of which 64 (or 72·7 per cent.) possessed pink tubercles. Poulton adds that his larvæ were exposed to surroundings of different colours, but that the tubercles and the black markings were entirely unaffected, while the dulness or brightness of the green ground colour certainly seemed to be influenced by dark or light surroundings. While the great majority of Poulton's larvæ possessed the uniformly well-developed markings noted by Dixey, in a few individuals these were only present in a very slight degree. This variation in the colour of the tubercles appears not to be confined in nature to any particular brood, or foodplant, or locality, for Bowles notes (*Ent. Rec.*, ii., p. 225) both pink- and yellow-tubercled forms of the larvæ on *Spiraea ulmaria* in the Norfolk Broads in August, 1891.

Pupation.—The cocoon is spun up on or among the foodplant, attached to stems on bushy plants of heather (Gordon); among the tops of *Calluna vulgaris* and quite conspicuous at Ringwood (Fowler); the cocoons are usually found in Ireland on the heather, sometimes in places which must often be flooded in winter (Kane); found cocoons on the summit of the Belmore mountain near Fermanagh, in the autumn of 1897, where the ling was short and scanty, these cocoons were placed almost on the ground, whilst those found on the Lancashire moors are generally placed well above the ground (Allen); a single cocoon on the slopes of a headland on the coast of Co. Antrim, about 20 yards from the sea, on November 4th, 1898 (Greer); cocoons at the foot of hawthorn hedges, preferably at the foot of low isolated bushes near end of hedge, at Enfield, &c. (Bayne); made low down in hedges or placed in cracks in garden walls in Namur district (Lambillion); cocoons are easily found among the heather on the moors at Harrogate; when the plants are withered they are more readily seen, being either spun up on the heather, or, as is frequently the case, loosely on the ground (Arbuthnott); cocoons spun up on branches of a short, thick, whitethorn hedge about a foot from the top of the bank, on which the hedge was growing, near Sudbury; while the hedge is in foliage the cocoons must be very completely hidden, and, later, exposure to the weather has so brought the colour into uniformity with those of the surrounding branches that even when the hedge is leafless it is difficult to detect them (Ransom).

Cocoon.—The cocoon is flask- or pear-shaped; the broad end rounded and closed, the narrow end with a bottle-neck-shaped opening for exit of moth; composed of a loose fluffy silken outside covering, into which pieces of leaves, dirt, etc., are spun. The inner portion felted, deep red-brown in colour; the inside surface shining and smooth as if gummed. The peculiarity of the cocoon is the remarkable eel-trap arrangement, that, springing from the shoulders inside the cocoon, makes an exit which, while it excludes any external marauders, opens readily under the pressure of the emerging insect from the inside. Albin was the first to notice the peculiar exit made by the Saturniid larvæ to their cocoons, but Réaumur's description of the cocoons and of the mode of escape of the imagines therefrom is quite unrivalled. He explains how, in spite of the toughness of the silk, the moths on emergence have only to push open a sort of fringe in order to escape. His detailed observations, after noting that the cocoons containing a living pupa and one from which the imago has emerged are perfectly similar, and the outlet for escape scarcely visible in the latter, read (*Mém.*, i., p. 627) as follows: "Un des bouts de la coque (pl. xlviii., fig. 4*f*; pl. xlix., fig. 3; pl. l., fig. 2) est plus menu que l'autre, et on y voit des poils qui ne sont pas couchés comme ils le sont ailleurs. Si on se contente de regarder grossierement ce bout de la coque, on juge seulement que le fil n'y est pas devidé, qu'il y forme une masse cotonneuse, semblable à celles qui enveloppent d'autres coques en entier; mais si on regarde plus attentivement, on observe que tous ces fils, qui ne sont pas adherants les uns aux autres, se dirigent vers un même point pour former une espece d'entonnoir qui est le bout de la coque; enfin le bout de la coque est une espece d'entonnoir formé par les fils d'une frange. La comparaison même aux fils de frange est exacte, si on prend une frange avant que ses fils ayent été tors, ou en termes de l'art guipés, alors chaque fil de la frange est composé d'un fil plié en deux, c'est en tordant ces deux parties du fil qu'on les réunit; le bout de chacun des brins de soye qui se rendent à la pointe de la coque, est fait aussi par un fil qui se replie sur lui-même. Nous avons déja dit que ces fils sont gros; d'ailleurs, ils sont bien gommés, leur ressort les tient tous dans la premiere direction qui leur a été donnée et les y ramene lorsque quelque force les en a tirés." To emerge the imago advances freely in this funnel, it finds no great trouble to widen the detached threads which form the walls, and when it has emerged the elasticity of the silk makes them return to their former situation, and it thus results that a cocoon with a living pupa, and one from which the imago has emerged, are externally similar. Réaumur then goes on to show that not only does the construction of the cocoon allow easy egress to the emerging imago, but also that it keeps out its numerous enemies. He writes (*loc. cit.*, p. 628): "Outre l'entonnoir exterieur, outre celui dont nous venons de parler, on en verra un interieur, formé précisement de la même maniere (pl. xlviii., figs. 6—7; pl. xlix., fig. 4*h—i)*; mais dont les fils sont encore mieux arrangés en fils de frange, et plus serrés les uns contre les autres. Le nombre des entonnoirs n'augmente point, ou augmente peu la difficulté que le papillon trouve à sortir; mais l'entrée dans la coque en est renduë plus difficile aux insectes qui voudroient s'y introduire. On connoît la structure des nasses dans lesquelles on prend le poisson; leur artifice consiste en ce qu'elles sont composées de plusieurs entonnoirs d'osier ou de reseau, mis l'un dans l'autre. La circonference évasée du premier entonnoir offre une entrée facile au poisson, il n'en craint rien; il parcourt tout ce premier entonnoir, et entre sans défiance dans le second, qui se presente de même à lui; il se rend dans la grande cavité de la nasse. Mais lorsqu'il veut revenir en arriere, il ne sçait plus trouver, ou enfiler les petites ouvertures par où il est sorti de chaque entonnoir. Les entonnoirs de notre coque sont tournés, par rapport au papillon, comme les ouvertures des nasses qui invitent les poissons à s'y engager; et les entonnoirs de ces coques sont tournés, par rapport aux insectes qui voudroient penetrer dans l'interieur de la coque, comme le sont les entonnoirs des nasses par rapport aux poissons qui en veulent sortir. Nous ne devons pas encore oublier de remarquer que la chenille, avant sa metamorphose, se place dans la coque de maniere que la tête de la crisalide, et par consequent celle du papillon, se trouveront tout près de l'entonnoir interieur." Réaumur further notes that he knows of no other larvæ except the Saturnias—*pavonia* and *pyri*—that make cocoons with exits of this character. Latter records (*Trans. Ent. Soc. Lond.*, 1895, p. 406) an experiment which showed that an abundant alkaline secretion is discharged by the emerging moth prior to exit from the cocoon. Doubtless the fluid softens the converging silk fibres at the neck of the flask-shaped cocoon, and thus the labour imposed upon the moth is lessened. Judging only by the size of blue stain * produced, the amount discharged is little less than that produced by *Dicranura vinula.* The head of the moth and of the pupa present no modifications correlated with the possession of a hard cocoon.

Abnormal cocoons.—There are many abnormal cocoons of this species on record. One of the most frequent abnormalities is the formation of two exits to an otherwise normal cocoon. Such an one is in our collection, received from Mr. Alderson, of Farnborough. Newport describes (*Zool.*, xii., p. 4175) a similar one, with two exits and containing but one pupa, and Newman another (*loc. cit.*, p. 8529) the exits being noted as smaller than the one usually present, the pupa contained being a healthy one. Culpin records a similar one, large, and made of white silk (*Ent. Rec.*, i., p. 174) and Fowler describes an oblong cocoon with two exits, obtained at Ringwood, August 1st, 1896. Warburg has one spun by a larva found in Southern France in June, 1885. Hoffmann states that larvæ found in the Upper Hartz frequently make cocoons with two normally-formed emergence openings, whilst Edmunds describes, from

* The cocoons were placed in cones of loosely coiled red litmus paper, the apex of which was left open and directed towards the light; the head of the pupa lying near the apex.

Worcester, a cocoon constructed with three valvular emergence apertures, two of which are quite perfect and beautifully formed, the third being deficient in the usual converging filamentary portion; this was constructed by a larva from which a fine ♂ specimen was afterwards bred. Réaumur refers (*Mém.*, i., pp. 634—635) to a larva that spun a cocoon without a normal opening, the resulting imago being quite unable to force its way out on emergence, and Rye records a similar one "rounded at both ends like an ordinary 'eggar' cocoon." Sheppard exhibited a similar one at the meeting of the Entomological Society of London, August 4th, 1851, and Poulton mentions another (*Trans. Ent. Soc. Lond.*, 1892, p. 311) spun without any apparent valvular opening, whilst Bell notes (*Ent. Rec.*, vii., p. 71) two cocoons without the usual outlet, almost spherical in shape, and of small size. Newport describes (*Zool.*, xii., p. 4175) a large flattened cocoon, the joint production of two larvæ, divided by a septum into two chambers, in one of which was a dead larva and, in the other, a pupa from which the imago had failed to escape; Harwood mentions (*Ent. Wk. Int.*, vii., p. 28) a cocoon that contained two ♂ pupæ, and Frohawk describes and figures (*Ent.*, xvii., p. 73) a similar one, one of the imagines from which emerged, but failed to get out of the cocoon; Fowler notes two cases in which two larvæ, taken at Ringwood, spun common cocoons, each the work of two larvæ, whilst Milton mentions (*Ent. Rec.*, iii., p. 12) a cocoon containing two pupæ; Seyffler states that such cocoons have frequently come under his notice in Wurtemberg. Such cocoons appear to result only from an overcrowding in confinement. At the meeting of the Entomological Society of London, held December 4th, 1901, Pickett exhibited several abnormal cocoons, one with two openings, one with no opening, and a third containing three pupæ, whilst at the meeting held on May 4th, 1868, Trimen exhibited a cocoon in which the imago, having failed to get out of the anterior end, forced its abdominal segments through the posterior end.

Variation in colour of cocoons.—Cocoons of this species vary in tint from pale yellowish or white to almost black. Quail and others note light cocoons as occurring among those spun by Wicken larvæ, the silk almost white; Culpin a long white one with two exits, whilst other pale-coloured cocoons are on record, all, however, made by larvæ reared in confinement. Poulton (*Colours of Animals*, 1890, pp. 142-6) suggested that this difference in colour was due to an ability on the part of the larva to spin a cocoon in response to the conditions of its surroundings. This view was challenged by Bateson and others, and the former (*Trans. Ent. Soc. Lond.*, 1892, pp. 45 *et seq.*) detailed at length observations which he had made in 1891 on certain experiments that he had carried out, that tended to contradict Poulton's conclusions. He notes:

(1) Eleven cocoons found spun in hedges in a state of nature, all of full colour. (2) Fifteen larvæ, shut up in and among various dark substances, spun cocoons which were all light in colour, some being quite white, no dark cocoon being spun by a larva thus confined. (3) Fifteen larvæ fed in a large vessel on food surrounded with crumpled white paper, produced 7 dark cocoons (3 attached to the paper and 4 among leaves), 4 light brown in colour, 4 white (attached to paper and leaves).

As a general fact Bateson found it difficult to obtain any considerable number of dark cocoons from *S. pavonia* larvæ in captivity, even when they were left with their food and disturbed as little as possible; further that the colour of the cocoons did not appear to depend upon foreign substances. He suggested that a meconial fluid, viscous and dark brown in colour and containing some fæcal matter, voided by the larva, was the material with which the cocoon was coloured. During 1892, further experiments were undertaken and the results detailed (*loc. cit.*, pp. 205 *et seq.*) at considerable length. He had two batches of eggs that gave about 140 larvæ of *S. pavonia*, these were sleeved on hawthorn in the open air, and on July 2nd divided into two sections:

(1) 66 larvæ, covered with a large sleeve of white muslin, containing much crumpled white paper; these gave—7 cocoons on the white sleeve, 18 in white paper, 19 partially attached to white paper and partly to twigs, 9 on leaves or twigs. With one exception, all the cocoons are of the full dark colour, the exception being also a brown cocoon, which is thin and deficient in substance (it is one of the 19). (2) 44 larvæ, covered with a large sleeve of black muslin, placed on same bush, containing much crumpled brown paper, darkest obtainable; these gave—2 cocoons in brown paper, 1 between paper and leaves, 4 on black sleeve, 31 in leaves or massed against each other. All these were of full dark colour.

These experiments were held to show that there was no relation between the colour of the cocoons and that of the substances to which they are attached. Further evidence is given to show that the colouring substance came from the alimentary canal, and after weighing the evidence Bateson concludes that:

(1) The brown colour of the cocoons is derived from the alimentary canal. (2) It is produced in the digestion of the food. (3) It is probably a chlorophyll derivative. (4) It is imparted to the silk from the mouth of the larva, and perhaps by evacuation from the intestine also.

May records (*Ent. Record*, vii., p. 238) an experiment which goes to show that after pale cocoons are spun in confinement, exposure to damp surroundings tends to darken them. He states that from dark cocoons received from Yorkshire, small imagines were bred, that, from a pairing of these, eggs were obtained and the larvæ divided into two lots: (1) Fed on abundant supply of fresh whitethorn, in roomy cage, dry, light and well ventilated; 19 spun up producing 18 more or less pale-coloured and only one dark cocoon. (2) Fed on whitethorn, often short of food, under a glass shade without ventilation, in a continuously damp atmosphere; 16 cocoons resulted, every one dark. On November 24th three of the pale cocoons were placed on damp sand in the forcing cage, kept in a kitchen, and three days later the cocoons were noticed to be dark brown; wishing to make sure that this change was due to moisture three more were placed with them, and on taking them out two hours later the change had already taken place. May suggests that the colour of the cement that is used in the construction of the cocoon and that makes it waterproof, is perhaps influenced by dampness and gives the cocoons their colour. He notes, however, that the cocoons spun by his larvæ were thin in texture, and not so hard as those he had had before. Reference to our account of the variation of the cocoons of *Lachneis lanestris* (*anteà*, vol. ii., p. 512) will give our view of the cause of the variation in colour.

Comparison of cocoons of Saturnia pyri and S. pavonia.—The cocoon of *S. pyri* (about $2\frac{1}{4}$ inches long) is of a deep brown colour, very similar in shape and construction to that of *Saturnia* *pavonia*, except that it is longer, narrower, and has not so pronounced a neck as the latter. It is composed of very hard and tough silk, which cuts like thin horn. The outer surface is rough, covered with a thin coating of stout, wiry silk threads. The interior has a smooth glazed surface, two separate coats of the viscous silk having apparently been used in its construction. This can be best seen by opening the cocoon lengthwise. The opening, like that of *S. pavonia*, is constructed on a similar principle to that of a crab- or lobster-pot, with the exception that it prevents ingress and not egress. In the cocoon of *S. pyri* this trap is double, a distance of about $\frac{1}{3}$ of an inch separating the outer from the inner. The cocoon of *S. pavonia* also has remnants of an outer trap, but it is imperfect, being little more than an opening with ragged edges, while the inner is even more perfect than that of *S. pyri* (Bacot).

Pupa.—The general colour blackish; the whole surface is finely wrinkled, and nowhere presents any spines, or points, or any pits; the ventral organs (legs, antennæ, etc.) and abdominal segmental incisions red-brown. The head narrower than the thorax, which again is less wide than the front abdominal segments, which increase in size from the 1st to 4th, and then decrease to the cremaster. The labrum and clypeus prominent; inter-antennal region pale in colour as if thin and delicate; the maxillæ short and enclosed between the first pair of legs, the 1st and 2nd pairs of legs extending beyond the antennæ, which are fixed frontally; the second pair of legs extending about four-fifths from the base towards the apex of the wings. The glazed eye is very inconspicuous. The prothorax, placed frontally, is ill-developed; the mesothorax prominent; the metathorax ill-developed; a fine, smooth line running down the centre of the thorax. The forewings with a thick costal margin; the hindwings showing from the metathorax as a slight extension beyond the margin of the forewings to the middle of hind margin; the prothoracic spiracle in the suture separating the pro- and mesothorax. The abdominal segments show, dorsally, scars denoting the position of the larval tubercles. The spiracles are placed laterally, and are conspicuous on the abdominal segments 2—7, aborted on the 8th. Each consists of a narrow red-brown slit set in a prominent black rim. The ventral area is flattened and shining. The movable incisions are placed between 4—5, 5—6, and 6—7. The cremaster flattened out and bearing about 24 long black hairs graduating into shorter ones. The genital organs are clearly seen on the 8th and 9th abdominal segments in the ♀, and on the 9th in the ♂ as usual (Tutt). The antenna-cases are nearly as well developed in the ♀ as in the ♂ pupa, whilst in the imagines the antennæ are only very slightly pectinated in the ♀, and only occupy a small portion of the space covered by the pupal ones (Bacot).

Comparison of pupæ of Saturnia pyri and S. pavonia.—The pupa of *S. pyri* has a low double cremaster with a few short scythe-shaped spines on it, in which feature it resembles the pupa of *S. pavonia*, except that, in the latter, the ventral hollow and cremaster are developed to a far greater extent. It, however, differs greatly in shape from the pupa of *S. pavonia*, which is much flattened out laterally, curved ventrally, and tapers rapidly towards the head and anus. The pupa of *S. pyri* is, in shape, almost, if not quite, cylindrical, tapers only very slightly to the shoulders (base of wings), and then abruptly to head, forming a blunt front. It tapers more evenly towards anus, which is rather blunt, and does *not* curve up ventrally as the pupa of *S. pavonia* does, though the segments are somewhat compressed ventrally. The pupa of *S. pyri* is not unlike that of *Mimas tiliae* in shape, only rather wider in regard to its length, and, of course, differing at head and anus. In general shape and appearance, omitting the antenna-cases, it tends rather towards the Amorphid (Smerinthid) than the Saturniid shape, as typified by *S. pavonia* (Bacot). The pupa of *S. pyri* is much nearer the typical Saturnian pupa than is that of *S. pavonia*, which is really a rather exceptional form, both in its curvature and antero-posterior flattening. The Smerinthid (practically=Citheronian) pupa is the basal form of Saturnian pupa (Chapman).

Pupal habits.—Like *Lachneis lanestris*, *Dimorpha versicolora* and other species that appear to have had a northern origin*, *Saturnia pavonia* frequently goes over two, three or more winters in the pupal stage*, and this habit appears to be almost as frequent among broods of more southern as among those of more northern origin. Chapman records breeding imagines in May at Glasgow after passing two years in the pupal stage, and Barrett notes a whole brood, reared from Yorkshire ova, that pupated in August, 1866, went over the whole of 1867 in the pupal stage, and produced imagines in the spring of 1868. Mead observes that from 1890 pupæ he bred imagines January 22nd (♂), February 2nd (♀), February 7th (2 ♂ s), and February 9th (♀), 1892; whilst Nash bred a ♀ March 31st, 1890, and a ♂ April 5th, 1890, at Hardwick, from pupæ of the second year. Fenn reared, in 1890, from Bournemouth ova of 1889, a large number of imagines between March 8th and May 19th, but a few pupæ went over a second winter, and the first of these emerged June 1st, 1891; from the same locality Mrs. Cowl has repeatedly bred imagines after the pupæ have gone over two winters. Beadle had several emerge (*Ent. Rec.*, xi., pp. 280, 306) after being three years in the pupal stage, and King (*loc. cit.*, i., p. 109), in the spring of 1890, bred several that had been in the pupal stage three years. [See also *anted* p. 315.]. Hoffmann notes that, in the Hartz, the pupal stage sometimes lasts 2, 3 or 4 years, such pupæ generally producing ♀ s, whilst Hewett insists that the bulk of the imagines reared in the York district from two- and three-year old cocoons

* We suspect strongly that this custom has much to do with the hereditary persistence of a habit engendered, in the case of these species, when they had to meet a much longer winter (and shorter summer) than now. We may suppose that this happened in their present breeding-grounds, or that the habit was engendered in a more northern latitude, and that the species have since spread, maintaining the habit as being even now occasionally of service to them. It occurs in a much more southern latitude than ours, for Warburg states that six larvæ from southern France, fullfed in June, 1885, gave imagines in February, 1886 and 1887, and Turner reared a brood (parents captured wild at Digne in the Basses-Alpes in April, 1898), that gave some examples that emerged after being two years in the pupal stage, *viz.*, in April 1899, 21 ♂ s; in April 1900, 2 ♂ s and 7 ♀ s. Standfuss observes (*Handbuch*, etc., p. 105) that 50 per cent. of pupæ from Dantzig did not give their imagines the first spring (*i.e.*, after one hybernation), whilst only 30 per cent. of pupæ from Naples and Capri lay over. The maximum period of delay observed by Standfuss has been four winters.

are cripples. [For further instances of lengthened pupal stage see *posteà*, pp. 335 *et seq.*]

PARASITES.—*Amblyteles armatorius*, Forst. (Marshall); *Cryptus fumipennis*, Grav. (Bridgman), *Exetastes illusor*, Grav. (Barker), *Pezomachus insolens*, Grav. (Elliot), *Apanteles immunis*, Hal. (Decie), *Meteorus luridus*, Ruthe (Barker), *Pteromalus* sp. ? (Fitch), *Exorista grandis*, Zett. (Bignell), *Masicera sylvatica*, Fln. (Fenn).

FOODPLANTS.—Almost polyphagous—white poplar, etc. (Burrows), *Rosa*, *Rubus*, *Ulmus*, *Corylus*, *Salix*, *Pyrus* (Linné), sallow, purple-loosestrife, hawthorn, etc. (Farren), *Spiraea ulmaria* (Tutt), *Erica*, *Calluna* (Pearson), *Myrica gale* (Brown), bramble, apple (Ransom), *Erica tetralix*, etc. (Atmore), *Ononis* (Montgomery), willow, etc. (Edelsten), *Tormentilla* (Dalglish), *Vaccinium*, *Sorbus* (Hoffmann), apple, pear, *Rumex crispus* (Lambillion), raspberry (Romanoff), birch, elm (Adkin), *Helianthemum halimaefolium* (Walker), plum, lilac (Finch), whortleberry (Rühl), *Potentilla* (Tutt), *Sambucus* (Blaber), *Prunus spinosa*, *Carpinus betulus*, *Quercus robur*, *Alnus glutinosa*, *Betula alba*, *Salix caprea*, *Rosa canina*, *Erica vulgaris*, *Fragaria vesca*, *Vaccinium myrtillus*, *Hippophaes* (Ochsenheimer), walnut (St. John), oak for about fourteen days, then blossoms of bramble, refusing oak for the latter (Winkley), blaeberry (Varty), large strawberry bed eaten almost bare (Johnson).

HABITS.—This is one of the early spring moths, and its habits are very similar to those of *Dimorpha versicolora*. The ♀ is quiet and lethargic, resting near the cocoon from which she has emerged until copulation has taken place, and flying at dusk for the purpose of oviposition. Hewett, however, captured a ♀ on the wing on Strensall Common at 4 p.m., and Gordon observed another at Corsemalzie. The ♀ is sometimes captured at light; Jones and Fenn record one each on lamps at Eltham, Bayne one on a street lamp at Enfield, Jenner-Fust another on a street lamp at Bromley, April 24th, 1868. The ♂ flies swiftly by day, in full sunshine, its erratic flight very intimately connected with the discovery of the ♀. The males are most active from just before noon until 5 p.m., although Holland says that, in his experience, the ♂ flies chiefly between 2.30 p.m. and 5 p.m., rarely earlier. In confinement the greater number of specimens emerge between 9 a.m. and noon (9.45 a.m. is stated by Elliot to be the usual time), and from about 1 p.m. until 3 p.m. the ♂s assemble freely to a newly-emerged ♀, but we have seen them attracted as early as 11 a.m. and as late as 5 p.m. Finlay considers the ♂s most difficult to net between 11 a.m. and 2 p.m. Edleston records that he obtained many ♂s on White Moss, near Manchester, on April 30th, 1843, by means of a virgin ♀, whilst, in the same locality, on April 28th, 1844, the species was exceedingly abundant, a virgin ♀ of *S. pavonia* attracting, on this date, ♂s of *Macrothylacia rubi*, but the latter flew off without attempting to pair. Heathcote with a virgin ♀ attracted many ♂s as early as February 29th, 1844, at Winchester, and so freely do they come on the Lancashire mosses that Ellis records as many as 200 ♂s assembled on one afternoon by a single ♀ on Simonswood Moss, whilst Lambillion states that, at Namur, the ♂s will enter a house after a newly-emerged ♀. Newnham notes that, on May 12th, 1892, he took a newly-emerged ♀ to the Longmynds, and assembled literally hundreds of ♂s between 3 p.m. and 5 p.m. Hewett states that the ♂s assemble best from noon to 2.30 p.m., after which they get wild and will not settle; at the time named, however, they come up freely, many more being attracted by a ♀ that is held in the hand by one of the forewings than by one quite at liberty, the struggles of the captive ♀ evidently diffusing more scent, the ♂s, he says, copulate freely with a ♀ thus held. Gordon observes that, on the moors of Corsemalzie, any number of ♂s can be taken by assembling, and though seen more frequently from 3 p.m.—4 p.m., they appear to fly at all times of the day; Ash also considers 4 p.m. the time when ♂s fly most abundantly at Skipwith, whilst Dalglish asserts that, in western Scotland, the ♂s fly on into the evening. Haggart, on the other hand, considers 1.30 p.m. the best time to assemble ♂s at Galashiels, whilst Lofthouse states that 2.30 p.m. is the most satisfactory time at Great Ayton. At Mallow, Newland notes that a captive ♀ attracted ♂s during three days, the males appearing regularly at 2 p.m. in bright, hot sunshine, the nearest known habitat of the species being two miles distant, whilst Burrows observes that, although a ♀ was exposed at Brentwood daily from May 5th, she did not attract any ♂s till May 15th, when a number came up at about 2.30 p.m. Thornhill observed a ♀ at sallow-bloom in 1896 at Boxworth, surely a most unusual occurrence.

Habitat.—The habitats of this species are most diverse. It abounds on most of the moors and downs throughout the British Islands, appears to be equally abundant in the Fen districts, is often an abundant hedgerow species, and is not uncommon in the woods of Kent and elsewhere. Abroad it is found in equally dissimilar situations, being abundant on the hills around Digne, where the larvæ abound in hedges, equally abundant on the heather-clad moors of the Upper Hartz, occurs at Evolena and on most of the alpine ranges to 5000 or 6000 feet, and in the valleys of the Upper Engadine; is very abundant at Gibraltar, where it is only met with in the cork woods at the end of March; occurs on the borders of woods and meadows in the Zürich district (Rühl), in dry meadows at Damm (Hering); in Scotland, it is common on all moors and mountains up to 3000 feet (Reid); in Ireland it is found on every bog (Kane). On the moors at Rannoch and the heaths in South Carnarvonshire (Day), on the heaths of Dorset and Hants (Bankes), the heaths and commons at Oxton (Studd), common on all the Yorkshire moors, especially so on those of the West Riding (Butterfield), on moorland wastes in the Carlisle district, Todhills moss was literally covered with larvæ in 1856 (Armstrong), on the moors at Ardclach (Thomson), on all the moors around Paisley and up the western coast of Scotland (Dunsmore); on the mountain slopes of Galway and Enniskillen from the sea level to 1200 feet (Allen), distributed throughout the moorland and mountain districts of Tyrone where heather is plentiful (Greer), on heaths on the mountains around Windermere (Freeman); on all the heaths of Gloucestershire (Mason), and of King's Lynn (Atmore), on the heathery cliffs in Guernsey and Sark (Luff), on the cliff slopes at Leigh and Benfleet (Whittle), on the slopes facing the sea at Eastbourne (Montgomery); in Cambridgeshire it frequents all sorts of localities, peat, gravel, chalk, and on hedges near the town (Farren), on hawthorn hedges about Boxworth (Thornhill), in the hedgerows at Brandon (Ransom), on hawthorn hedges at Namur (Lambillion), and also at St. Neots, Enfield, Tottenham, &c. (Bayne), in the woods at Chattenden (Tutt), in willow beds as well as commons of heath and birch (Clarke), abundant all over Wicken and the adjacent fens (Tutt), in the marshes at Pwllheli (G. O. Day), and along the north bank of the Thames (Mera).

Time of appearance.—From the end of March to the middle of June, not altogether dependent on the season or latitude, *e.g.*, Porritt notes a beautiful ♂ in the third week of June, 1899, at Rannoch, but found young larvæ that had already left the eggs at the same time. Fritsch gives dates from March 17th—May 27th for Austria; Walker notes end of March (earliest date March 6th) at Gibraltar, and Standfuss the ♂ s quite over in early April, in 1892, at Rome; March 2nd, 1899, in the Esterels, common March 18th, 1899, at Trayas and Mal Infernet (Chapman); abundant throughout April at Digne (Tutt); April and May in the Eure dept., May 14th, 1883, at Pont de l'Arche (Dupont), May 1st, 1872, in Guernsey (Luff); average date for Namur district, May 20th (Lambillion); a pupa found in August, 1832, at Lycksele, in Lapp. Umensis, from which a ♀ emerged April 26th, 1834 (Zetterstedt). Autumnal emergences are very rare, but Blaber records one at Lindfield, August 16th, 1886, and Standfuss mentions some (*antea*, p. 234) obtained by keeping the pupæ dry for 7—10 weeks, and then freely and repeatedly moistening them. Actual dates are as follows: common May 10th, 1843, a ♀ also attracted ♂ *Macrothylacia rubi*, abundant on White Moss, April 28th, 1844 (Edleston); March 13th, 1850, at Lewes (Tompkins); larvæ in autumn of 1849 at Stowmarket, from which imagines emerged mid-April to mid-May, 1850 (Bree); April 18th, 1857, at Tilgate, May 15th, 1857, at Poynings (Image); June 2nd, 1858, 112 ♂ s attracted by a single ♀ at Roche Abbey (Smith); June 1st—21st, 1858, at Greenock (Somerville); bred May 7th—16th, 1859, at Brighton (Merrifield); May 1st, 1859, on Wandsworth Common, May 15th, near Leeds, August 16th, 1897, fullfed larvæ at Lynmouth, imagines May 3rd, 1898 (T. Briggs); May 9th, 1859, attracted 50 ♂ s with 1 ♀ on Huddersfield moors (Varley); bred April 30th—May 27th, 1860, from Halifax, April 3rd—May 12th, 1861, from Lee, captured May 1st, 1862, at Tilgate, bred April 28th—May 3rd, 1885, from Barnsley, bred May 1st—10th, 1887, captured April 23rd, 1889, at Bournemouth, bred March 8th—May 19th, 1890, from Bournemouth ova, also June 1st, 1891, after being two years in pupal stage (Fenn); April 5th—18th, 1861, at Worcester (Edmunds); May 6th—10th, 1865, near Mansfield, May 12th, 1893, at Sancreed Beacon, near Penzance (Daws); larvæ, at Harray, Orkney, July, 1866, 11 pupæ obtained, 4 ♀ s emerged May 23rd—June 16th, 1867, and 3 ♂ s April, 1868, the other 4 produced ichneumons (Traill); April 5th—12th, 1868, at Chat Moss (Campbell); April 24th, 1868, at Bromley (Jenner-Fust); February 5th, 1869, bred in a room without a fire at Forest Gate (Phillips); April 25th, 1870, at Dartford Heath, May 25th, 1890, at Teesdale Moors, October 11th, 1891, pupa at Chislehurst, cocoons spun on heather (Bower); May 8th, 1871, at Wanstead, April 16th, May 5th—10th, ♀ June 3rd, 1886, May 8th—15th, June 9th, 1887, at Brentwood (Burrows); April 20th, 1875, at Bulmershe, April 28th, 1875, at Mortimer West, April 21st, 1889, at Bulmershe, April 11th, 21st, 22nd and 24th, 1892, at Burghfield, April 20th, 1892, at Padworth, April 7th and 9th, 1893, at Burghfield, April 12th, 1893, at Aldermaston, March 30th, 1893, at Wokingham (Holland); May 26th—June 7th, 1877, at Wicken Fen, May, 1880, at Eltham (A. H. Jones); imagines bred April 26th—May 3rd, 1878, a female of this batch believed not to have paired laid 115 eggs from May 8th—10th, only one hatched, this larva pupated August 4th, 1878, imago February 5th, 1879, in a warm room; imagines also bred April 27th—May 18th, 1880, from Bolton pupæ; bred March 21st—28th, 1882, from Bournemouth pupæ, young larvæ at Chattenden on June 21st, 1884, had all pupated by August 18th, but imagines were not bred till May 17th—28th, 1886, one of these females laid ova which hatched June 16th, 1886, the larvæ commenced to pupate August 3rd, imagines May 18th—31st, 1887 (Adkin); on February 14th, 1880, six cocoons placed on mantel-shelf of sitting-room, ♂ emerged February 23rd, a ♀ February 24th, a ♂ 27th, ♀ 28th, 2 ♂ s on the 29th, all between 5 p.m. and 6 p.m. (Shuttleworth); May 10th, 1880, at Donegal (Walker); imagines on wing June 9th, 1881, on Strensall and Sandburn Commons, and on May 2nd, 1882, a male just emerged, also May 20th, 1882, several males; on April 18th, 1883, a cocoon, from which a male emerged April 21st, 1883, all from Strensall Common, also bred two females May 5th, two males May 17th, 1883, and found males on wing May 11th, 1883, on Strensall Common, May 4th, 1890, May 30th, 1891, on wing on Riccall Common, a male bred May 31st, 1892, from cocoon from Strensall Common, imagines on wing April 25th, 1893, and April 9th, 1894, on Strensall Common, many bred from May 6th—May 15th, 1894, others (from 1893 pupæ) emerged April 28th—29th, 1895, all cripples, males on wing April 29th and May 4th, 1895, on Strensall Common, many assembled May 5th, 1895, to 12 virgin females on Rhombald's Moor, others bred May 6th—23rd, 1895, out of doors, imagines on wing May 11th, 1895, on a moor near Keighley, males assembled at Strensall on May 11th, 1896, and several bred between May 10th and May 23rd, several males assembled also on May 4th, 7th and 17th, 1896, at Rhombald's Moor, and on May 11th, 1901, many males assembled to ♀ s on Rhombald's Moor (W. Hewett); imago May 7th, 1884, near Painswick (Watkins); June 3rd, 1885, June 4th, 1892, April 7th, 1896, May 17th, 1897, April 22nd, 1898, April 26th, 1899, near Carlisle (Wilkinson); larvæ pupated August, 1885, none emerged in spring 1886, but a ♀ most unexpectedly emerged about August 16th, 1886, at Lindfield (Blaber); larvæ July 22nd, 1886, and June 25th, 1889, imagines on wing, April 28th, 1891, in Isle of Purbeck, bred a series May 19th —27th, 1892 (Bankes); May 19th, 1888, May 1st, 1890, in New Forest (G. M. A. Hewett), April 23rd—25th, 1889, in the Trossachs, May 19th, 1889, at Rothesay, April 20th, 1892, in the Trossachs, April 15th, 1893, at Loch Riddon (Dalglish); March 31st to April 6th, 1890, at Hardwicke, having been two years in pupæ (Nash); April 19th, 1890, ♂ hanging from a gorse bush fresh, April 10th, ♂ s flying at 12 a.m., not earlier, in South Devon, August 29th, 1897, a fullfed larva at Reigate, from which ♀ moth emerged May 6th, 1898 (Prideaux); from pupæ of 1890 imagines emerged January 22nd, 1892 (♂), February 2nd (♀), February 7th (2 ♂ s), February 9th (♀), box kept in an outhouse (Read); April 1st, 1891, at Armagh (Johnson); imagines captured May 7th, 1891, at Leigh, May 1st, 1892, at Benfleet, bred April 28th—May 5th, 1897, from larvæ, imagines June 8th, 1896, at Eastwood, also larvæ June 19th, 1898, at Eastwood (Whittle); May 31st, 1891, at Wicken, May 18th, 1897, at Fulbourne, May 31st, 1897, at Windermere (Freeman); larvæ August 3rd—4th, 1891, at Wicken, gave pupæ from which imagines emerged April 22nd—May 7th, 1892 (Bloomfield); larvæ 1879, most emerged 1880, five emerged 1881, 2 ♂s April 28th, and 1 ♀ April 29th, 1882, at Bournemouth (McRae); April 10th, 1892, April 2nd, 1893, April 29th, 1894, May 15th, 1898 (♀) (Freer); May 12th, 1892, on the Longmynds (Newnham); May 8th, 1892, well out April 10th, 1894, April 15th—23rd, 1895, April 15th, 1896, ♀ imagines bred April 13th—19th, 1891, from Stirlingshire pupæ, April 15th, 1896, April 14th, 1897, from Oxton larvæ (Studd); larvæ at Penrith in 1892, produced imagines March 5th (♀), 6th (♂), 8th (♀), 9th (2 ♀s), 10th (♀ and ♂), 12th (♂) 1893, May 10th, 1894 (♂), April 23rd (2 ♀s, 2 ♂s), 29th, 1895 (♂), March 12th (♀), 13th (♂), 24th (♀), April 2nd (3 ♂s and 1 ♀), May 2nd (♀), 7th (♂), 1897, all at Penrith (Varty); March 25th—April 1st, 1893, at Penarth (Birkenhead); March 7th, 1893, from Wicken (Kaye); March 13th, 1893, at Bexley (Lathy); April 5th, 1893, ♀ at Molesworth (Wood); April 5th, 1893, at Hereford (Blathwayt); April, 7th, 1893, at Alton, Hants (P. Reid); April 22nd, 1893, April 27th—28th, 1894, April 27th, 1895, in Carlisle (Day); April 26th, 1893, at Forest Row (Dallas-Beeching); larvæ first week in July, 1893, at Eastbourne, from which imagines (males) appeared April 2nd—9th, 1894, ♂ April 20th, 1895, larva obtained August 25th, 1894, and a ♀ emerged April 23rd, 1895 (Montgomery); April 7th—18th, 1894, near King's Lynn (Glenny); May 1st, 1894, near Mallow (Newland); May 23rd, 1894, at Carrick Hill, May 23rd, 1895, at Arrochar, May 12th, 1897, at Waas Hill, May 19th, 1898, at Ardlui; April 23rd, 1900, at Carrick Hill (Dalglish); imagines bred May 6th—19th, 1894, from larvæ obtained July 24th, 1893, at Enniskillen (Brown); imagines May 13th, 1894, and from cocoons collected September 3rd, 1894, imagines emerged May 6th—19th, 1895, at Carlisle (Routledge); May 13th, 1894, at Castle Carrock (Warne); April 24th, 1895, at Enfield (Bayne); May 6th, 1895, at Inglis Maldis, near Montrose (Gunning); May 20th, 1895, at Newstead (Kaye); April 4th, 1896 and following days, at Morpeth (Finlay); imagines, April 5th, 1896, April 25th—30th, 1898, from larvæ found June 7th, 1897, at Wyre Forest (Wainwright); April 18th—25th, 1896, at Skipwith (Ash); May 14th, 1896 (Broome); May 20th, 1896, at Great Ayton (Lofthouse); ♂ June 13th, 1896 (Lifton); bred February 4th, 1897, at Boxworth (Thornhill); captured on wing April 14th—May 10th, 1897, April 19th—June 4th, 1898, up to 1000 feet elevation on moorlands of Tyrone, June 17th, 1897, at Dungannon (Greer); May 10th, 1897, imagines bred from Rothiemurchus Forest (Morton); May 22nd, 1897, on Belmore Mountain (Allen); May 24th, 1897, at Scone (Wylie); June 4th—11th, 1897, near Denny Bog (Tremayne); June 12th, 1897, on Waas Hill (Stewart); young larvæ at Folkestone on May 27th, 1897, pupated August 24th—September 29th, 1897, imagines emerged March 20th—April 5th, 1898 (Lane); larvæ found June 5th, 1897, imagines emerged April 25th—May 6th, 1898, and May, 1900, at Worcester (Rea); April 25th, 1898, May 25th—June 1st, 1899, at Bournemouth (Cowl); April 25th, 1898, in Hants (Bartlett); May 5th, 1898, in New Forest (B. W. Adkin); ♂ first seen in 1898, on May 7th, flying freely on May 23rd, 2 ♀ s emerged May 29th, and several June 9th; in 1899, first seen April 22nd, others April 25th, May 11th—16th, at Corsemalzie (Gordon); May 15th, 1898, at Galashiels (Haggart); imagines April 1st—May 4th, 1899 (Burraud); April 24th, 1899, at Farnboro' (Alderson); earliest appearance in 1899 was May 6th, at Kinloch Rannoch (W. Reid); May 27th, 1899, at Burnley (Clutten); bred May 25th, 1899, from Ingleby Greenhow (Elgee).

LOCALITIES.—Probably in every English county, common throughout Scotland and the Islands, abundant in Hoy, the most northerly point at which it was met (McArthur); generally distributed on west coast of Scotland (Dunsmore); common in the south of Ireland (McArthur); everywhere fairly abundant on hills, plains, heaths, commons, and bogs, appears to be in every Irish list (Kane). ABERDEEN: throughout the county (Horne), Braemar (Robinson), Stuartfield district (Prout), Pitcaple (Reid). ANTRIM: generally distributed in mountains (Greer), Slemish mountain (Kane). ARGYLL: common — Loch Riddon, Lochgoilhead, &c. (Dalglish), Glen Massan (Ord), Kilberry (Cottingham). ARMAGH: Armagh (Johnson). AYR: Beith, Kilmarnock (Rose), Straiton, Barr, &c. (Dalglish), Carrick Hill (Wilson). BERKS: Reading (Clarke), Newbury (Kimber), Burghclere district (Alderson), Burghfield, Padworth, Wokingham, Aldermaston, Bulmershe (Holland), Moulsford (Clarke). BUTE: Bute—Rothesay, the Cumbraes (Dalglish), Arran (Smith). CAMBS: generally distributed throughout the county—Cambridge (Farren), Milton (Moss), Horningsea, Swaffham fens (Jenyns), Boxworth (Thornhill), Wicken (Tutt), Fulbourne (Freeman), Whittlesford, Soham, Burwell Fen (Balding). CARMARTHEN: Carmarthen (Robertson). CARNARVON: common on coast (Johnson), Pwllheli, Abersoch (G. O. Day), Conway, Trefriw (Bland), nr. Conway, Capel Curig (Gardner), Penmaenmawr (Porritt). CHESHIRE: common on mosses and heaths (Ellis), Heswall (Freeman), Sandbach (Heap), Delamere Forest (Arkle), Danes Moss, Macclesfield (South), West Kirby, Barnton (Gardner), Wilmslow (Johnson), Bidston, nr. Birkenhead (Newstead), Whitehall, Tarporley (Stock), Oxton Moor (Prince), Thurstaston, Wirrall, Rudheath, nr. Knutsford (G. O. Day), Whitegate Heath (Collins). CORK: Mallow, Millstreet (Newland), Timoleague, Glandore, &c., common (Donovan), Berehaven and Glengarriff (Kane). CORNWALL: Penzance, nr. Sancreed Beacon (Daws), Newlyn (Burrows). CUMBERLAND: Todhill Moss, nr. Carlisle (Armstrong), Castle Carrock Fell (Warne), Hayton Moss (Routledge), Carlisle, Orton, Durdar, Todhills, Salkeld, Kingmoor (Day), Bolton Fell (Thwaytes), Skiddaw, Keswick (Beadle), Penrith (Varty). DENBIGH: very common Minera district (Newstead), nr. Llangollen (Gardner). DERBY: Tatenhill (Brown), Little Eaton (Hill). DEVON: common (McArthur), Oxton, nr. Exeter, common (Studd), Lynmouth (Briggs), Sidmouth (Wells), Stoke (Harvie). DONEGAL: Pettigo (Kane), Donegal (Campbell), summit of Slieve League (Walker). DORSET: throughout on heaths (Dale), I. of Purbeck, Wareham, common (Bankes), Bloxworth, abundant (Cambridge), Weymouth (Forsyth). DUBLIN: Dublin mts. and Howth (Kane). DUMBARTON: common – Arrochar, Ardlui, Glen Mallon, Craigmaddie, Milngavie, Glen Falloch, Bonhill (Dalglish). DUMFRIES: Dumfries (Lennon). DURHAM: common on the heaths and moors—West Hartlepool (Robson), nr. Durham (Ornsby), Shull (Backhouse), High Force (Howse), moors near Wolsingham (Hewett), Teesdale (Bower), Bishop Auckland (Greenwell). EDINBURGH: Edinburgh (Evans). ESSEX: generally common—Tilbury (Image), Brentwood, Wanstead, Rainham, &c. (Burrows), Henny, Brandon (Ransom), Chelmsford (Miller), Plaistow Marshes (Cooper), Maldon (Raynor), Leigh, Benfleet, Eastwood (Whittle), Thundersley (Bacot), Forest Gate (Phillips), Colchester (Harwood). ELGIN: Forres district—Altyre (Norman). FERMANAGH: Enniskillen, on Belmore mountain (Allen). FIFE: Lomonds (Evans). FLINT: very common both sides of Nantyffrith valley (Newstead). FORFAR: Clova (Barclay), Montrose, Inglis Maldis (Gunning). GALWAY: Galway (Allen), Clonbrock, Leenane, Connemara, etc. (Kane). GLAMORGAN: Swansea (Robertson), Barry Is., nr. Cardiff, Penarth (Birkenhead). GLOUCESTER:

Huntingford, nr. Tortworth (Perkins), Cranham Woods, nr. Painswick (Watkins), Bristol (Hudd), nr. Hampstead, Newnham, Upton (Lifton), Hardwicke (Nash). HANTS : Bournemouth (Cowl), New Forest (Carr), Hayling Island (May), Ringwood (Bankes), Hartley Wintney (Claxton), Brockenhurst (Ogden), Lyndhurst (Lockyer), Wimborne (Fowler), Mortimer West (Holland), Winchfield (Robertson), Alton (Reid), Denny Bog (Tremayne), Fleet, Castle Douglas (Russell). HEREFORD : Hereford (Blathwayt), Tarrington (Wood), Leominster (Hutchinson). HERTS : Hertford (Stephens), Baldock (Wood). HUNTS : St. Neots (Bayne), Molesworth (Wood). INVERNESS : Rothiemurchus Forest (Morton), I. of Lewis, very common (McArthur), Corrimony (Barclay). ISLE OF MAN : Douglas Hd., hills round Sulby, Lezayre, hills above Laxey (Clarke). KENT : Eltham, Darenth (Jones), Keston (Colthrup), Folkestone (Briggs), Chattenden, Cuxton (Tutt), Lee (Fenn), Forest Row (Beeching), Stone, Dartford, Dartford Heath, Chislehurst (Bower), Farnborough (Alderson), Bexley (Lathy), Bromley (Jenner-Fust), Otford (Newman), Plumstead (West). KINCARDINE (Esson). KING'S COUNTY : Toberdaly, Tullamore (Kane). KERRY : Killarney, abundant (Kane). KIRKCUDBRIGHT : Cloke Moss (Robinson). LANARK : abundant — Douglas (Mackonochie), Bishop Loch (Ord), Stepps (Cross), Airdrie (Dalglish), Carluke (Morton), Lanark (Kerswell). LANCASHIRE : all the moorlands (Allen), common on mosses and hills—Simonswood Moss, etc. (Ellis), Grange (Goulty), Rivington, nr. Horwich (Whittaker), nr. Windermere (Freeman); Bolton (Gregson), Cheetham (Edelston), Manchester (Marshall), Chat Moss (Campbell), Morecambe, Heysham Moss, Haverthwaite (Arkle), White Moss, nr. Manchester (Heathcote), Burnley (Clutten), Warrington (Collins). LEICESTER : Gumley (Matthews). LEITRIM : Mohill (Kane). LINCOLN : Hartsholme (Carr), Lincoln (Mason). LONDONDERRY : Derry (Campbell). MAYO : Crossmolina, shores of L. Conn (Kane). MERIONETH : Barmouth (Sheldon). MIDDLESEX : Enfield Lock, Forty Hill (Edelsten), Enfield, Tottenham (Bayne), Isleworth (Meyers), Waltham Cross (Davis), Willesden (Wormald). MONAGHAN : Slieve Beagh range (Kane). NAIRN : Ardclach district (Thomson). NORFOLK : Aylsham (Freeman), King's Lynn (Atmore), The Broads (Edelsten). NORTHAMPTON : Peterborough (Mousley). NORTHUMBERLAND : common (McArthur), Morpeth (Finlay), Twizell (Robson), Redewater district (Howse), Rothbury, Sweethope (Maling), Bellingham (Rhagg). NOTTS : near Mansfield, Ratcher Hill (Daws), Newstead (Kaye), Sherwood Forest district (Lievers). ORKNEY : Stromness (Cheesman), Harray (Traill). OXFORD : Chinnor (Spiller). PEMBROKE : Tenby (Mason). PERTH : all the county (White), Rannoch (G. O. Day), Trossachs (Dalglish), Kinloch-Rannoch (Reid), Perth, Scone (Wylie), Doune (Evans), Camachgouran (Longstaff), Pitlochrie (James), Dunkeld (White). RENFREW : Gleniffer Braes (Dunsmore), Waas Hill (Stewart), Gourock, Dargavel (Dalglish), Paisley (Dunsmore), Greenock (Somerville). ROSCOMMON (Kane). ROSS : Inverurie (Barclay), Strathcarron (Christy), Contin (White). ROXBURGH : Galashiels (Haggart), Hawick district, common (Guthrie), Roxburgh (Elliot). SHROPSHIRE : Shrewsbury (Oldfield), Netley (Hope), Church Stretton, on the Longmynds (Newnham). SLIGO : Sligo (Carpenter), L. Gill and Hollybrook (Kane). SOMERSET : Brockley Coombe (Mason), Quantock Hills, common (St. John), Weston-super-Mare (Crotch), Taunton (Rawlinson). STAFFORD : generally distributed—Chorlton Moss (Daltry), Rugeley, Cannock Chase, common (Freer), Leek (Hill), Burnt Woods (Woodforde). STIRLING : Fintry (Eggleton), Drymen (Ord), Craigmaddie, &c. (Dalglish), Stirling (Studd). SUFFOLK : not uncommon (Bloomfield), Sudbury (Ransom), Felixstowe, Brantham (Buckell), Stowmarket (Bree). SURREY : all heaths in the county (Turner), Ripley, Combe Wood (Stephens), Shirley (Sheldon), Dorking (King), Wandsworth (Briggs), Reigate (Prideaux), Oxshott (Carr). SUSSEX : on the south downs generally, but not common—Polegate, &c. (McArthur), Groombridge (Blaber), Hastings and St. Leonard's dist. (Bloomfield), Tilgate, Poynings (Image), Wannock (Pearson), Lewes (Nicholson), Eastbourne (Montgomery), Abbott's Wood (Hanes), Ashdown Forest (Dallas-Beeching), Lindfield (Blaber), Brighton, dist. common (Merrifield), Newhaven (Reeve). SUTHERLAND : Melness, Strathmore (Mackay), Assynt district—Lochinver (Beveridge). TIPPERARY : (Kane). TYRONE : mountain and moorland districts throughout, Dungannon, &c. (Greer). WARWICKSHIRE : Sutton (Wainwright). WATERFORD : Comeragh mts., near Portlaw (Flemyng). WESTMEATH : Mullingar (Middleton). WESTMORLAND : Witherslack (Shuttleworth), Windermere (Freeman), Kendal dist. (Moss). WICKLOW : Lough Bray, in Wicklow mtns. (Scharft). WIGTOWN : all the moors — Darsney Flow, Loch Chesnay, Corsemalzie, White Dyke Moor (Gordon). WORCESTER: Wyre Forest (Wainwright), Worcester (Edmunds), Bewdley (Tyrer), Monk Wood (Rea). YORKS: general on the moors—Eston Hills, Great Ayton (Lofthouse), abundant on all West Riding moors (Butterfield), Skipwith (Ash), Heathfield, Pateley, Bramham moor (Storey), Birstwith (Walker), Scarborough (Williamson), Strensall Common, Rhombald's Moor, Keighley, Riccall Common, Sandburn Common, Thorne Moor (Hewett), nr. Leeds (T. Briggs), Bradford (Carter), Halifax, Huddersfield (Porritt), Ilkley (Denny), Otley Chevin (Taylor), Penistone (Harrison), Richmond (Sang), Ripon (Meldrum), Selby (Foster), Sheffield (Doncaster), Wakefield (Talbot), Whitby (Clarke), Harrogate (Arbuthnott), Ingleby Greenhow (Elgee), Roche Abbey (Smith), Barnsley (*teste* Fenn), Cleveland district—Brotton (Sachse).

DISTRIBUTION.—ASIA: Amurland, Kentei mts., Bureja mts. (Staudinger), Altai mts. (Speyer), Amasia, common, Brussa (Staudinger), Persia—Irak dist. (Young). AUSTRO-HUNGARY: Tyrol, not rare (Hinterwaldner), Taufers, Innsbruck (Weiler), Lavantthal (Höfner), Upper Carinthia, Salzburg, Moellthal, rather rare (Nickerl), Fiume, Drága (Mann), Bucovina, only in mountain regions (Hormuzaki), Pressburg (Rozsay), Bohemia, occasionally (Nickerl), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Galicia, distributed but apparently very rare—Lemberg (Nowicki), Brünn (Müller), Hermannstadt (Czekelius), Chemnitz (Pabst), Hungary—Kocsocz (Vángel), Gölnitz (Hudák), Eperies, common (Husz), Dalmatia, Buda (Speyer), Inn Valley, not common (Himsl). BELGIUM: generally distributed (Lambillion), nr. Rouge Cloître (Coubeaux), Mons, Frameries, common (Derenne), Virton (Bray). BULGARIA: Sofia, not rare (Bachmetjew). CHANNEL ISLES: Guernsey, Sark (Luff), Jersey (Ansted). DENMARK: one of the commonest species (Wallengren), pretty generally distributed (Bang-Haas). FINLAND: occurs throughout (Reuter). FRANCE: very common throughout (Guenée), Meuse, Moselle, Meurthe depts., Hyères (Speyer), Puy-de-Dôme (Guillemot), dept. Var (Cantener), Basses-Alpes—Digne, etc. (Tutt); Morbihan (Griffith), Gironde (Trimoulet), Doubs dept. (Bruand), Aube (Jourdheuille), Douai (Foucart), depts. Indre, Cher, Cantal, Auvergne (Sand), Saone-et-Loire (Constant), Eure-et-Loir (Guenée), Haute-Garonne, common (Caradja), Seine-Inférieure—Pont de l'Arche, etc., rather common (Dupont), Loire-Inférieure (Bonjour), Aude (Mabille), Sarthe (Desportes), St. Quentin (Dubus), Normandy—Tancarville (Leech), Manche—nr. Cherbourg, Rennes (Oberthür), the Esterels, Trayas, Mal Infernet (Chapman), Cannes (Warburg). GERMANY: generally common, Upper Hartz, Black Forest to beyond 3400ft. elevation (Speyer), north-west Germany, almost everywhere (Jordan), Brunswick, everywhere especially on heaths (Heinemann), Hanover, not rare (Glitz), Thuringia—Gotha, Berlach, Siebleber Holz, Friedrichroda, Georgenthal (Knapp), Pomerania, —not very rare—Damm, Carolinenhorst, Stepenitz, Vogelsang, Grambow, Nemitz, (Hering), Silesia—Leubeusch (Prittwitz), Alsace (Peyerimhoff), Wernigorode (Fischer), Rhine Palatinate (Bertram), Würtemberg (Seyffler), Giessen (Dickore), Lower Elbe district (Zimmermann), Waldeck (Speyer), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle—Dessau (Stange), Munich, not common (Kranz), Hesse-Darmstadt, not common (Glaser), Rudolstadt (Meurer), Mecklenburg (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia, not rare (Schütze), Upper Lusatia, not rare (Moeschler), Dresden, not rare (Steinert), Prussia—Konigsberg (Schmidt), Nassau (Rössler), Ratisbon (Schmid), Grimmer dist., Mayence, Wiesbaden (Homeyer), Frankfort-on-Oder (Kretschmer), Eutin (Dahl). GREECE: Corfu, Tinos (Staudinger). ITALY: throughout the mainland, ? Corsica (Curò), Calabria—south of Naples (Oberthür), Modena (Fiori), Sicily (Minà-Palumbo), Roman Campagna (Calberla). NETHERLANDS: all provinces but not common (Snellen); the eastern provinces, rather common, Breda, &c. (Heylaerts). ROUMANIA: Jassy, Comanesti (Leon), Turn Severin (Haberhauer). RUSSIA: Moscow district (Albrecht), Wolmar (Lutzau), Volga dist., not rare, Kasan, Baschkiria (Eversmann), St. Petersburg (Erschoff), Transcaucasia—Tiflis (one only) (Sievers), Istidara, Daratchitchag (Christoph), Baltic Provinces, distributed throughout, but rare (Nolcken). SCANDINAVIA: one of the commonest species (Wallengren), Arctic Norway — Karasjok, Komagfjord (Schöyen), northern Lapland (Portin), Kobbervik, Langfjorddalen (Sandberg), distributed throughout Norway (Siebke), Finmark (Chapman), Christiania (Jordan), Lycksele, Lapponia-Umensis (Zetterstedt). SPAIN: Southern Spain (Staudinger), Catalonia (Martorell y Peña), Teruel (Zapater), Barcelona—Calella, &c. (Cuní y Martorell), Galicia—Santiago, &c. (Macho-Velado), Bilbao (Seebold), Gibraltar (Walker). SWITZERLAND: Everywhere up to 5000ft — Canton St. Gallen (Täschler), Gadmenthal (Rätzer), valleys of the Upper Engadine (Pfaffenzeller), Weissenburg (Huguenin), Evolena

(Tutt), Grisons (Killias), Zürich dist., distributed but not common (Rühl), Valais—Morgins (Dupont), not rare in the Rhone Valley—nr. Martigny, Mt. Chemin, Sion, Sierre, Viège, Brigue, &c. (Favre).

ADDENDUM.—GYNANDROMORPHISM.—The following instance of gynandromorphism has been unearthed since the printing of pp. 309-313—

i''. I have bred a specimen of *Saturnia pavonia* this spring, which has the left wings like those of the ♂ except the costal margin of the hindwing, and the right wings like those of the ♀; the body resembles that of the ♀, but is small; the antennæ are more pectinated than those of the ♀, but not so much as those of the ♂; the white blotch on the tip of the forewings is larger and brighter than usual, the span of the wings about the same as that of a large ♂ (Milton, *British Naturalist*, iii., p. 111).

CATALOGUE OF THE PALÆARCTIC DIMORPHIDES, BOMBYCIDES, BRAHMÆIDES AND ATTACIDES.

In giving a list of the Palæarctic Attacids we note the following suggestions, for which we are indebted to Chapman, as to the affinities of this superfamily. All the authorities agree that there are five main divisions—the Hemileucids, Citheroniids, Automerids, Agliids, Attacids—in the Holarctic fauna. The questions that have arisen are as to (1) the order of their evolution, and (2) their relationship *inter se*. The greatest amount of doubt appears to attach to the position of the Hemileucids. The true relationships of the others do not appear so difficult to determine. The Hemileucids are certainly near the bottom of the stirps, *teste* the two anal nervures of the hindwings. They also differ from the others in having a single pair of pectinations to each antennal segment. Bodine considers (*Antennae*, etc., p. 43) that this shows that the Hemileucids belonged to the branch which produced the later families, after it had separated from the branch giving rise to the *Bombycidae*. Chapman, accepting Dyar's statements as to the structure of the larvæ, thus formulates the following table for the Holarctic families :

1. IMAGO: Hindwings with two inner anal nervures; IV_1 and IV_2 of forewings separate; antennæ bipectinate. LARVA: Single dorsal tubercle on 9th abdominal; urticating setæ.
   a. Primitive form lost
   b. IV_1 and IV_2 forked .. .. HEMILEUCIDÆ.
2. Antennæ quadripectinate
   c. Partially only. Larval urticating setæ lost .. CITHERONIIDÆ.
3. Hindwings with one inner nervure
   d. .. .. AUTOMERIDÆ.
4. Urticating setæ lost; no single tubercle on 9th abdominal segment
   e. .. .. AGLIIDÆ.
5. Nervures IV_1 and IV_2 forked .. .. .. SATURNIIDÆ.
   e. Discoidal cell closed. No unpaired dorsal tubercle on 8th abdominal .. .. SATURNIINÆ.
   f Discoidal cell open. An unpaired dorsal tubercle on 8th abdominal .. .. ATTACINÆ.

The following appears to be a complete list of the Palæarctic Dimorphids, Bombycids, Brahmæids and Attacids :

DIMORPHIDES.
DIMORPHIDÆ.
 DIMORPHINÆ.
  DIMORPHIDI.
   Dimorpha, Hb.
    versicolora, Linn.
     ab. pallida, Tutt
     ab. pallida-obsoleta, Tutt
     ab. obsoleta, Tutt
     ab. clara, Tutt
     ab. obscura, Tutt
     ab. obscura-obsoleta, Tutt
     var. lapponica, Bau

BOMBYCIDES.
BOMBYCIDÆ.
 BOMBYCINÆ.

DAILALAMIDI.
Dailalama, Staud.
bifurca, Staud.
BOMBYCIDI.
Bombyx, Hb.
mori, Linn.
mandarinus, Moore
Oberthuria, Staud.
cæca, Obth.
Rondotia, Moore
menciana, Moore
var. lurida, Fixs.
lineata, Leech
Mustilia, Walk.
falcipennis, Walk.
Andraca, Walk.
gracilis, Butl.
BRAHMÆIDES.
BRAHMÆIDÆ.
BRAHMÆINÆ.
BRAHMÆIDI.
Brahmæa, Walk.
certhia, Fab.
var. undulata, Butl.
var. carpenteri, Butl.
ledereri, Rghfr.
christophi, Staud.
wallichii, Gray
hearseyi, White
japonica, Butl.
ATTACIDES.
AGLIIDÆ.
AGLIINÆ.
AGLIIDI.
Aglia, Ochs.
tau, Linn.
ab. ferenigra, Thierry-Mieg.
ab. lugens, Stdfss.
ab. nigerrima, Stdfss.
ab. melaina, Gross
var. japonica, Leech
ATTACIDÆ.
SATURNIINÆ.
SATURNIIDI.
Mirina, Staud.
christophi, Staud.
Saturnia, Schrank
spini, Schiff.
ab. obsoleta, Tutt
dixeyi *hybr.*, Tutt
bornemanni *hybr.*, Stdfss.
hybrida *hybr.*, Ochs.
? hybrida - major *hybr.*, Staud.
schaufussi *hybr.*, Stdfss.
cephalariæ, Chr.
pavonia, Linn.
ab. obsoleta, Tutt
ab. subobsoleta, Tutt
ab. rosacea, Newnh.
ab. lutescens, Tutt
ab. infumata, Newnh.
ab. minor, Tutt
ab. fasciata, Tutt
var. alpina, Favre
var. meridionalis, Calb.
complexa *hybr.*, Tutt
standfussi *hybr.*, Wisk.
emiliæ *hybr.*, Stdfss.
hybrida-media *hybr.*, Staud.
risii *hybr.*, Stdfss.
pyri, Schiff.
schlumbergeri *hybr.*, Stdfss.
atlantica, Luc.
var. numida, Aust.
var. marocana, Aust.
var. matheri, Vall.
pyretorum, Bdv.
bieti, Obth.
stoliczkana, Feld.
var. schenki, Staud.
huttoni, Moore (? sp.)
LOEPIDI.
Perisomena, Wlk.
cæcigena, Kupido
Loepa, Moore
katinka, Westd.
oberthüri, Leech
Rhodinia, Staud.
jankowskii, Obth.
davidi, Obth.
fugax, Butl.
var. diana, Obth.
Salassa, Moore
thespis, Leech
ATTACINÆ.
CALIGULIDI.
Caligula, Moore
japonica, Moore
boisduvalii, Ev.
var. jonasii, Butl.
ANTHERÆIDI.
Antheræa, Hb.
pernyi, Guér.
perny-yama *hybr.*, Bourd.
yama-mai, Guér. (? sp.)
kirbyi *hybr.*, Tutt
moorei *hybr.*, Tutt
hartii, Moore
ATTACIDI.
Attacus, Linn.
cynthia, Drury
var. pryeri, Butl.
var. walkeri, Feld.
ACTIAIDI.
Graëllsia, Grote
isabellæ, Graëlls
Actias, Leach
dubernardi, Obth.
artemis, Brem. (? sp.)
selene, Hb.
var. mandschurica, Staud.
sinensis, Walk.

Superfamily IX: SPHINGIDES.

Réaumur gave (*Mém.*, ii., p. 253, pl. xx., fig. 1) the name "Sphinx" to the larva of *Sphinx ligustri*, and Linné, in the 1st edition of the *Fauna Suecica*, p. 248, repeated the appellation in his references to this species. With the introduction of the binomial system of nomenclature, Linné utilised the name for his large group of the Sphingid moths, containing, indeed, many heterogeneous elements (*Syst. Nat.*, xth ed., pp. 489 *et seq.*), but he again quotes Réaumur's name with the references to *ligustri*. For 170 years, then, this name has been indissolubly connected with this species, and there can be no doubt, however changed our modern methods, that the typical species of *Sphinx* for all time will be *ligustri*. Linné's division *Sphinx* (*loc. cit.*) represents considerably more than our superfamily, *Sphingides*. His diagnosis and subdivisions of the group read as follows :

SPHINX. Antennæ medio crassiores s. utraque extremitate attenuatæ subprismaticæ. Alæ deflexæ (volatu graviore vespertino s. matutino).

I. LEGITIMÆ. Alis angulatis.—*Ocellata*, *populi*, *tiliae*, *ocypete*, *nerii*.

II. LEGITIMÆ. Alis integris, ano simplici.—*Convolvuli*, *ligustri*, *atropos*, *caricae*, *celerio*, *ello*, *labruscae*, *ficus*, *vitis*, *elpenor*, *porcellus*, *euphorbiae*, *alecto*, *megaera*, *pinastri*, *tisiphone*, *thyelia*.

III. LEGITIMÆ. Alis integris ano barbato.—*Tantalus*, *tityus*, *ixion*, *stellatarum*, *bombyliformis*, *fuciformis*, *culiciformis*, *salmachus*, *belis*.

IV. ADSCITÆ. Habitu et larva diversæ.—*Filipendulae*, *phegea*, *creusa*, *polymena*, *cassandra*, *pectinicornis*, *statices*.

After Linné, the first author who attempted any advance in the classification of the Sphingids was Fabricius, who, in 1775, restricted the name *Sphinx* to Linné's sections I and II (*suprà*), named section III *Sesia*, and section IV *Zygaena*. His grouping results as follows (*Sys. Ent.*, pp. 536—556) :

1. SPHINX. Palpi duo reflexi pilosi, lingua spiralis plerisque exserta. Antennæ squammatæ.—*Ocellata*, *lugubris*, *populi*, *tiliae*, *nerii*, *obscura*, *ello*, *jatrophae*, *carolina*, *strigilis*, *atropos*, *clotho*, *ficus*, *tetrio*, *rustica*, *pinastri*, *euphorbiae*, *lineata*, *vitis*, *satellitia*, *oldenlandiae*, *boerhaviae*, *didyma*, *parce*, *elpenor*, *porcellus*, *convolvuli*, *ligustri*, *cingulata*, *celerio*, *alecto*, *gnoma*, *hespera*, *labruscae*, *caricae*, *tersa*, *thyelia*.

2. SESIA. Palpi reflexi, lingua exserta*, truncata†. Antennæ cylindricæ, extrorsum crassiores.—*Tantalus*, *hylas*, *stellatarum*, *thysbe*, *fuciformis*, *apiformis*, *haemorrhoidalis*, *culiciformis*, *tipuliformis*.

3. ZYGÆNA. Palpi reflexi, lingua exserta testacea. Antennæ sæpius medio-crassiores.—Containing the Anthrocerids, Syntomids, Thyridids, &c. (see *anteà*, vol. i., p 383).

Scopoli, in 1777, still further subdivided (*Introd. Hist. Nat.*, p. 413) the *Sphinx* of Linné, calling, however, the four groups *Spectrum*—α, β, γ, δ—and suggested types. But as a field-naturalist he went further, and subdivided the heterotypical species which Fabricius had placed in *Sesia* (Linné's *Sphinx*, sect. iii, *suprà*), calling the Sphingid section *Macroglossum* and the true clearwings *Trochilium*, a most important division. He diagnoses and illustrates the groups as follows :

I. SPECTRUM.—Alæ angulatæ, fasciatæ, subcaudatæ. Larva glabra.

α. *Spectrum* alis angulatis. Larva acrocephala, rugosa. Pupa nuda, sepulta—*Sphinx tiliae*, etc.

β. *Spectrum* alis fasciatis. Larva amblocephala. Pupa prioris—*Sphinx ligustri* ‡, etc.

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* Probably refers to *tantalus*, *hylas*, *stellatarum*, *thysbe and fuciformis*.

† Probably refers to *apiformis*, &c.

‡ Scopoli divides the genus *Sphinx*, Linn., into *Spectrum*, *Macroglossum*, *Trochilium* and *Anthrocera*, and retains no section *Sphinx*. His *Spectrum* contains *ligustri*, Linné's type of *Sphinx*, and should, therefore, fall as a synonym thereof.

γ. *Spectrum* alis semifasciatis. Larva maculata. Pupa exposita, obtecta foliis colligatis—*Sphinx euphorbiae*, etc.

δ. *Spectrum* alis subcaudatis. Larva capite retractili. Pupa prioris—*Sphinx celerio*, etc.

II. Macroglossum.—Corpus compressum, lateribus et apice barbatum. Larva elongata, absque maculis ocellaribus. Pupa exposita tecta foliis elongatis—*Sphinx stellatarum*, etc.

III. Trochilium.—Alæ pellucidæ. Abdomen appice sæpius barbatum. Larvæ pilis albis, exiguis pubescens. Pupa folliculata*.

IV. Anthrocera.—Antennæ nigræ, subclavatæ. Alæ longæ, maculatæ. Volatus diurnus—*Sphinx filipendulae*.

It is quite clear from Scopoli's diagnosis that the larval characters restrict *Trochilium* to the "clearwings" proper, and exclude such species as *fuciformis*, *bombyliformis*, etc. It is, however, not the place here to enter into the synonymy of the "clearwings." One can only express regret that Scopoli did not name his four sections of *Spectrum*, which is broadly synonymous with the *Sphinx* of Fabricius, the Macroglossids and Trochiliids being excluded, and thus differing from the *Sphinx* of Linné, the type *ligustri*, however, being specifically included. It is also clear to us that Scopoli's action in erecting *Macroglossum* [containing as it did the Sphingid clearwings, see diagnosis] ought to have limited the *Sesia* of Fabricius to *apiformis*, *haemorrhoidalis*, *culiciformis* and *tipuliformis*, as possible types, but did not do so as he was not dealing with the Fabrician genera, whilst Scopoli's *Trochilium*, being cited without a type, cannot be held to affect the nomenclature, except, as we have already noted, that the reference to the larva shows it to be restricted to the true "clearwing" (*sens. strict.*) species. But, in 1777, Fabricius elaborated the genera of the *Systema Entomologiae*, in the *Genera Insectorum*. His extended description of *Sesia* (p. 159) becomes most important, in spite of Scopoli's synchronous completed action in definitely naming the two main groups included in the Fabrician *Sesia* of the *Systema Entomologiae*, for, after an extended description of the imago—

Lingua spiralis cornea, exserta, porrecta, involuta, filiformes; obtusa, truncata, bifida: laciniis æqualibus, obtusis, intus canaliculatis supra palporum basin inserti.

He adds—

Larva 16 poda, agilis, plerumque nuda, inermis antice attenuata. Puppa quiescens, nuda lævis, antice posticeque acuminata. Victus larvæ e foliis plantarum, imaginis e nectare florum.

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* Prout says: "From the scope of Scopoli's work one knows that he intended to include in *Trochilium*, Schiffermüller's '*Sphinx*, Fam. F.,' which comprises *fuciformis*, *crabroniformis* (*apiformis*, L.), *culiciformis*, *tipuliformis*, *vespiformis*, *tenthrediniformis*, *ichneumoniformis*, *fenestrina*, *asiliformis* (=*tabaniformis*, Rott.), and *spheciformis*. It is, therefore, almost synonymous with *Sesia*, Fab., but with *Macroglossum* excluded." We prefer to look at it from an entirely different standpoint. Scopoli was essentially a field-naturalist (see *Ent. Carniolica*), and separated the two widely-divergent groups, the Sphingid and Trochiliid clearwings. His *Macroglossum* includes just such species as agree with his diagnosis, and his *Trochilium* comprises the true clearwings—"larvæ pilis albis, exiguis pubescens; pupa folliculata." Scopoli, therefore, reached in 1777, exactly the same point at which Fabricius arrived in 1807, when he restricted *Sesia* to the Macroglossid species, and created *Ægeria* for Scopoli's Trochiliid clearwings. The inclusion of Schiffermüller's *fuciformis* and *fenestrina* would make the genus of course quite heterogeneous.

There are no types mentioned in *Genera Insectorum*, and Durrant considers the types those of 1775 (*suprà*). The latter also adds: "The only larvæ that Fabricius knew, in 1775, were those of *stellatarum* and *fuciformis*, and these, therefore, were the only really potential types of the genus." Fabricius, however, did not specify either of these species as type. That Fabricius himself had no idea at this date of the heterogeneous nature of his *Sesia*, or of separating its various heterotypical parts, is evident, for, in the *Mantissa*, ten years later, he includes (pp. 98—101) a still more mixed assemblage. Thus we note:

SESIA. Palpi duo reflexi. Lingua exserta truncata. Antennæ cylindricæ—*Tantalus*, *ixion*, *melas*, *hylas*, *fadus*, *stellatarum*, *brunnus*, *octomaculata*, *marica*, *thysbe*, *fuciformis*, *apiformis*, *sphegiformis*, *asiliformis*, *haemorrhoidalis*, *culiciformis*, *tenthrediniformis*, *tipuliformis*, *ichneumoniformis*, *vespiformis*.

Fabricius thus maintained *Sesia* as a hopelessly heterotypical group, ten years after Scopoli had separated the Sphingid and Trochiliid sections; indeed, he did so until 1807, when he retained the Macroglossid section in *Sesia** and renamed the Trochiliid section *Ægeria*. In 1779, Leske cited (*Anfangsgründe der Naturgeschichte*, p. 458) *Sphinx stellatarum* and *S. fuciformis* as examples of *Sphinx*, Fam. C., Linn.=*Sesia*, Fab.; whilst in 1797, Cuvier (*Tabl. Elem.*, etc., p. 592) cites *euphorbiae* and *atropos* as examples of *Sphinx*, and *stellatarum* as an example of *Sesia*†. Whether the action of Cuvier constituted a restriction of the genus *Sesia* to *stellatarum*, as appears to be the case to us, must be argued by synonymists. The general application of the name *Sesia* to the true "clearwings" depends upon Laspeyres, who, in 1801, published his excellent monograph *Sesiae Europaeae*, and who points out (*loc. cit.*, p. 1) that Fabricius gives the same characters, which he described in *Syst. Entomologiae*, in the *Mantissa*, ii., p. 98, and in *Entom. Systematica*, iii., pt. 1, p. 379, but that he adds "palpi duo," and in diagnosing the antennæ, the words "extrorsum crassiores" are omitted. He then writes: "Licet serius, Fabricio quoque Scopoli in 'Introductione ad historiam naturalem,' Pragae, 1777, p. 414, genus novum *Trochilium* ut hisce insectis locus certus daretur, proposuit. Huic generi, a nemine tamen adhuc recepto, tertio in gente prima, tribus sextæ, characteres sequentes adscripsit:

'Alæ pellucidæ. Abdomen apice sæpius barbatum. Larva pilis albis, exiguis, pubescens. Pupa folliculata.'

Summo autem jure ingeniosus, neodum pro meritis laudatus Scopoli hasce Sesias Fabricianas '*stellatarum*, *bombyliformem* et *fuciformem*' a genere suo '*Trochilium*' removat, novum iis genus constituens, cui nomen *Macroglossum* (μακρος, longus, et γλωσσα, lingua) dedit. Characteres generici Fabriciani, præsertim secundarii, mihi non omnino satisfecere, quapropter novos stabilivi,

* In his *Philos. Ent.* (1778), in a list of commendable generic names, because conveying some suggestions (etymologically) of the characters of the species contained, Fabricius includes *Sesia*, which he correctly translates "*tinea*," *i.e.*, a clothes-moth (Greek Σης). One wonders how this name can be applied as a correctly suggestive generic name to either the Sphingid or Trochiliid clearwings included by him in the genus (Prout).

† If it be held, as I consider to be the case, that Cuvier here fixed the type of *Sesia*, Fab., as *stellatarum*, then *Macroglossum*, Scop., falls before *Sesia*, Fab. (Prout).

quos Entomologiæ cultorum examini hic subjicio." He then details the generic characters at length, basing them not only on imaginal, but also on larval, pupal, and oval characters, restricting the genus to the internal-feeding species, the essential characters being noted as:

Palpi duo, acuminati, reflexi. Lingua spiralis, exserta*. Antennæ subcylindricæ, ante apicem incrassatæ, apice setigeræ—*Apiformis, siriciformis, asiliformis, crabroniformis, spheciformis, scoliaeformis, hylaeiformis, chrysidiformis, ichneumoniformis, vespiformis, melliniformis, andrenaeformis, thynniformis, culiciformis, formiciformis, hyphiaeformis, mutillaeformis, nomadaeformis, tipuliformis, tenthrediniformis, philanthiformis.*

In the same year, Lamarck noted (*Syst. Anim. sans Vert.*, p. 281) *fuciformis*, Fb., as the type of *Sesia*, whilst his restriction (*loc. cit.*, pp. 281, 282) of *Sphinx* to *convolvuli* and *ocellata* was clearly *ultra vires* in the face of the genus already having *ligustri* for its type. On the other hand, in 1802, Latreille (*Hist. Nat. Crust. Ins.*, iii., pp. 400 *et seq.*) upheld Laspeyres' restriction of *Sesia* to the "clear-winged, boring-larva" species, although including, as did Laspeyres, both the "*apiformis*" and "*culiciformis*" groups, whilst he further isolated *ocellata* and *tiliae* under the generic title *Smerinthus*. The following details (*loc. cit.*) will give Latreille's view at this time of the classification of the Sphingids:

A. SPHINGIDES BOMBINATRICES.—Antennes toujours prismatiques, et terminées par une petite pointe particulière, dans le grand nombre. Palpes extérieurs fort larges, très-dilatés, très hérissés d'écailles, fort obtus ou terminés seulement par un article tuberculiforme. Corps gros, fort. Yeux grands. Abdomen conique. Pattes grosses; deux crochets simples, entiers, au bout des tarses.

Gen. I: SPHINX†.—Une trompe plus longue que la tête. Antennes simple, terminées par un petit filet.

1. Antennes n'étant pas fort renflées; extrémité très-crochue. Corps alongé. Point de brosse au bout du ventre. (Ailes toujours opaques.)
   α. Ailes à bord postérieur droit, point anguleux—*Sphinx convolvuli, atropos*, Linn.
   β. Ailes à bord postérieur anguleux—*Sphinx oenotherae*, F.
2. Antennes très-grosses et fort renflées; extrémité peu ou point crochue. Corps court, large. Une brosse d'écailles au bout du ventre. (Des ailes vitrées en tout on en partie dans plusieurs.)—*Sesia stellatarum, fuciformis*, F.

Gen. II: SMERINTHUS.—Trompe très-courte ou nulle. Antennes en scie ou pectinées, terminées en pointe crochue, sans filet au bout. Ailes dentées ou anguleuses—*Sphinx tiliae, ocellata* ‡, Linn.

B. SPHINGIDES MUTI.—Antennes n'étant pas ou presque pas prismatiques, à anneaux ou contours également continus et arrondis dans plusieurs. Palpes menus, cylindrico-coniques, terminés insensiblement en pointe, ou cylindriques. Corps mince dans plusieurs. Yeux petits ou moyens. Abdomen souvent cylindrique. Pattes assez menues. Crochets des tarses unidentés dans quelques-uns.

Gen. I: SESIA.—Antennes terminées par une petite houppe d'écailles, simples. Second article des palpes extérieurs toujours plus couvert d'écailles que le dernier. (Ailes horisontales, étroites, toujours vitrées du moins en partie.)

1. Abdomen sans brosse au bout. Dernier article des palpes peu alongé, conique—*Sesia apiformis*, F. [*Obs.*—Sa trompe est fort courte ou presque nulle.]
2. Abdomen terminé par une brosse. Dernier article des palpes alongé, menu, presque nu, cylindracé—*Sesia tipuliformis, culiciformis*, F.

Gen. II: ZYGÆNA.

Gen. III: STYGIA.

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* It is remarkable that Laspeyres describes the true clearwings as having a "lingua exserta," the very term we have hitherto supposed to belong more particularly to the Macroglossid section.

† Does not specify Linné's type, *ligustri*.

‡ Omits *populi*, the type of Hübner's *Amorpha* (1806).

In 1805, Latreille gave (*Hist. Nat. Crust. Ins.*, xiv., pp. 126 *et seq.*) a more extended view of the contents of the genera *Sphinx*, *Smerinthus* and *Sesia* as follows:

Sphinx.—Antennes en massue prismatique, terminées par un petit filet simple; palpes fort larges; une langue—*Atropos*, *ligustri*, *convolvuli*, *elpenor*, *porcellus*, *euphorbiae*, *gallii*, *lineata*, *celerio*, *vespertilio*, *oenotherae*, *stellarum* (*sic*), *fuciforme*, *bombyliforme*.

Smerinthus.—Antennes prismatiques, pectinées ou en scie, crochues à leur extrémité; langue très-courte ou presque nulle—*Tiliae*, *ocellata*, *populi*.

Sesia.—Antennes en fuseau et peu contournées, terminées par un petit faisceau d'écailles; palpes presque coniques; le second article plus fourni d'écailles ou de poils - *Apiforme*, *tipuliforme*, *culiciforme*, *chrysidiforme*.

The year 1806 saw the determination of the types of several genera. Hübner, in his *Tentamen*, p. 1, gives the following types of stirpes relating to the groups under discussion:

Phalanx ii: Sphinges.
- Tribus i: Papilionides:
  1. *Zygaenae—Zygaena filipendulae.**
  2. *Chrysaores—Chrysaor statices.*†
  3. *Glaucopes—Glaucopis phegea.*
- Tribus ii: Hymenopteroides:
  1. *Sphecomorphae—Sphecomorpha incendaria.*
  2. *Sesiae—Sesia culiciformis.*
  3. *Thyrides—Thyris pyralidiformis.*
- Tribus iii: Legitimæ:
  1. *Bombyliae—Bombylia stellatarum* ‡.
  2. *Eumorphae—Eumorpha elpenor.*
  3. *Manducae—Manduca atropos.*
  4. *Amorphae—Amorpha populi.*

The selection of *culiciformis* as the type of *Sesia*, must be considered in the light of Cuvier's restriction of 1797. Otherwise it would appear to have left the residuary and not congeneric species of the "*apiformis*" group to represent *Trochilium* (a view taken by Oken in 1815), whilst *atropos* being selected as the type of *Manduca*, *elpenor* as the type of *Eumorpha*, and *populi* as the type of *Amorpha*, determined once for all the generic appellations of these species.

In 1807, Fabricius makes a personal advance, but goes back on much of the work of his immediate predecessors, and practically reaches Scopoli's position of 1777. He gives us (*Illig. Mag.*, vi., pp. 287—288) the following groupings, which do not much influence the synonymy:

Laothoe §.—Taster zwei, rauh, sehr stumpf, zweigliedrig. Rollzunge sehr kurz, häutig, fast undeutlich. Fühler fadenförmig; Glieder unten schuppig. —*Sphinx ocellata*, *quercûs*, *tiliae*, *populi*. 21 Art.

Sphinx.—Taster dikk, rauh, sehr stumpf, zweigliedrig. Fühler fadenförmig, unten schuppig. (1) Gezähnte Flügel.—*Sphinx ello*, *tetrio*. (2) Ganzrandige Flügel.—*Sphinx nerii*, *atropos*, *euphorbiae*, *ligustri*. 74 Art.

Sesia ‖.—Taster zwei, kurz, dikk, rauh, sehr stumpf, zweigliedrig. Fühler nach aussen dikker mit einem kleinen Haken an der Spitze. (1) Flügel ausgenagt. —*Sphinx oenotherae*. (2) Flügel ganzrandig.—*Sphinx stellatarum*, *fuciformis*. 18 Art.

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* Cotypical with Scopoli's *Anthrocera*, fixed in 1777.

† Cotypical with *Adscita*, Retzius, 1783.

‡ Cotypical with Scopoli's *Macroglossum*, fixed in 1777; and Fabricius' *Sesia*, fixed in 1797.

§ Grote, in 1874, pronounced (*Bull. Buff. Soc.*, i., p. 24) *populi* to be the type of *Laothoë*, which may be considered as making it synonymous with *Amorpha*. We have hitherto been inclined, however, to look upon *quercûs* as the residuary type of the genus *Laothoë*.

‖ Already restricted (1797) by Cuvier with *stellatarum* as type.

ÆGERIA.—Taster zwei, vorgestrekkt, dreigliedrig; zweites Glied länger vom Kopfe abstehend, drittes kürzer, kegelförmig, spitz. Fühler walzenförmig, vielgliedrig: Endglied länger, feiner, spitz.—*Sesia apiformis, ichneumoniformis, vespiformis.* 19 Art.

In 1809, Laspeyres' important review of the first two vols. of Ochsenheimer's *Die Schmett. von Europa*, was published (*Jena. Allg. Lit. Zeit.*, 1809, iv., pp. 89—104). In this he proposes (p. 100) the generic names *Deilephila* * (for the 2nd and 3rd families of the *Vienna Catalogue*) and *Acherontia* (for *atropos*), both of which were adopted by Ochsenheimer in 1816.

In 1810, Latreille (*Considérations Ord. Nat. Animaux*, &c., pp. 357-358 and 440-441) named *euphorbiae* as the type of *Sphinx*, which was *ultra vires*, and fixed *ocellata* as the type of his *Smerinthus* to the exclusion of *tiliae*. Thus we find:

SPHINX.—The type fixed on p. 440 as *Sphinx euphorbiae* †, Fab.
SMERINTHUS.—The type fixed on p. 440 as *Smerinthus ocellata*, Linn.
SESIA.—The type fixed on p. 440 as *Sesia apiformis* ‡, Fab.

In 1815, Oken gave (*Lehrbuch der Zoologie*, i., pp. 747 *et seq.*) a further grouping of Sphingid genera. His classification works out as follows:

I. SPHINGES ILLEGITIMÆ, HYALINÆ.—Genus 1—THYRIS. Genus 2—ÆGOCERA. Genus 3—ÆGERIA, SESIA, TROCHILIUM. [Sect. A.—TROCHILIUM—*apiformis*§ and *bembeciformis*. Sect. B.—ÆGERIA‖—all the small clearwings.] Genus 4—SETIA¶ (*Sesia, Sphinx, Macroglossum*).—Like *Sphinx*; anal tuft; tongue long and rolled in; antennæ thicker and shorter, club-shaped, anteriorly pointed and hooked, distinctly flossy. Abdomen broad, tufts of hairs on sides and end; wings small; fly by day. Larvæ long, cylindrical, on the "Kreuz" [*i.e.*, the small of the back] a horn or "Spiegel-fleck," no other spots, head globular, transformation above ground among spun-up leaves or bits of plants. [*a.* Wings entire—*fuciformis, bombyliformis, stellatarum.* *b.* Wings emarginate—*oenotherae.*]

II. SPHINGES ILLEGITIMÆ, ADSCITÆ. PAPILIONES PHALÆNOIDES.—Burnets, etc.

III. SPHINGES PHALÆNOIDES.—Genus: LAOTHOE (*Smerinthus*).—Antennæ prismatic, spindleformed, serrate, hook at end, tongue doubtful, palpi pressed near together, well scaled, last joint scarcely perceptible. Larva obliquely-striped, with a caudal horn, head tetrahedral; pupa in earth, without cocoon; imago with very short tongue, bipartite; head small, prone; antennæ prismatic, serrate, tip hooked; wings dentate, emarginate, broad; body unicolorous; fly at night.—*L. tiliae, L. ocellata, L. populi, L. quercûs.*

IV. SPHINGES LEGITIMÆ. Genus 1: ELPENOR**.—Spitzleibige Schwärmer, Mackelraupen, Augenraupen. Body smooth, naked, "Kreuzhorn," head globular, retractile, on the neck some eyespots; pupa, on the earth, among leaves spun together; imago with the abdomen pointed, not ringed, tongue moderate, wings not dentate, slightly narrowed, pointed, antennæ of almost uniform thickness, scaled beneath, apex thread-like, eyes large, fly morning and evening.—*E. nerii, E. celerio* (*phoenix*), *E. vitis* (*elpenor*), *E. porcellus.*

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* Curtis fixed *elpenor* as the type of this genus (*Brit. Ent.*, fol. 3, 1824). It therefore falls as a synonym of *Eumorpha*.

† *Ultra vires* since *ligustri* was already (from 1758) the type of *Sphinx*.

‡ This of course fails, as Cuvier (in 1797) had already fixed the type of *Sesia* as *stellatarum*, and Hübner (in 1806) had named *culiciformis* the type.

§ As *apiformis* and *bembeciformis* have hitherto been considered congeneric this fixes these species as representing *Trochilium* (*sens. rest.*).

‖ *Ægeria* has, apart from *apiformis*, only two possible types at this date, *vespiformis* and *ichneumoniformis*.

¶ *Setia* is evidently intended as a classical emendation of *Sesia*, and falls before the latter.

** As no type has ever yet, to our knowledge, been fixed for this genus, and all the species contained have, in the meanwhile, been constituted the types of other genera, it appears to us best to declare *elpenor*, L. (=*vitis*, Oken) the type, and to sink *Elpenor*, Oken, before *Eumorpha*, Hb.

Genus 2 : CELERIO*. Halbbandierte, halbringleibige Schwärmer; Fleckenraupen. With small, globular, not retractile head, body smooth, a caudal horn, coloured lateral spots ; pupa on the earth, among leaves ; imago on the sides of the belly with interrupted rings, tongue longer, forewings elongate, smooth-margined, inner margin hollowed, antennæ as in the preceding.—*C. galii*, *C. euphorbiae*.

Genus 3 : HERSE †. Tongue longest and thick, longer than body.—*H. convolvuli*, *H. ligustri* (*spiraeae*), *H. pinastri*.

Genus 4 : ATROPOS ‡. Tongue very short, thick, almost wanting.—*A. solani* (*Sph. atropos*).

In 1815, Leach gave (*Edinburgh Encyclop.*, ix., pp. 130—131) the following groupings :

LAOTHOE.—*Ocellata*, *tiliae*, *populi*.

SPHINX.—*Porcellus*, *elpenor*, *lineata*, *galii*, *euphorbiae*, *pinastri*, *convolvuli*, *ligustri*, *atropos*.

SESIA.—*Stellatarum*, *bombyciformis* (=*fuciformis*, Linn.), *fusiformis*.

ÆGERIA§.—*Apiformis*, *crabroniformis*, *vespiformis*, *tipuliformis*.

In 1816, Dalman (*Vetens. Acad. Handlingar*, pp. 204 *et seq.*) divided the Sphingides into the following groups :

(1) DILINA—*ocellata*, *tiliae*, *populi*. (2) SPHINX—*atropos*, *convolvuli*, *ligustri*, *pinastri*, *galii*, *elpenor*, *porcellus*. (3) HEMARIS—*stellatarum*, *fuciformis*, *bombyliformis*.

Dalman names *ocellata* the type of *Dilina*, *ligustri* the type of *Sphinx*, *fuciformis* the type of *Hemaris*, but does not indicate the type of his *Sesia*. He, however, places (*loc. cit.*, p. 217) *Sesia* in the *Zygaenides*, using the genus for *apiformis*, *melanocephalus* (*crabroniformis*), *scoliaeformis*, *spheciformis*, *hylaeiformis*, *ichneumoniformis*, *palpina*, *culiciformis*, *tipuliformis*, etc. We may here repeat that *Smerinthus*, Latr., was created for *tiliae* and *ocellata* in 1802, that, in 1810, *ocellata* was indicated as the type, and that in 1816, Dalman created *Dilina* for *ocellata*, *tiliae* and *populi*, and also indicated *ocellata* as the type; thus it would appear that *Dilina*, Dalm., is synonymous with *Smerinthus*, Latr., and falls as such, *tiliae* still awaiting, in 1816, a separate generic restriction. Dalman accurately fixes *ligustri* as the type of *Sphinx*, and, although his *Hemaris* contains *stellatarum*, the type of *Sesia* and *Macroglossum*, he names *fuciformis* as the type of the new genus, which becomes restricted to the group of which the last-named species is the exponent.

In 1808, Ochsenheimer had separated (*Die Schmett.*, ii., p. 185) the true clearwings and limited *Sphinx* to the following species :

Fam. I—*Fuciformis*, *bombyliformis*, *croatica*, *stellatarum*, *oenotherae*, *gorgon*. Fam. II—*Nerii*, *celerio*, *elpenor*, *porcellus*‖. Fam. III—*Lineata*, *galii*, *hippophaes*, *euphorbiae*, *zygophylli*, *vespertilio*‖. Fam. IV—*Atropos*, *convolvuli* *ligustri*, *pinastri*. Fam. V—*Tiliae*, *ocellata*, *populi*, *quercûs*.

In 1816 the same author published a classificatory catalogue, the

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* The species, *gallii* and *euphorbiae*, appear to us to be possibly congeneric. Hence Oken's generic name must stand for them. We propose making *gallii* the type.

† As this genus retains *ligustri*, Linné's type of *Sphinx*, the name should sink as a synonym of the latter genus. We therefore make *ligustri* the type, so that *Herse* falls as a synonym of *Sphinx*.

‡ Synonymous with *Manduca*, Hb., and *Acherontia*, Lasp., *atropos* being the type of all three.

§ *Apiformis* and *crabroniformis* are placed in *Trochilium* by Oken ; *vespiformis* is the only one mentioned here of the two other possible types of *Ægeria* (cfr. *anteà*, p. 348 footnote), and should, therefore, be accepted as the type.

‖ Fam. II is absolutely identical with Oken's genus *Elpenor* and contains the same four species. Fam. III contains both Oken's genotypes of the genus *Celerio* (see *suprà*).

"Systema Glossatorum Europæ" (*Die Schmett.*, etc., vol. iv., pp. 1—97), and here, on pp. 41—45, he respectively termed the families mentioned above—Fam. I—*Macroglossa* (*Macroglossum*, Scop.). Fams. II-III—*Deilephila* (*Spectrum*, Scop.). Fam. IV—*Acherontia* (*Manduca*, Hb.) and *Sphinx*. Fam. V—*Smerinthus*, Latr. (*Laothoë*, Fab., *Amorpha*, Hb.), thus reducing, by his own references, two of his names to the position of synonyms, *viz.*, *Macroglossa*, Ochs., which falls before *Macroglossum*, Scop., and *Acherontia*, Lasp., before *Manduca*, Hb.

Soon after this time (about 1822) Hübner published that part of the *Verzeichniss* which contained the Sphingids (pp. 115 *et seq.*), and determined most of the genera belonging to the group. His grouping is as follows:

Horde II (Phalanx secunda): SPHINGES (=*Sphinges*, Linn.; *Sphinges*, *Sesiae* and *Zygaenae*, Fab.).

Tribus I: PAPILIONIDES.—Stirps I: ZYGÆNÆ—divided into Fam. 1, *Circumfluae* Fam. 2, *Atrosignatae*. These include the Anthrocerids.

Stirps II: CHRYSAORES—divided into Fam. 1, *Immaculatae*. Fam. 2, *Excelsae*. These include the Adscitids and Syntomids.

Stirps III: GLAUCOPES—divided into Fam. 1, *Amplae*. Fam. 2, *Angustae*. Fam. 3, *Dubiae*. Fam. 4, *Hyalinae*.

Stirps IV: SPHECOMORPHÆ, divided into Fam. 1, *Nobiles*. Fam. 2, *Exiles*.

Tribus II: HYMENOPTERIDES.—Stirps I: SESIÆ—divided into Fam. 1, *Corpulentae*. Fam. 2, *Graciles*. These include the true clearwings.

Stirps II: APYRALIDES, containing Fam. 1, *Vitratae*. This includes only *Thyris fenestrina* and two of Cramer's species.

Tribus III: LEGITIMÆ (=*Sesiae*, Fab.).—The palpi thick, blunt, the antennæ in front broader; "short-bladed," almost bent back at the end, the body thick and the wings strong.

Stirps I: BOMBYLIÆ.—The tongue very long: the antennæ almost club-shaped and pointed at the tip; the body with tufts of hairs.

Fam. 1: VULGARES.—The wings somewhat short, their margins entire; the body with tufts on the sides and anus.

Coitus *a*: *Cephonodae*.—The wings almost scaleless, the body variegated—*Cephonodes hylas*, Fab., *C. bombyliformis*, Esp., *C. fuciformis*, Linn., *C. pelasgus*, Cram., *C. croatica*, Esp.

Coitus *b*: *Aellopodes*.—The forewings with transparent white lines; the hindwings sinuate—*Aellopos titan*, Cram., *A. fadus*, Cram.

Coitus *c*: *Psithyri*.—The forewings grey and black banded, hindwings rust yellow and blackish; the tufts of hair chequered—*Psithyros stellatarum*, Linn., *P. belis*, Cram., *P. ceculus*, Cram., *P. faro*, Cram.

Fam. 2: ÆQUIVOCÆ.—The wings sinuate and dentate; the body with tufts of hair on the anus only.

Coitus *a*: *Proserpini*.—The back of the thorax ornamented; the forewings dark-banded, traversed with whitish—*Proserpinus oenotherae*, Schiff., *P. gaurae*, Abb., *P. gorgoniades*, Hb. (*gorgon*, Esp.).

Coitus *b*: *Enyones*.—The forewings almost falcate at the apex, marked with pale and dark like the agate—*Enyo japyo*, Cram., *E. pylus*, Cram., *E. gorgon*, Cram., *E. lyctus*, Cram., *E. camertus*, Cram., *E. danum*, Cram., *E. phegeus*, Cram., *E. anceus*, Cram., *E. syces*, Hb. (*ficus*, Cram.).

Coitus *c*: *Hemeroplanae*.—The forewings with blunt tip, agate-like, and with a light mark in the central area—*Hemeroplanes pan*, Cram., *H. triptolemus*, Cram., *H. plutonius*, Hb. (*pluto*, Cram.), *H. oiclus*, Cram.

Coitus *d*: *Amplypteri*.—The forewings sinuate at the margin; in the central area with shining markings—*Amplypterus ganascus*, Stoll, *A. panopus*, Cram., *A. bubastus*, Cram.

Coitus *e*: *Nephelae*.—The forewings with cloudy stripes; the hindwings dark—*Nephele morpheus*, Cram., *N. didyma*, Fab. (*penaeus*, Cram.), *N. chiron*, Cram.

Stirps II: EUMORPHÆ.—The antennæ somewhat long and thin, their end bent back; the body long, pointed, quite smooth.

Fam. 1: ELEGANTES.—The head, thorax, and body not entirely unadorned, the wings variegated.

Coitus *a: Pholi.*—The forewings brownish-grey; the hindwings finely coloured; both pairs brown-shaded, and with angular black markings—*Pholus crantor*, Cram., *P. licaon*, Cram., *P. strigilis*, Fab., *P. ficus*, Linn.

Coitus *b: Daphnides.*—The forewings a particularly beautiful green, and with softly variegated markings—*Daphnis megaeacus*, Hb. (*eacus*, Cram.), *D. hippothous*, *D. nerii*, Linn.

Coitus *c: Argei.*—The forewings green, with pale lines; the hindwings variegated—*Argeus labruscae*, Linn., *A. pandion*, Cram.

Fam. 2: OBLIQUOSTRIATÆ.—The forewings outwards from the middle of the inner margin to the apex marked with pale and dark stripes and lines.

Coitus *a: Amphiones.*—The forewings dark reddish-grey, striped with shadowy spots; hindwings red—*Amphion nessus*, Cram., *A. brennus*, Cram.

Coitus *b: Theretrae.*—Both pairs of wings exteriorly with dentate bands; hindwings shaded with yellow and black—*Theretra equestris**, Fab., *T. nechus*, Cram., *T. porcellus*, Linn., *T. tersa*, Fab.

Coitus *c: Hippotiones.*—The forewings externally with oblique white bands and brown stripes, also white nervured; hindwings with almost red spots—*Hippotion celerio*, Linn., *H. ocys*, Hb.† (*celerio*, Cram.).

Coitus *d: Isoplae.*—The forewings brown, the outer part obliquely pale- and dark-striped; hindwings red—*Isoples eson*, Cram., *I. alecto*, Linn., *I. neoptolemus*, Cram., *I. theylia*, Linn.

Coitus *e: Xylophanae.*—The forewings with oblique wood-coloured stripes; hindwings shaded with black—*Xylophanes anubus*, Cram., *X. lycetus*, Cram., *X. gortys*, Hb. (*gordius*, Cram.), *X. cajus*, Cram., *X. drancus*, Cram.

Coitus *f: Orei.*—The forewings with alternately coloured stripes; hindwings with black and coloured bands—*Oreus gnoma*, Fab. (*butus*, Cram.), *O. acteus*, Cram., *O. elpenor*, Linn., *O. amadis*, Cram., *O. licastus*, Cram.

Stirps III: DEILEPHILÆ.—The antennæ outwards a little thicker; the forewings with obliquely shaded bands.

Fam. 1: PALLIDOVENOSÆ.—The forewings spotted and striped with a brownish shade; hindwings black, red banded; body black-marked on the sides.

Coitus *a: Dupones.*—The forewings longitudinally as well as transversely banded, paler nervured; the hindwings pale grey and rose red—*Dupo vitis*, Linn., *D. jussieuae*, Hb. (*vitis*, Cram.).

Coitus *b: Phryxi.*—The forewings almost entirely white nervured; the body on the back and on the sides chequered with black and white—*Phryxus livornica*, Pet. (*lineata*, Fab.), *P. caicus*, Cram.

Fam. 2: POPULARES.—The forewings transversely with shadowy bands; the hindwings red across the middle.

Coitus *a: Hylae.*—The forewings on the costa with cloudy spots; the body at the sides "adorned with black and white cubes" (? chequered)—*Hyles galii*, Schiff., *H. opheltes*, Cram., *H. zygophylli*, Ochs., *H. hippophaës*, Esp., *H. nicea*, Prunn., *H. euphorbiae*, Schiff., Hb.

Coitus *b: Thaumae.*—The forewings with only cloudy spots and stripes; the body sparsely "marked with cubes" (? chequered)—*Thaumas vespertilio*, Esp., *T. capensis*, Linn. (*aeas*, Cram.), *T. cecrops*, Cram.

Coitus *c: Chromes.*—The forewings band-wise, with angular markings; the hindwings yellow, black margined.—*Chromis erotus*, Cram.

Coitus *d: Clanes.*—The forewings tolerably broad; dull-coloured, with blackish transverse stripes—*Clanis nicobarensis*, Schwarz, *C. phalaris*, Cram., *C. achemenides*, Cram.

Stirps II: MANDUCÆ.—All the species very large; the tongue strong, the eyes large; the wings striped; the body variegated.

Fam. 1: LEVES.—The tongue long; all the members somewhat "schlänglich."

Coitus *a: Hyloici.*—All the species whitish-grey, black marked, the forewings with straight and waved stripes; the hindwings shaded with blackish—*Hyloicus pinastri*, Linn., *H. coniferarum*, Abb., *H. menephron*, Cram., *H. pamphilius*, Cram., *H. hylaeus*, Cram., *H. hasdrubal*, Cram.

Coitus *b: Erinnyes.*—The forewings brownish-grey, with dentate black stripes; the hindwings rust-coloured, with black border—*Erinnyis ello*, Linn.,

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* Moore declares (*Lep. Ceyl.*, ii., p. 22) this species (= *nessus*, Dru., Cram.) to be the type of *Theretra*, a decision which we consider *ultra vires* in view of Stephens' prior restriction (*posteà* p. 354).

† Kirby gives (*Cat.*, p. 653) *ocys*, Hb. = *celerio*, Linn., which makes *Hippotion* monotypical.

E. oenotrus, Cram., *E. scyron*, Cram., *E. alope*, Cram., *E. caricae*, Linn. (*cacus*, Fab.).

Fam. 2: PONDEROSÆ.—All the species tolerably thick and short, elegantly marked.

Coitus *a*: *Acherontiae*.—The tongue very short; the antennæ at the end with a plumule; the back of the thorax marked like a mask; the fringes of the wings short—*Acherontia atropos*, Linn., *A. chionanthi*, Abb., *A. morta*, Hb. (*atropos*, Cram.).

Coitus *b*: *Cocytii*.—The tongue long; the thorax almost unmarked; the abdomen half yellow spotted—*Cocytius jatrophae*, Fab. (*medor*, Cram.), *C. rustica*, Fab., *C. forestan*, Cram.

Coitus *c*: *Phlegethontii*.—The thorax almost without markings; but the abdomen entirely adorned with yellow spots—*Phlegethontius cluentius*, Cram., *P. lucetius*, Cram., *P. hannibal*, Cram., *P. carolina*, Linn., *P. paphus*, Cram.

Coitus *d*: *Agrii*.—The hindwings and the abdomen red- and black-banded—*Agrius anchemolus*, Cram., *A. convolvuli*, Linn., *A. cingulatus*, Hb. (*cingulata*, Fab. = *convolvuli*, Cram.).

Coitus *e*: *Lethiae*.—The forewings only exteriorly with dentate stripes; the hindwings banded—*Lethia ligustri*, Linn., *L. prini*, Abb., *L. drupiferarum*, Abb., *L. kalmiae*, Abb., *L. gordius*, Cram.

Stirps V: SMERINTHI.—The head small, almost hidden; the tongue very short and delicate; the palpi small; the antennæ curved; the wings with angled margins; the (?) arms thickly clothed with peculiarly coloured hairs.

Fam. 1: DENTATI.—The thorax without markings; the wings jagged or dentated.

Coitus *a*: *Colaces*.—The forewings with one angle, with shiny central-markings; hindwings pale—*Colax apulus*, Cram.

Coitus *b*: *Polyptychi*.—The forewings with many projections or toothed; with shaded band and blackish stripes—*Polyptychus dentatus*, Cram., *P. timesius*, Stoll, *P. juglandis*, Abb., *P. populi*, Linn., *P. quercûs*, Schiff.

Fam. 2: ANGULATI.—The thorax with coloured markings; the wings with blunt angles, and soft shading.

Coitus *a*: *Paoniae*.—The hindwings marked above with an eye-spot—*Paonias salicis*, Hb. (*ocellata*, Linn.), *P. myops*, Abb., *P. excaecatus*, Hb. (*excaecata*, Abb.).

Coitus *b*: *Mimantes*.—The palpi fairly moderate. The forewings with deep inlets and blunt angles, banded—*Mimas tiliae*, Linn.

Fam. 3: UNCINATI.—The forewings curved like a beak; the hindwings sharp-angled.

Coitus *a*: *Oti*.—The forewings with shaded stripes; the hindwings at the anal end dark—*Otus choerilus*, Cram., *O. myron*, Cram.

Swainson, in 1821—22 (*Zool. Illus.*, ii., pl. 81 expl.), gave *convolvuli* as "generic type" for *Sphinx*, but this was *ultra vires*, as *ligustri* was already type of *Sphinx*. Curtis, in 1824 (expl. pl. iii), specified *elpenor* as the type of *Deilephila*, but Hübner had already, in 1806 (*anteà*, p. 347), specified *elpenor* as the type of *Eumorpha*, so that *Deilephila* falls as a synonym of the latter. Stephens, in 1828, divided (*Illus. Haust.*, i., p. 111) the Sphingids into four genera:

1. SMERINTHUS, Latr.—*Ocellatus, populi, tiliae.*
2. ACHERONTIA, Ochs.—*Atropos.*
3. SPHINX, Auct.—*Convolvuli, ligustri, pinastri.*
4. DEILEPHILA, Ochs.—*Euphorbiae, galii, lineata, celerio, elpenor.*

This author united (*loc. cit.*, pp. 132—136) *Macroglossa*, Ochs. (with *stellatarum* as the type) and *Sesia*, Fab. (with *fuciformis* and *bombyliformis*) as the *Sesiidae*, and referred the true "clearwings" to the family *Ægeriidae* (*loc. cit.*, pp. 136 *et seq.*). Humphreys and Westwood (*Brit. Moths*, i., p. 5) also place the Macroglossids in *Sesia*, referring this genus to the *Sphingidae.*

Boisduval, in 1829, gave (*Eur. Lep. Ind. Meth.*, pp. 32—34) the following grouping:

MACROGLOSSA—*Fuciformis, bombyliformis, creatica, stellatarum.*

PTEROGON—*Œnotherae*, gorgoniades.*

SPHINX—*Nerii, celerio, cretica, elpenor, porcellus, lineata, dahlii, galii, hippophaes, vespertilioides, euphorbiae, nicaea, zygophylli, convolvuli, ligustri, pinastri.*

BRACHYGLOSSA †—*Atropos.*

SMERINTHUS—*Tiliae, ocellatus, populi, tremulae, quercûs.*

In 1835 Stephens published, as an appendix to vol. iv of his *Illustrations (Haustellata)*, an "Abstract of the Indigenous Lepidoptera contained in the *Verzeichniss Bekännter Schmetterlinge* by Hübner." In this he gives (p. 5) the following list of the British ‡ "Sphinges Legitimæ":

CEPHONODES (SESIA).—*Bombyliformis, fuciformis.*
PSITHYROS (MACROGLOSSA).—*Stellatarum.*
DAPHNIS.—*Nerii.*
THERETRA (DEILEPHILA, B, *pars*).—*Porcellus.*
HIPPOTION (DEILEPHILA, B, *p.*).—*Celerio.*
OREUS (DEILEPHILA, B, *p.*).—*Elpenor.*
PHRYXUS (DEILEPHILA, A, *p.*).—*Livornica.*
HYLES (DEILEPHILA, A, *p.*).—*Galii, euphorbiae.*
HYLOICUS (SPHINX, *p.*).—*Pinastri.*
ACHERONTIA (ACHERONTIA).—*Atropos.*
PHLEGETHONTIUS (SPHINX, *p.*).—*Carolina.*
AGRIUS (SPHINX, *p.*).—*Convolvuli, cingulata* (?).
LETHIA (SPHINX, *p.*).—*Ligustri.*
POLYPTYCHUS (SMERINTHUS, *p.*).—*Populi.*
PAONIAS (SMERINTHUS, *p.*).—*Salicis.*
MINIAS [*sic*] (SMERINTHUS, *p.*).—*Tiliae.*

Although this mere citation of the British species does not in the least restrict Hübner's genera, and Stephens makes no attempt to fix their types, yet his list had without doubt some influence in introducing the genera to the notice of British entomologists, and, in 1837, Curtis distinctly fixes *nerii* as "type of the genus" *Daphnis*. In Stephens' *List of the Specimens of British Animals in the Collection of the British Museum*, part v, Lepidoptera (1850)—a catalogue which had perhaps more influence on nomenclature because containing a new classificatory system—the names become still further associated (as subgeneric, in most cases) with the same species, *Phryxus*, however, being mis-spelled "*Phrynus*." The classification adopted in this work (pp. 25—30) is as follows:

Fam. II: SPHINGIDÆ.
SMERINTHUS, Latr.
a. PAONIAS, Hb.—*ocellatus*, *L.*
b. POLYPTICHUS, Hb.—*populi*, L.
c. MIMAS, Hb.—*tiliae*, L.
ACHERONTIA, Ochs.—*atropos*, L.
SPHINX, Auct.
a. AGRIUS, Hb.—*convolvuli*, L.
b. LETHIA, Hb.—*ligustri*, L.
c. HYLOICUS, Hb.—*pinastri*, L.
DEILEPHILA, Ochs.
a. HYLES, Hb.—*euphorbiae*, L., *galii*, Schiff.
b. PHRYNUS, Hb.—*livornica*, Esp.
CHÆROCAMPA, Dup.
a. HIPPOTION, Hb.—*celerio*, L.

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* D'Orbigny makes (*Dict.*, x., p. 613) *oenotherae* (=*proserpina*), the type.

† Absolutely synonymous with *Manduca*, Hb.

‡ *Carolina* and *cingulata* are, of course, not British. Kirby notes (*in litt.*) that Hübner figures (*Samml. Exot. Schmett.*, vol. ii., *ante.* 1826) *cingulata* under the generic name *Agrius*, this being the earliest use of the generic title for a single species after its erection. Kirby considers that this is sufficient to constitute *cingulata* the type of *Agrius*.

b. THERETRA, Hb.—*porcellus*, L.
c. OREUS, Hb.—*elpenor*, L.
DAPHNIS, Hb.—*nerii*, L.
Fam. III: SESIIDÆ.
MACROGLOSSA (MACROGLOSSUM, Scop.)—*stellatarum*, L.
SESIA, Fb.—*fuciformis*, L., *bombyliformis*, Esp.

In 1835, Duponchel published (*Hist. Nat. Lép.*, supp. ii., pp. 155 *et seq.*) the Sphingid section of his "Catalogue Méthodique des Lépidoptères d'Europe." Tabulated, his results work out as follows:

1. SPHINX, L.—*Ligustri*, L., and var. *spireae*, Hb., *convolvuli*, L., *pinastri*, L.
2. DEILEPHILA, Ochs.—*Nicaea*, de Prun., *euphorbiae*, L., *galii*, F., *dahlii*, Tr., *epilobii*, Bdv., *esulae*, Bdv., *tithymali*, Bdv., *zygophylli*, Ochs., *hippophaes*, Esp., *vespertilio*, Fab., *amelia*, Feisth., *lineata*, Fab. (*livornica*, Esp.).
3. CHŒROCAMPA, Dup.*—*Nerii*, L., *celerio*, L., *osyris*, Dalm., *cretica* (=*alecto*), Bdv., *elpenor*, L., *porcellus*, L.
4. BRACHYGLOSSA, Bdv.—*Atropos*, L.
5. SMERINTHUS, Latr.—*Tiliae*, L., *ocellata*, L., *populi*, L., *tremulae*, Zett., *quercûs*, Fab.
6. PTEROGON, Bdv.—*Oenotherae*, Fab., *gorgon*, Esp.
7. MACROGLOSSA, Scop.—*Stellatarum*, L., *croatica*, Esp., *fuciformis*, L., *bombyliformis*, Ochs., *milesiformis*, Dahl.

In 1836, Duncan created (*Brit. Moths*, p. 154) the heterotypical genus *Metopsilus* for *nerii* (type of *Daphnis*†, Hb.), *celerio* (type of *Hippotion*, Hb.), *elpenor* (type of *Eumorpha*, Hb.), and *porcellus* (type of *Theretra*, Hb., and *Choerocampa*, Dup.), whilst Westwood, in 1840, gives (*Gener. Synops.*, pp. 88—89) the following summary of the Sphingid genera:

Family 1: SPHINGIDÆ, Leach.

SMERINTHUS, Latr. (*Laothoe*, Fb.).—3 spp. *Sph. ocellata*, L.—Wings angulated; spiral tongue short.

ACHERONTIA, Ochs. (*Brachyglossa*, Bdv.).—1 sp. *Sph. atropos*, L.—Wings entire, acute, spiral tongue short.

SPHINX, Linn. (*Eumorphae*, Hb.).—6 spp. *Sph. ligustri*, L.—Wings entire, acute, spiral tongue very long; antennæ not clavate; labial palpi robust.

DEILEPHILA, Ochs. (*Spectrum*, *p.*, Scop.).—3 spp. *Sph. euphorbiae*, L.—Wings entire, not subfalcate; spiral tongue long; labial palpi robust; antennæ clavate; neck of larva not retractile.

DAPHNIS, Hb. (*Sphinx*, L.).—1 sp. *Sph. nerii*, L.—Wings entire, acute, posterior slightly lobed; spiral tongue long; antennæ and labial palpi slender; caterpillar with the neck retractile.

METOPSILUS, Duncan (*Eumorphae*, Hb.).—3 spp. *Sph. elpenor*, L.—Forewings subfalcate; antennæ obscurely clavate; spiral tongue long; neck of caterpillar retractile.

MACROGLOSSA, Ochs. (*Sesia*, *p.*, Fb.).—1 sp. *Sph. stellatarum*, L.—Wings squamose; apex of abdomen strongly tufted.

SESIA, Fb. (*Macroglossa*, *p.*, Ochs.).—2 spp. *Sph. fusiformis*, L.—Wings partially hyaline; abdomen tufted at the extremity.

Westwood's determinations are correct for *Smerinthus*, *Sphinx*, *Daphnis* and *Macroglossum*, but the latter under existing rules falls before *Sesia*, Fab. By fixing *elpenor* as the type of *Metopsilus*, the latter becomes a synonym of *Eumorpha*, Hb., whilst his *Sesia* is, of course, synonymous with *Hemaris*, Dalm. We have already noted (*anteà*, pp. 348, 352) that Curtis' action in fixing *elpenor* as the type of *Deilephila* makes the latter genus synonymous

* In D'Orbigny's *Dict. Univ. Hist. Nat.*, iii., p. 613 (1843), Duponchel fixed on *porcellus* as the type of this genus.

† Curtis, *Brit. Ent.*, xiv., fol. 626 (January, 1837), figured *nerii*, and declared it to be the type of the genus *Daphnis*.

with *Eumorpha*, Hb., the fixing of *euphorbiae* as type by Westwood being altogether *ultra vires*.

So far as the British species are concerned, this may be said to complete the literature relating to their synonymy. We only add here Boisduval's grouping, from his still-born work of 1875. In this (*Histoire Nat. des Insectes, Lépidoptères*, vol. i), the author confesses that his work is not up-to-date, and that he has made no attempt to make it so. He divides the Sphingids into the following tribes and genera:

Tribe I: ACHERONTIDES—*Acherontia*, Ochs.

Tribe II: SMERINTHIDES—*Brachyglossa*, Latr., *Metagastes*, Bdv., *Calymnia*, Bdv., *Euclea*, Bdv., *Niceryx*, Bdv., *Smerinthus*, Latr., *Eurypteryx*, Feld., *Basiana*, Walk., *Daphnusa*, Walk., *Cypa*, Walk., *Ceratomia*, Harris.

Tribe III: LEUCOPHLEBIDES—*Leucophlebia*, Westd.

Tribe IV: EURYGLOTTIDES—*Meganoton*, Bdv., *Macrosila*, Bdv., *Amphonyx*, Poey, *Euryglottis*, Bdv., *Sphinx*, Auct. (two groups), *Anceryx*, Bdv., *Pachylia*, Bdv., *Zonilia*, Bdv., *Madorya*, Bdv.

Tribe V: DEILEPHILIDES—*Deilephila*, Ochs., *Elibia*, Walk., *Ambulyx*, Bdv., *Philampelus*, Harr., *Aleuron*, Bdv., *Everyx*, Bdv., *Euchloron*, Bdv., *Acosmeryx*, Bdv., *Eucheryx*, Bdv., *Choerocampa*, Dup. (with 13 groups, the first group termed "*Daphnis* et *Darapsa*," the eighth group *Pergasa*), *Panacra*, Walk.

Tribe VI: MACROGLOSSIDES—*Temnora*, Bdv., *Lapara*, Walk., *Arctonotus*, Bdv., *Tylognathus*, Feld., *Epistor*, Bdv., *Tricholon*, Bdv., *Ocyton*, Bdv., *Aspledon*, Bdv., *Lophura*, Bdv., *Pterogon*, Bdv., *Pogccolon*, Bdv., *Angonya*, Bdv., *Œnosanda*, Walk., *Perigonia*, Bdv., *Microlophia*, Feld., *Thyreus*, Swain., *Macroglossa*, Ochs., *Sataspes*, Moore, *Dasysphinx*, Felder.

We have now given a summary of the whole of the literature, so far as we know it, that bears on the vexed question of the generic synonymy of the British Sphingids, and in our opinion the types of the genera work out as follows:

1. SPHINX, Linné (1758).—Type fixed as *ligustri* by Linné in 1758.
2. SESIA, Fab. (1775).—Type fixed as *stellatarum* by Cuvier in 1797.
3. MACROGLOSSUM, Scop. (1777).—Type fixed as *stellatarum* by Scopoli, in 1777 (Falls before *Sesia*, Fab.).
4. SMERINTHUS, Latr. (1802).—Type fixed as *ocellata* by Latreille in 1810.
5. EUMORPHA, Hb. (1806).—Type fixed as *elpenor* by Hübner in 1806.
6. MANDUCA, Hb. (1806).—Type fixed as *atropos* by Hübner in 1806.
7. AMORPHA, Hb. (1806).—Type fixed as *populi* by Hübner in 1806.
8. DEILEPHILA, Lasp. (1809).—Type fixed as *elpenor* by Curtis in 1824 (Falls before *Eumorpha*, Hb.).
9. ELPENOR, Oken (1815).—Type fixed as *elpenor* by Tutt in 1902 (Falls before *Eumorpha*, Hb.).
10. CELERIO, Oken (1815).—Type fixed as *gallii* by Tutt in 1902. [*Gallii* and *euphorbiae* are the only species included in Oken's genus.]
11. HEMARIS, Dalm. (1816).—Type fixed as *fuciformis* by Dalman in 1816.
12. DAPHNIS, Hb. (*circ.* 1822).—Type fixed as *nerii* by Curtis in 1837.
13. HIPPOTION, Hb. (*circ.* 1822).—Type fixed as *celerio* (=*ocys*) by Hübner *circ.* 1822.
14. PHRYXUS, Hb. (*circ.* 1822).—Type fixed as *livornica* by Stephens in 1850.
15. HYLES, Hb. (*circ.* 1822).—Type fixed as *euphorbiae* by Tutt in 1902.
16. THERETRA, Hb. (*circ.* 1822).—Type fixed as *porcellus* by Stephens in 1850.
17. HYLOICUS, Hb. (*circ.* 1822).—Type fixed as *pinastri* by Stephens in 1850.
18. AGRIUS, Hb. (*circ.* 1822).—Type fixed as *cingulata* by Hübner *ante* 1826.
19. MIMAS, Hb. (*circ.* 1822).—Type fixed as *tiliae* by Hübner *circ.* 1822.
20. CHŒROCAMPA, Dup. (1835).—Type fixed as *porcellus* by Duponchel in 1843 (Falls before *Theretra*, Hb.).

Having completed our review of the literature of the Sphingids to the point of determining the generic nomenclature of our British species, we have now to review the Sphingids as a whole, and the relationship of the various sections that make up the superfamily.

Réaumur diagnosed the group in 1734 (*Mémoires*, i., p. 288) as follows:

Les papillons portent de ces especes d'antennes que nous avons nommées prismatiques *, c'est-à-dire, de celles qui entre leurs deux bouts, dans la plus grande partie de leur étenduë, ont un diametre à peu-près égal, et dont la coupe est un secteur de courbe, ou un triangle curviligne. Tous les papillons de cette classe doivent aussi avoir des trompes. Ceux de la plûpart des genres qui lui appartiennent, ont les aîles disposées de maniere qu'elles laissent le dessus du corps à découvert, qui ordinairement se termine en pointe. Leurs aîles inferieures sont petites par rapport aux superieures (pl. xiii., figs. 5, 6, 9). Le côté interieur de ces dernieres est plus court, et souvent considerablement plus court que le côté exterieur. Le bout de celui-ci va jusqu'au derriere, et quelquefois par-delà le derriere, au-lieu qu' après la fin de l'autre, il reste encore quelques anneaux. Ces papillons, qui ont le corps gros et pesant, dont les aîles inferieures sont courtes, et dont les superieures, malgré leur longueur, n'ont pas une grande surface, font beaucoup de bruit en volant; ils font entendre un bourdonnement très-fort: ils ne scauroient se soûtenir en l'air sans agiter leurs aîles avec une grande vîtesse. Nous avons vû des papillons bourdons dans la 6me classe des diurnes (pl. xii., figs. 5, 6, *M. stellatarum*), et nous avons des bourdons-phalenes dans la premiere classe de ceux-ci.

The general characters of the superfamily are very marked, yet there have been many difficulties as to the exclusion or inclusion of doubtful species, mainly, however, due to ignorance of the earlier stages. Reference to the earliest diagnoses (*anteà*, pp. 343 *et seq.*) of the superfamily will show that they were all more or less unsatisfactory, and, as we have already shown, included the Ægeriids (Sesiids), Anthrocerids, and their allies. The elimination of these has already been dealt with, although it is remarkable that many recent authors have insisted on placing the Ægeriids and Anthrocerids in close proximity to the Sphingids in spite of their amazing difference. Even Hübner included (*Verz.*, pp. 115 *et seq.*) the Anthrocerids and Ægeriids in his Horde ii, Sphinges, but it is here (see, *anteà*, pp. 350 *et seq.*) that we have the first clue to a proper appreciation of the natural subdivisions of the Sphingids (*sens strict.*), considered in their world-wide variety of form and structure. It is true that Hübner's characters are superficial, but not more so than those of all authors of his time, and he stands, in spite of all weaknesses in his work, the first exponent of modern ideas, of the collection of small groups of closely-allied species into distinct genera, as apart from huge groups—often of superfamily value—that served his predecessors, and still serve many of his successors, for genera. The work of our British lepidopterists has been, so far as this superfamily is concerned, exceedingly weak. Stephens not only maintained an alliance between the Sphingids, Sesiids (Macroglossids), Ægeriids (Sesiids), and Anthrocerids (Zygænids), which he united under the name of *Crepuscularia*, but his knowledge of the groups is well exhibited by the weakness of his generic tabulation, which reads:

Alæ	plus minusve angulatæ			SMERINTHUS.
	integræ, acutæ. Maxillæ	breves		ACHERONTIA.
		elongatæ; antennæ	haud clavatæ	SPHINX.
			clavatæ	DEILEPHILA.

These characters are certainly no better than those of Hübner, and do not attempt to deal with the group in the same detailed manner.

* This description will give a good idea whence came the terms "prismatic antennæ," etc., used by Stephens and others. They evidently originated with Réaumur.

The work of Curtis, Stainton and Newman, does not really touch the classification of the superfamily, and no real alteration in the early genera was made either at home or abroad until, in 1865, Grote and Robinson published their "Syn. Cat. of North American Sphingidæ" (*Proc. Ent. Soc. Phil.*, v., pp. 149 *et seq.*), and divided the *Sphingidae* into the tribes *Macroglossini*, *Choerocampini*, *Smerinthini* and *Sphingini*. In 1876, Butler brought out his *Monograph of the Sphingidae*. Here we find another attempt to raise the Sphingids practically to superfamily rank, and to subdivide them into important sections, based on larval and imaginal structure. The *Sphinx* of the older authors is divided into *Choerocampinae*, *Acherontiinae* and *Sphinginae*, the genus *Smerinthus* is subdivided into *Smerinthinae* and *Ambulicinae*, whilst *Macrŏglossum* is raised to *Macroglossinae*. His diagnoses, poor as they are, show a better appreciation of the material to be considered than do those of his predecessors, and read as follows:

MACROGLOSSINÆ.—Larva: with the anterior segments tapering towards the head, retractile; horn long and curved, head rather small. Imago: generally with externally angulated palpi; the antennæ often gradually thicker from the base to the apex; thorax large and prominent; abdomen of the male always with a more or less developed anal tuft of hair-scales.

CHŒROCAMPINÆ.—Larva: with the anterior segments retractile, the fifth somewhat abruptly broader; the fifth and sometimes all the segments laterally ocellated; horn variable; head rather larger. Imago: generally with externally rounded palpi, the antennæ generally rather slender; eyes salient; thorax large and prominent; abdomen without an anal tuft.

AMBULICINÆ.—Larva: with the anterior segments non-retractile, tapering slightly towards the head, which is abruptly rather large and rounded; horn oblique, not curved, but slightly pointing upwards at the tip; a series of lateral oblique stripes. Imago: with externally rounded palpi, the antennæ slender in both sexes; eyes salient; thorax rather short; abdomen of the male produced behind, with lateral angular expansion.

SMERINTHINÆ.—Larva: rugose, with the anterior segments tapering towards the head, which is abruptly and decidedly larger, flattened in front, and angular above; horn straight. Imago: with the head and thorax short and broad; palpi small; antennæ of male more or less pectinated.

ACHERONTIINÆ.—Larva: thick, clumsy, Sphinx-like, but with the horn always more or less recurved at the tip, and tuberculated or granulose. Imago: clumsy; legs, antennæ, and prŏboscis thick, the latter very short; head, thorax, and abdomen short and broad.

SPHINGINÆ.—Larva: with the anterior segments very slightly smaller than the posterior, generally marked with oblique lateral stripes; horn (when present) rather long; head tolerably large; position of the larva in repose almost sigmoidal. Pupa: frequently with an external sheath for the proboscis. Imago: Chœrocampine in form, but with the head generally smaller; the thorax variable in length; proboscis very long.

Herrich-Schäffer, however, in 1845, had published (*Schmett. von Europa*, vol. ii., p. 82) an account of the Sphingids, and had given a very satisfactory diagnosis of the superfamily, which reads as follows:

IMAGO: Quite large to fairly small, strongly built lepidoptera, with elongated forewings, with the outer margin slightly shorter than the inner margin; hindwings small. No ocelli, palpi three-jointed, heavily clothed with hair, lying close to the head, with inner surfaces hollowed out, in which lies the proboscis, externally convex, the second joint thicker than basal and the third extremely small, only slightly discernible above the hair of the second joint, frequently almost entirely enveloped in hair; the antennæ somewhat more slender near the base and at the tip, the thickening terminating in an angle which, viewed beneath, has a central longitudinal ridge; in the male this bears two rows of bristles on each of the surfaces forming the middle ridge, the one at the front margin, the other at the hind margin, which two rows unite together towards the outer margin; in the ♀ instead of this is only a short raised semi-oval curve. Forewings with 11 or 12 nervures, 1 free, 2—7 at equal distances out of cell, 8 out of 7, 9 divided near apex of wing when 12 nervures are present; in the latter case, therefore, 10 is from 9, 11 from top of cell, 12 free; if nervure 9 be not forked 10 arises from front edge of cell and 11 is free; hindwings with 9 nervures, 1 free, the following all with tolerably equal interspaces, 4 from apex of cell, 5 as a continuation of one of the weak dividing nervures of cell (the fold ?) or even further on towards the costa, 6 and 7 on a short footstalk, 8 from base sending back an oblique nervure to middle of front margin of cell.

He, however, did not get beyond genera in his subdivisions, his table of the latter working out as follows:

I. Antennæ with the apex pencillated, hooked.	
1. Abdomen with sides and anal segment barbed ..	MACROGLOSSA.
2. Abdomen with sides and anal segment not barbed.	
a. Abdomen with anal segment acute	SPHINX.
b. Abdomen with anal segment obtuse	ACHERONTIA.
II. Antennæ neither pencillated nor hooked	SMERINTHUS.

This division, as far as it goes, is a natural one, but is neither better nor worse than that of Stephens, both being meagre in the extreme, and not dealing with the superfamily from a sufficiently broad standpoint.

For comparison with Herrich-Schäffer's diagnosis of the superfamily we append Meyrick's (*Handbook*, &c., p. 292) which reads:

IMAGO: Head with dense appressed hairs. Ocelli absent. Eyes glabrous. Antennæ thickened towards middle or posteriorly, in ♂ ciliated with partial whorls. Labial palpi moderate, ascending, with dense projecting scales. Thorax densely hairy beneath. Femora densely hairy. NEURATION: Forewings—1*b* furcate, 6 out of 8, 9 absent (rarely present in exceptional individuals). Hindwings—3 and 4 approximated at base, 5 from middle of transverse vein, parallel to 4, 6 and 7 connate or stalked, 8 connected by oblique bar with margin of cell before middle, more or less approximated to 7 near beyond cell. OVUM: Spheroidal, smooth. LARVA*: Stout, usually with an oblique projecting anal horn, anterior segments sometimes retractile or raised in repose. PUPA*: Subterranean.

Grote, in 1886, published his work, the *Hawk Moths of America*. In this he largely maintained the subfamilies of Butler, but attempted, in addition, to show the origin of the superfamily, and the interrelation of the subfamilies. He made the *Smerinthinae* the central and generalised group, and from the Smerinthoid type, he considered the *Choerocampinae* and *Macroglossinae* had deviated in the direction of a specialisation of the imago by a narrowing of the wings, a strengthening of the costa of the forewings, a reduction of the hindwings, and an increase in the relative size of the prothorax and mesothorax. In the lower genera of the *Choerocampinae*, represented by *Ambulyx*, he considered the wing-proportion of the *Smerinthinae* to be carried over, no less than the soft brown colour, and, in the case of *A. sexoculatus*, Grote, from Brazil, the ocellated hind-wings. He further suggested that while these three groups stand in a nearer ascending relation, the typical *Sphinginae* had probably a different line of development, standing nearer to the *Acherontiinae*, the latter group being now somewhat independent. This was the beginning of a considerable amount of excellent detailed work by Poulton, Packard, Chapman, Bacot, Dyar and others, which is far too comprehensive to enter into at length here; a summary of some of it is, however, necessary, and, as a preliminary, we have to note the main Sphingid

* These characters certainly take rank with those of the authors of a century and a half ago.

characters, showing in what direction, in the various stages, affinities may be expected to be found. These may be noted as :

OVUM.—Of the flat type, oval in outline, plump, green in colour, shell transparent, surface smooth.

LARVA.—Tubercles i, ii, iii and iv with simple setæ, v atrophied, a supernumerary prespiracular, base of tubercles i on 8th abdominal developed into caudal horn, and carrying tubercles i in 1st stadium (after 1st moult, i generally obsolete).

PUPA.—Of two forms: (1) Amorphid—rough, with short maxillæ; wider antennæ. (2) Sphingid—smooth, with long maxillæ; narrowed antennæ.

IMAGO.—Frenulum; two anal nervures to hindwing; otherwise of two forms: (1) Amorphid—short tongue, broad wings. (2) Sphingid—with long tongue, narrow, sharp-pointed wings.

We should, therefore, expect in the primitive Sphingid, at least the following characters :

OVUM.—Flat type, shell transparent.

LARVA.—First stage (and possibly later), with i, ii, iii, iv and v generalised in structure and position; tendency to consolidation and enlargement of bases of i on abdominal segment 8.

PUPA. — With distinct, and probably fairly strong, projecting points on movable segments.

IMAGO.—With distinct proboscis; thickly scaled; frenulum; two anal nervures to hindwing.

Grote, at first, fell into the error that has proved a stumbling-block to most of his successors in attempting to derive one group from another existent group. The lowest members that we now have of any stirps, are as many generations from the common ancestor as the highest, and, therefore, though they may not have specialised in the same way as the highest, in so many, and what we regard as so important, characters as they have, yet have had as much time to specialise, and very possibly have specialised in some characters quite as much as they. This gives us the result that often puzzles us, that, what we cannot help thinking the lower form, is, from some points of view, much the higher. Specialisation is understood to mean elaboration of organs and functions, and higher and lower forms can only be such, in proportion to the greater or less elaboration of what we consider (often rather arbitrarily) the higher organs and functions. The practical result of this is that every case must be judged on its own merits, and the common ancestor of a superfamily, family, subfamily, tribe or genus, must be built up as possessing all the generalised characters found anywhere in the group, and none of the specialised ones, *i.e.*, specialised as compared with other members of the group. Having obtained this as well as we can, we must work forwards to the present representatives of the group. The result almost invariably is that no present forms can be derived from any other present forms, and that nothing very definite exists between any present form and its most remote ancestors, *e.g.*, one may build up a common ancestor to *pinastri* and *ligustri*, but neither is that common ancestor, nor is any other existent species. If *atropos* be added to the group, the ancestor is varied, but is equally nonexistent, and so on. This will make quite clear our disagreement with most of the conclusions of Poulton, Packard and others on this subject, for it must be quite clear that neither *Aglia* nor *Dimorpha*, nor any other already suggested existent form, can be a direct ancestor of the Sphingids, for neither of these has a larva which, in the first stage, has i, ii, iii, iv, so generalised in structure and position as have the Sphingids. Neither has the imago of *Aglia* a frenulum, nor tongue, nor two anal nervures to the hindwings, all of which characters must have been present in the ancestral Sphingid. The Sphingid branch, therefore, left the main Sphingo-Micropterygid stirps quite separately from either that of the Dimorphids or Attacids and not through them. We have already presented this view of the subject (*anteà*, vol. i., pp. 124—126).

Poulton published (*Trans. Ent. Soc. London*, 1888, pp. 555 *et seq.*) in detail the ontogeny of *Aglia tau* and discussed its affinities. He also considered the structure of various Sphingid larvæ and finally concluded that "the Sphingids are a specialisation of the group of Saturnian-Bombyces, and that the following order represents the nearest affinity and is an approach towards the expression of genetic relationship: *Sphinx*, *Acherontia*, *Smerinthus*, *Ceratomia*, *Lophostethus*, *Aglia*, *Ceratocampa* (*Attacus*), *Saturnia*." He then adds "The other genera of *Sphingidae* will precede *Sphinx* as in the usual arrangement . . . . . *Endromis* and *Bombyx mori* will also be included in some of the gaps in the above mentioned list, but their exact position is uncertain . . . . . The imaginal condition of the *Sphingidae* which comes nearest to *Aglia*, &c., is strongly in favour of the above arrangement. They alone do not feed in the perfect state, and do not fly in the characteristic manner of other hawk-moths; in the strict sense of the word they are not hawk-moths. Their mode of flight and especially their rudimentary and unused mouth-parts, are further points of affinity to the Saturnians."

We need not say that we disagree almost wholly with these conclusions. If anything is clear in the phylogeny of the Sphingids, it is that no one of the genera mentioned above has been derived through any other one. It is equally certain that neither *Dimorpha* (*Endromis*) nor *Bombyx* (*mori*) could fill up any conceivable gap in the series mentioned, both forms being, in one or more aspects, more generalised than any one of those mentioned. It is also certain that the Amorphid branch* has evolved within the Sphingid stirps from a tongued ancestor, and that its tongueless condition is quite independent of the parallel condition found in the Attacids. Their slower mode of flight is possibly even a specialised (and not ancestral) trait, and consequent on the loss of the frenulum. Our treatment of the various subfamilies will possibly afford further critical differences from the conclusions arrived at by Poulton.

His detailed facts, however, must be referred to by every student. We can only mention a few points. His summary of the resemblances† between the larva of *Aglia tau* and those of the Sphingids, in general, is as follows:

(1) *Caudal horn:* Changes of size during growth; 2 terminal bristles; bifurcation; longest and movable in early stages; colour, and white zone; thorn-like

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* This, we suspect, is the branch that Poulton intends by "The imaginal condition of the *Sphingidae* which comes nearest to *Aglia*."

† Many of these characters, *e.g.*, attitude, shagreen hairs, oblique stripes, are spread over groups as separate as Lachneids, Dimorphids, Bombycids *(Bombyx mori)*, and Attacids, whilst shagreen hairs occur in some butterfly larvæ, and oblique stripes and a caudal horn in the Notodontids, where they cannot indicate alliance (Bacot).

processes. (2) *Oblique stripes:* As in *Sesia* (*Hemaris*). (3) *Subspiracular stripe:* As in *Sesia* (*Hemaris*), *Macroglossa*, &c. (4) *White thoracic lines:* As in *Sphinx ligustri.* (5) *The appearance and arrangement of the chief tubercles.* (6) *Shape of head:* As in young *Sphinx* and *Smerinthus* and adults of many other genera. (7) *Sphinx-like attitude:* Also the fact that it is chiefly marked in young larvæ. (8) *Position on leaves and twigs of foodplant*, at different times in larval life. (9) *Shagreen dots:* With bristles, and the times at which they appear and persist (*Smerinthus*, *Sphinx*). (10) *Individual differences in shade of ground colour:* As in *Smerinthus.* (11) *Distribution of shades of ground colour:* As in *Smerinthus*, *Manduca* (*Acherontia*), *Sphinx.* (12) *Probable slight susceptibility of larval tints to surrounding colours:* As in *Smerinthus*, *Sphinx.* (13) *The colours of the spiracles in the last stage:* As in *Sphinx.* (14) *Change of colour before pupation:* As in *Smerinthus.* (15) *The shape and texture of the pupa:* As in *Amorpha populi.*

Poulton adds that nearly all these points of resemblance* are very striking, and appear to prove that the larva has the closest affinity to the Sphingids and especially to the genus *Smerinthus.* He then details the peculiarities and apparent differences as follows:

(1) *Ova:* Very different in colour. (2) *Expansion of spines:* Immediately after hatching. (3) *The presence of four thoracic spines and the anal spine.* (4) *Absence* (?) *of subdorsal line.* (5) *The length of the first stage.* (6) *The ridges on abdominal segments.* (7) *The terrifying mark:* Position and concealment during rest, but origin much as in *Eumorpha* (*Choerocampa*). (8) *Loss of caudal horn in last stage*, but certain Sphingid larvæ also lose the horn. (9) Only four stages in the ontogeny.

Discussing these differences and peculiarities, Poulton says that 1, 2, 6 and 7 are entirely adaptations to the peculiar conditions of the larva and cannot be considered to prove any great divergence in affinity, any more than the various adaptations which form such sharp characteristics within the group of the Sphingids themselves, such as the terrifying marks of *Eumorpha* (*Choerocampa*), etc. It is impossible at present to decide whether 5 and 9 are adaptive. The subdorsal line (4) may be represented in part, and points 3 and 8, in reality indicate affinity as much as divergence; thus, the caudal horn degenerates in size and shape in the latter stages of many *Sphinx* larvæ. He says that it nearly disappears in the last stage of *Theretra* (*Choerocampa*) *porcellus*; it is absent from all except the earliest stages (if indeed it is present in these latter) of *Thaumas* (*Deilephila*) *vespertilio* and *Pterogon oenotherae* (Weismann, *Studies in the Theory of Descent*, pp. 209 and 259). The ontogeny of *Aglia* is more exaggerated than that of any Sphingid larva; it commences with a more specialised caudal horn than that which any *Sphinx* possesses, and associated with a specialised remnant of the spinous covering of allied *Bombyx* larvæ; and suddenly, at the last ecdysis, all these prominent features are lost as completely as is the horn† in the later stages of certain Sphingid larvæ.

There is no need to follow Poulton in detail through all the interesting facts by means of which he attempts (*loc. cit.*, pp. 568 *et seq.*) to show the affinities or "natural position" of the Sphingids. He points out the well-known facts, without, however, showing the well-known evolutionary principle involved, that within the Attacid stirps,

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* Similar habits necessitate similar needs, whilst a common ancestry often leads to the needs being met in a somewhat similar manner (Tutt).

† The horn is not lost so suddenly in any Sphingid larva as it is, for example, in *Aglia tau.* In *Theretra porcellus* it is never really a horn as generally understood mong the Sphingids.

specialisation proceeds in the larva (1) by the atrophy of tubercle ii and the development of i on abdominal segments, (2) by the development of i, iii, iv + v into a series of projecting spine-bearing processes on either side of each segment from the mesothorax to the 7th abdominal, (3) by the special development of i (and ? ii) on the meso- and metathorax as a pair of highly-developed spine-bearing processes, (4) by the union of bases of i on abdominal segment 8 into a caudal horn. He instances the various stages indicated by means of: (1) *Platysamia cecropia* and *Callosamia promethea*, which show the usual ringed series on each segment commencing from the mesothorax, characteristic of the Attacids *(sens. strict.)*, and with no defined caudal horn on the 8th abdominal. (2) *Eacles imperialis* and *E. penelope*, in which i on the meso- and metathorax are small and inconspicuous. (3) *Citheronia wardii*, *C. principalis*, *C.* var. *argyracantha*, which have i on meso- and metathorax, and the caudal horn rather better developed than the others. (4) *Rhescynthis erythinae*, *Citheronia phoronea*, *C. ixion*, *C. regalis*, with large spined i on meso- and metathorax, well-developed caudal horn on 8th abdominal, and, in *R. erythinae*, a smaller on the 9th abdominal, whilst his description of *Ceratomia* taken alone would show it to be almost certainly Attacid, but Dyar writes (*Ent. Rec.*, xii., p. 21) that these horns are perfectly secondary and merely a special adaptation, the ordinary oblique lines being replaced by rows of teeth, and the "horns" only another manifestation of the peculiar conversion of markings into structural characters (see also, *postea*, p. 364). Poulton also notes that the horns, &c., of these specialised Citheroniid larvæ, are dropped at the last moult, the larvæ becoming entirely smooth, with atrophied tubercles, and with a coloration exactly suited to their environment. [For figures of the larvæ noted by Poulton, see Burmeister's *Atlas of the Lepidoptera of the Argentine Republic*, pl. xix *et seq.*]

Bearing on this last point is the fact that the essential facies of the adult Sphingid larva is similar to that just noted as being characteristic of certain adult Attacids. In the early stages of the Sphingid larva, however, we find an amazing difference from the Attacid, and the mode of evolution of a similar facies is entirely different. The newly-hatched Sphingid larva has, in its most generalised form, an almost primitive first stage, i and ii trapezoidal, iii supraspiracular, iv subspiracular, each simple and bearing one seta. Three specialisations (?) occur—(1) the atrophy of v; (2) the development of a special prespiracular (common in some Lachneids); (3) the presence of a more or less developed caudal horn on abdominal segment 8. Gradually, and never suddenly as in certain Attacids, the larva loses its simple primitive tubercles and becomes a smooth larva with only the caudal horn developed. Then the Sphingid larva bears a close superficial resemblance to the adult Citheroniid and Agliid larvæ, and Poulton makes the former a direct evolutionary branch of the latter and attempts to support his view with the African, spined, so-called Smerinthine, larva, *Lophostethus*, which, apparently from the description, is not Sphingid at all, and certainly not Smerinthine. The Sphingid larva is very specialised in colour and markings, but in a very simple, clear, and definite direction. The Attacid (*sens. lat.*) larva is even more specialised on distinctly different and independent lines and in a much more complicated manner. The two modes of development produce, in the adult larvæ of *Aglia* and *Sphinx*, a somewhat superficially similar adult animal. The only existent larva that we know that even very distantly approaches (but certainly does not satisfy) the possible ancestral Sphingid form is that of *Bombyx mori*, where we have i, ii, iii, iv and v in generalised position, occurring side by side with a wart-like condition of i and iii in the early stadia, a highly developed condition of i on 8th abdominal, and swollen thoracic segments. The Sphingid egg, larva and pupa, all show characters that prove that Sphingids were never developed either through Lachneids, Dimorphids, Attacids or Bombycids, *per se*, but, retaining some of the characters of each, their ontogeny abundantly proves that they have had a common origin with these. The impossibility of direct derivation from either of these groups is still further intensified by the imaginal structures—antennæ, maxillæ, and frenulum. The special form of the Sphingid antenna closes the superfamily absolutely, and, unless one is willing to admit a series of discontinuous variations and redevelopment of lost organs as exemplified by the frenulum and maxillæ, this direct derivation is obviously impossible. Poulton's position of attempting to prove that *Sphinx* has been evolved from *Aglia* through *Ceratomia* and *Smerinthus*, appears altogether untenable. Here we get an attempt to derive the most specialised Sphingids from the most specialised Attacids, whilst the generalised Sphingids (Eumorphids, etc.) and generalised Attacids (Hemileucids), where structure, if not adult appearance, would be expected to approach somewhat, are not brought into consideration. Bacot's paper on the subject (*Ent. Record.*, vii., pp. 227—230, 246—248) should be referred to as there are many interesting facts therein. Among others he notes the following resemblances between *Dimorpha versicolora* and the *Sphingides* as:

LARVA.—*First skin.*—(1) Caudal horn only faintly suggests that of the *Sphingides*. It more nearly represents that of *Eutricha quercifolia*. *Second skin.*—(2) Change in shape of head: *Smerinthus* (*ocellata*). (3) Dark medio-dorsal line: *Mimas tiliae* (in second skin). (4) Oblique stripes: as in *Sesia* (*Hemaris*) (mentioned by Poulton). (5) Strength of the 7th oblique as compared with the others: *Smerinthus*. In further support I would point out that the oblique stripes are caused (in *D. versicolora*) chiefly by the absence of the shagreen tubercles on the stripes, and though in *Smerinthus* the reverse is the case with the stripes, the borders, at a certain stage, are caused in the same way (*i.e.*, by the absence of the shagreen dots). (6) The fact that the lateral lines are coloured, while the oblique are due at first chiefly to structural arrangements: *Smerinthus*. (7) Small, thickly scattered, shagreen tubercles, each bearing one slightly bifid hair: *Smerinthus* and *Sphinx*. *Third skin.*—(8) Anal flap outlined with yellow: *Smerinthus*. (9) Darker bordering to oblique stripes: *Smerinthus* (? stage). (10) Ventral and anal prolegs developed much after the manner of *Smerinthus* (mentioned by Buckler). *Last stage.*—(11) Retractile head when fullfed: *Eumorpha elpenor* (mentioned by Buckler). (12) Change of colour before pupation: *Sphinx ligustri* and *Mimas tiliae* (mentioned by Buckler). (13) Only four stages in ontogeny (three moults) (mentioned by Buckler): *Amorpha populi*.

PUPA.—(14) Shape and general aspect approaches *M. tiliae*. (15) Cremaster (in some characters): *M. tiliae*. (16) Movement in cocoon; the pupa forces its way partly out: *Eumorpha elpenor* (Tutt and Buckler). (17) Spines on free and following segments: *E. elpenor*.

IMAGO.—(18) Shape of wings (roughly only): *Smerinthus*. (19) Scheme of coloration (roughly only): *Smerinthus*. (20) Discoidal lunule on forewings (? too general to be of much use).

The peculiarities and apparent differences may be tabulated as follows:

LARVA.—(1) Colour of 1st stage. (2) Tubercles bearing more than one hair (1st stage). (3) Habits (as a whole). (4) Colour of shagreen tubercles (2nd stage). (5) Shape of head (2nd stage). (6) Additional stripe on horn or hump of the 8th abdominal (best seen in last stage). (7) Double row of black spots (dorsal) 2nd stage.

PUPA.—(8) Bristles on anal armature: as in *Saturnia pavonia*.

Dyar concludes (*Ann. New York Acad. Sci.*, viii., p. 232) that the affinities of the larvæ suggest a relationship between Sphingids, Notodontids and Lachneids, an impossible combination, but his description of the larva here is so faulty that further criticism is needless. Later he gives (*Trans. New York Acad. Sci.*, xiv., p. 59) the following accurate diagnosis of the Sphingid larva:

The tubercles all remote, v moved up* in front of the spiracle, all the setæ disappearing or becoming obscured at the first moult; tubercles i on the 8th abdominal segment borne on the apex of a long process (caudal horn), but they are entirely unconsolidated.

He then says: "The consideration of the first larval stage shows plainly that the Sphingids are not related to the Attacids, but rank as a separate division." He further notes that Poulton's supposition that the thoracic horns of *Ceratomia amyntor* might be homologous with those of the *Citheroniidae*, can be shown to be unfounded, for, in the first larval stage of this Sphingid, these processes arise anteriorly to the setæ and entirely independently of them, whereas in the *Citheroniidae* the horns are developed out of the corresponding tubercles. Dyar's suggestion of a relationship with the Notodontids is contradicted on all other characters than those he notes—egg, pupa, imago, and even, in their broader aspects, by those of the larvæ.

Meyrick's note on the phylogeny of the group (*Handbook*, etc., p. 293) is characteristically airy. He writes: "The phylogeny is sufficiently simple; the group of *Smerinthus* and *Dilina* is of primitive character, and some exotic members of it closely approach the *Notodontidae*; the other genera constitute a more largely developed line of descent originating in the group." We wish we could accept this simple statement. The Sphingids (*sens. lat.*) are proved by the egg, larval, pupal and imaginal stages to have no structural relationship whatever with the Notodontids, and, certainly in the larval and some imaginal structures, the Amorphids (*Smerinthus* and *Dilina* of Meyrick) are probably more specialised than any other Sphingids. The evolution within the group is not simple. It is quite clear, as we have already pointed out, that the primitive Sphingid had, among others, the following characters:

OVUM: Oval, transparent shell. LARVA: Primitive tubercles from mesothorax to 7th abdominal; hump bearing i on 8th. PUPA: Rough skin, with well-developed dorsal points or spines. IMAGO: Well-developed (not necessarily long, but functional) tongue, frenulum, two anal nervures to hindwings.

As a matter of fact one finds within the group: (1) A very general and characteristic form of egg with scarcely any modification. (2) Larvæ represented by the Eumorphids

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* We doubt this; we believe v to be atrophied and the prespiracular here called v to be quite distinct from v.

(porcellus, elpenor, etc.) carrying many generalised characters; other larvæ represented by Sphingids *(ligustri),* Manducids *(atropos),* and Amorphids *(ocellata,* etc.), with fewer generalised and some distinctly specialised characters. (3) A more generalised form of pupa in Amorphids; a more specialised (especially with regard to maxillæ) form in the other groups. (4) A highly specialised form of imago, by development of tongue and frenulum, in all the groups except the Amorphids; an equally highly specialised imago in the Amorphids by the loss of maxillæ and frenulum. Based on different stages—larval, pupal and imaginal—different groupings would result owing to unequal specialisation in these stages, and one can only formulate a general conclusion by the consideration of all the structures. On this ground one is forced to the conclusion that within the group the lines of differentiation have been based: (1) On one line and one only in the larva, *viz.,* the development of that Sphingid larval form that will respond most perfectly to its environment, and in this particular the Amorphids and Sphingids *(sens. strict.)* come very close together. (2) On two distinctly divergent lines in the pupa and imago, *viz.,* the development (a) in excess, (b) in defect, of the tongue and frenulum, both characters dependent upon whether a swift-flying, nectar-feeding imago or a heavy-flying, non-feeding imago was being evolved. The former (development in excess) has left the greatest mark on the pupa and external appearance of the imago—Sphingids, Sesiids (Macroglossids), etc.—the latter has left less mark on the pupa and imago, and has possibly retained much more nearly the general characters and form of the other organs which have been less affected by the change. Hence one sees within the group two distinct lines of specialisation. (1) Towards the tongueless form (Amorphid). (2) Towards a highly-developed tongue and (its concomitant structure for rapid flight) long, narrow pointed wings (Sphingid). In the latter section we find different degrees of development in the larval structures, which appear to be rather more generalised in the Eumorphids, and more specialised in the Sesiids (Macroglossids), Sphingids *(sens. strict.),* Manducids and Amorphids. The comparatively short tongue of the Manducids has nothing in common with the special line of evolution of the Amorphids, but is proved distinctly by the pupa to be a special development of the Sphingid *(sens. strict.)* tongue by atrophy.

Based on larval characters Bacot obtains the following groupings:

I. 1st stage pale with greenish tinge; a longer or shorter caudal horn on the 8th abdominal, bearing tubercles i at summit; primary tubercles single-haired (except iii on meso- and metathoracic segments, where it bears two hairs); shagreen hairs strongly developed, usually on a cone-shaped base (in early or middle instars); iv atrophied on the meso- and metathorax; v atrophied on abdominals; a prespiracular tubercle (? ancestral) on abdominals; abdominal segments divided into ? 8 subsegments (best seen in stadia 2—4).

A. Dorsal tubercles on meso- and metathorax set in trapezoidal (or oblong) form (i and ii being on separate subsegments); an enlarged 1st subsegment (consisting of 3 or more of the normal subdivisions); the caudal horn less strongly developed than in B (? a good character); the hairs simple, hollow (not bifid).

1. With tumid 1st and 2nd abdominal segments bearing ocellated spots (when adult).

a. Fairly developed caudal horn . . . . . . HIPPOTION *(celerio).*

b. Small caudal horn .. .. EUMORPHA (*elpenor*).

c. Caudal horn all but absent in all stages .. THERETRA (*porcellus*).

2. Without tumid 1st and 2nd abdominal segments, and with tendency to produce ocellated spots on many segments.

a. With single row of ocellated spots .. .. PHRYXUS (*livornica*).

b. With double row of ocellated spots .. .. CELERIO (*galii*, *euphorbiae*).

B Tubercles i and ii on meso- and metathorax conjoined, or in close proximity on same subsegment; no enlarged 1st subsegment; the caudal horn long and markedly developed in 1st stage, and forked to a greater extent than in A (? good character).

1. With forked hairs but not tumid thoracic segments—

a. With primitive 1st stage (*i.e.*, without secondary hairs in 1st stadium).

i. With forked hairs slightly developed in 1st stadium .. .. SESIA (*stellatarum*).

ii. With forked hairs very strongly developed.

α. Hairs pale green .. .. HEMARIS (*fuciformis*).

β. Hairs black .. .. HEMARIS (*tityus*).

b. Primitive 1st stage lost, *i.e.*, a coat of secondary hairs developed in 1st stadium; head triangular in outline.

i. Head rounded in 1st stadium; 7th oblique stripe strongly developed .. MIMAS (*tiliae*).

ii. Head variable in 1st stadium; 7th oblique strongly developed.. .. SMERINTHUS (*ocellata*).

iii. Head triangular in 1st stadium; 1st and 7th oblique stripes strongly developed .. .. AMORPHA (*populi*).

2. Larvæ with slightly tumid and translucent-looking thoracic segments in later stadia; forked hairs ill-developed if present.

a. With stiff, pointed, curved caudal horn.

i. Markedly forked in 1st stadium .. HYLOICUS (*pinastri*).

ii. Not markedly forked in 1st stadium SPHINX (*ligustri*).

iii. AGRIUS (*convolvuli*).

b. With peculiar downward curved rough horn.

i. MANDUCA (*atropos*).

Based on certain pupal characters, *e.g.*, the keeling of the proboscis, the position of the glazed eye, the specialisation of the lateral surfaces of abdominal segments 5, 6, 7 in front of spiracles, &c., Chapman obtains the two following main divisions:

1. Broadly similar to the Saturniids or Ceratocampids—the proboscis short, allowing wings to meet in the middle line and presenting no trace of keeling or projections; convexity of glazed eye towards middle line ventrally, labrum ventral; a dorsal suture or mesothorax; no first femur visible—AMORPHIDÆ (*Amorphinae*, *Ambulicinae*).

2. Proboscis to extremities of wings, separating them in middle line, always with some fulness in region of labial palpi, least in *Manduca* (*Acherontia*), strongly keeled, or with a definite projecting horn; glazed eye with convexity directed forwards; labrum at anterior extremity of pupa or even dorsal; no dorsal suture; first femur exposed—SPHINGIDÆ (*Sesiinae*, *Eumorphinae*, *Sphinginae*, *Manducinae*).

Based on the whole of the structural characters obtainable in all the stages, Chapman suggests the following more detailed subdivision:

I. IMAGO with poorly developed proboscis; resting with spread wings, so as not only to require no frenulum, but to have lost the "holding area." PUPA of ordinary Citheroniid or Lachneid type, *i.e.*, unspecialised.—LARVA with secondary bifid hairs in earliest stage. .. AMORPHIDÆ.
  1. IMAGO: Proboscis nearly obsolete. PUPA: Without any special tubercles .. .. .. AMORPHINÆ.
  2. IMAGO: Proboscis functional. PUPA: Often with facial spines; callosity on metathorax .. AMBULICINÆ.

II. IMAGO with developed proboscis, resting attitude suggests that there ought to be a "holding area," but it continues wanting (*ergo*, derivation from a form that has lost "holding area"). PUPA specialised by thrusting back of head, apparently from immense development of maxilla cases (haustellum). LARVA indicates in various ways that secondary bifid hairs are lost (*e.g.*, in *Sphinx* exist on horn, but not elsewhere) SPHINGIDÆ.
  1. IMAGO: Long proboscis. LARVA: Small head, retractile front segments. PUPA: Maxilla-case more or less prominent and keeled, rarely horned.
    a. Abdomen tufted.. .. .. SESIINÆ.
    b. Abdomen hardly tufted .. .. .. EUMORPHINÆ.
  2. IMAGO: Proboscis still stronger, but become rather short. PUPA: Maxilla-cases Eumorphine, much longer than imaginal proboscis. LARVA: Thoracic segments well differentiated, but hardly retractile; horn distinctive, head large .. .. MANDUCINÆ.
  3. IMAGO: Proboscis extremely long, abdomen pointed. PUPA: Maxilla-cases usually produced into a horn or trunk, by folding of maxilla at base. LARVA: Head large, thoracic segments usually differentiated but not retractile .. .. .. SPHINGINÆ.

These schemes may be considered as merely tentative, but at any rate they bring into line the more marked structural characters that have been studied from a phylogenetic standpoint.

The Sphingid ovum is very characteristic, green in colour (usually laid on leaves or fresh stems), shell transparent, very smooth, and with the micropylar area difficult to detect. The eggs of some species of Sphingids are terribly parasitised, *e.g.*, Dimmock notes (*Psyche*, 1885, p. 282) that more than 30 minute hymenopterous parasites have been bred from a single egg of *Smerinthus excaecatus*.

The Sphingid larva is highly specialised, but rather to its mode of life than structurally. One feels pretty certain that its tubercular arrangement is simpler than that of the Attacids, and that its caudal horn, a specialised projection bearing tubercles i on the 8th abdominal segment is really, within the superfamily itself, a generalised structure, its absence here denoting specialisation. The tubercles i, ii, iii and iv are, on the abdominal segments, simple, generalised and single-haired in the 1st skin, save for the fact that the hairs are frequently either bifid (Sesiids) or chalice-like (Amorphids), whilst the so-called v, which is prespiracular, we consider to be homologous with the prespiracular wart of the Lachneids, v of the Lachneids being obsolete. These tubercles may be retained after the 1st moult (and sometimes the subsequent ones), but they dwindle, and the secondary shagreen hairs obscure them so that they cannot be at all readily detected. On the mesothorax and metathorax in stage 1, i and ii form two separate setæ on either side of median line in the Eumorphids *(elpenor, porcellus, gallii)*, whilst they (i and ii) arise from a single plate or raised area in the Sphingids *(ligustri)*, Sesiids *(stellatarum)*, and Amorphids *(ocellata)**. The caudal horn, however, remains conspicuous, although its bifid tip and tubercles are usually atrophied. Peck notes (*Can. Ent.*, viii., p. 239) that *Smerinthus astylus* has its caudal horn armed with two spines appearing bifurcate at first glance, the spines being present from its hatching. The Sphingid caudal horn is characteristic of the superfamily (although many Attacid and other larvæ have a very similar one), and when absent, as in adult larvæ of *Eumorpha*, *Theretra*, etc., it is replaced by a small, low, flattened elevation, and the segment is often swollen (*anteà*, vol. i., p. 50). The Sphingid larvæ that feed on low-growing plants are variable in colour, often dark, and are frequently ornamented with striking spots which are supposed to have a defensive purpose, and have been described as terrifying marks (*loc. cit.*, pp. 91—92). Those that live on trees and shrubs are usually green in tint (*nerii* may be excepted), and their colour has been the subject of considerable investigation (*anteà*, vol. i., pp. 43—44 and pp. 85—86). The remarkable attitude of *Sphinx ligustri*, from which the name of the superfamily was derived, has no doubt a protective value, and its probable mode of origin has already been discussed (*loc. cit.*, pp. 51—52). But apart from the position taken up by the larva, the whole *ensemble* of the Sphingid larval position is sometimes strikingly protective, *e.g.*, *Smerinthus ocellata*, *Elpenor* (*Deilephila*) *hippophaes* (*loc. cit.*, p. 80), etc.

Sharp writes (*Insects*, ii., p. 381): "The larvæ are remarkable for their colours and form. The anterior segments are attenuated but are capable of great retraction, so that, in repose, this shape is concealed by the curious attitudes that are assumed. There is, in nearly all cases, a conspicuous horn on the 11th segment, and the body at the extremity, behind the horn, is so much modified that the two terminal segments look like little more than a pair of large claspers. In the *Choerocampini* (Eumorphids), the thoracic segments are retractile, and can be withdrawn into the more or less inflated 4th segment and give the creature somewhat the appearance of a miniature hooded snake. The larvæ of *Sphingidae* do not bear any conspicuous hairs—except during the first instar." Weismann has discussed (*Studies in the Theory of Descent*), at length, various views on the origin of the lines, bands and spots found on the Sphingid larvæ, and his conclusions have been generally accepted. He suggests that the primitive markings of larvæ were lines and longitudinal bands, the spots appearing from interruptions of the lines or bands, and he concludes from his studies of the Sphingids that the subdorsal lines originated before the spiracular, although it is possible that the dorsal is older than either (*anteà*, vol. i., p. 44). As a matter of fact, generalisations of this kind must always be accepted with caution; no doubt ocellated spots and other markings have originated in a variety of ways under stress of very different and varied conditions. Piepers considers (*Tijdschr. v. Ent.*,

*The dorsals, i and ii, on the metathorax and mesothorax of *Sphinx (ligustri)*, *Sesia* (*stellatarum*), and *Amorpha* (*populi*), are close together; in *Sphinx* on a single plate, in *Sesia* (*Macroglossum*) on a little elevation, in *Amorpha* close together but obscured by secondary hairs, apparently, however, on a raised skin area, if not on a plate as in *Sphinx* (Bacot).

xl., pp. 27—103) from a study of the Javan Sphingid larvæ that much of what has been written as to the protective value of their colours and attitudes is fanciful and not warranted by facts. Kirby and Spence state that "the larva of *Manduca (Acherontia) atropos* if disturbed, draws back rapidly, making at the same time a rather loud noise which has been compared with the crack of an electric spark." Reed describes (*Can. Ent.*, i., p. 40) a Canadian Amorphine larva which had the "power of emitting a singing noise when handled or disturbed, the noise being similar to that produced by the common little beetle, *Lema trilineata*." Sanborn states (*loc. cit.*, p. 48) that the larva of *Cressonia juglandis*, which is found on *Carya alba* and *C. porvina*, gives utterance to a note resembling the sound *tcêp* or *tceep*, produced by the inspiration of a small quantity of air between the upper teeth of the human mouth and the lower lip, as in the act of sucking, and makes the same sound, if held, a little behind the middle, whilst it turns the body sharply from side to side. Sprague asserts (*loc. cit.*) that a similar sound is produced by the larvæ of *Smerinthus excaecatus* and *S. geminatus* when irritated. Mead also confirms (*loc. cit.*, p. 47) Reed's observations. We believe that it has somewhere been shown that this noise is made by the jaws in the same way as a cracking sound is made by releasing a fingernail from under that of the thumb. Fernald observes (*Sphingidae New England*, p. 94) that the larvæ of some species are so numerous at times in America that the amount of damage done by them far exceeds anything that could be imagined.

Newport has shown that the larva of *Sphinx ligustri* increased from $\frac{1}{80}$ of a grain on hatching to nearly 125 grains (when fullfed 32 days after), an increase of 9976 times its original weight, and further asserted that growth is most rapid after the last moult, and that a larva of the same species increased from 20 grains to 120 grains during its last stadium extending over eight days.

Considerable detail relating to the moulting of the Sphingid larvæ has already been noted (*anteà*, vol. ii., pp. 5, 19, 27—30, 32) chiefly, however, relating to the larval pupal moult. Speaking of the exuviation of Sphingids, Réaumur notes (*Mém.*, ii., p. 255) that "the larvæ which have a caudal horn leave it with the cast skin, a new one being developed with the new skin." Watching a larva of *S. ligustri* changing its skin, he waited until the anterior part of the body and the prolegs had been withdrawn, and the old skin was pushed well back posteriorly, but the caudal horn was not yet clear. To see whether the new caudal horn was contained within the old one, he cut the latter as low down as possible, and when the moulting was complete he found that "the new horn had been mutilated and had lost half its length, showing that the new horn was contained in the old as in a case." Chapman observes (*anteà*, ii., p. 19) that, at the moult to pupa, before the larval skin is exuviated, the relative size of the segments has much changed, the prothorax being large, the first abdominal very small, whilst he observed that the margin of the mesothorax against the prothoracic spiracle was already brownish as well as the flanges on the 5th, 6th, and 7th abdominal segments. [Further details of the moult are given *loc. cit.*, p. 32.]

Sharp observes (*Insects*, ii., p. 381) that "the Sphingid larvæ do not spin cocoons, but bury themselves in the earth," a general statement by no means true of all the species. Many spin cocoons, the Eumorphids and Sesiids often with a fair amount of silk, and one suspects that this is the ancestral habit of the larvæ of this superfamily, and that the frequent absence of puparia in the Amorphids (*populi*), although *Mimas tiliae* often uses quite a quantity of silk, and the construction of earthen ones (Manducids and Sphingids) are really signs of specialisation.

We have already noted (*antea*, vol. ii., pp. 59—60) that the characteristic markings of the larva may be seen upon the pupa immediately after the skin of the former is thrown off, and that these appearances may be fixed by placing the pupa in spirit, and thus checking the darkening of the surface*, the persistence of such colours depending upon the fact that the cells of the hypodermis of the larva and pupa are the same, so that any pigment contained in them during larval life may remain unchanged after the pupal period has begun. Poulton figures (*Morph. Lep. Pupa*, p. 193, fig. 2) a pupa of *Sphinx ligustri* in which the characteristic larval markings are very plainly developed, and, in this, the purple borders of the stripes bear a relation to the segments similar to that borne during the larval stage, and this is especially well seen in the border of the last stripe. . . . . The relation of the coloured borders to the spiracles is just the same as that of the larva. Poulton adds that, "on removing a portion of the cuticle and examining its under surface, it may at once be seen that the colour of the border is due to the pigment in the adherent hypodermis cells, which can be detached with loss of the colour. It is thus certain that the constitution of the coloured stripes in the pupa is similar to that in the larva, while the dark surface of the former is entirely different, and due to a darkening of the cuticle." Similar facts are true with regard to the newly-formed pupa of *Acherontia (Manduca) atropos*, *Smerinthus (Amorpha) populi* and *S. ocellata* (*loc. cit.*, p. 194).

The Sphingid pupæ are large and robust, varying considerably, however, in the density and character of the integument and in the development of the various parts, so that it is not at all easy to give any character that defines a Sphingid pupa from that of other families, although one finds some characters that, when present, are very distinctive, *e.g.*, antennæ, proboscis, lateral flanges, &c. One observes the homologues of the anal claspers of the larva usually to be traceable as two convex cushion-like structures on either side of the anus, and, in some instances, these cushions retain the general appearance of the larval structures (Poulton, *Morph. Lep. Pupa*, pl. xx., figs. 8, 9, 10). The position of the larval prolegs is usually represented by functionless scars upon the pupal cuticle, and one can almost always trace in the Sphingid pupa a scar corresponding with the larval caudal horn. Even in those species—*Eumorpha elpenor*, *Theretra (Choerocampa) porcellus*, &c.—in which it is feebly developed at the close of larval life, this scar is distinctly traceable,

* Larvæ of Sphingids can be well preserved in a saturated solution of alum (Lovett).

and there is usually also a well-marked depression on the 8th abdominal immediately behind the scar. Poulton thinks that this must be due to the bending downwards of the horn, which becomes quite horizontal before the larval skin is thrown off, so that the posterior edge of its base and the continuous adjacent larval cuticle are depressed, and leave a permanent impress upon the yielding surface of the pupa. In *Mimas tiliae* the area of the scar is smooth, although the rest of the skin is rough and corrugated. Poulton figures some interesting instances of well-developed scars (*Morph. of Lep. Pupa*, pl. xx., figs. 2, 4, 9, 10, 13, 14), and further notes that the peculiar rough plate upon the dorsal surface of the anal flap of the larva of *M. tiliae* is represented by the extremely rough dorsal surface of the terminal spine of the pupa, and this is a valuable aid to the identification of these two structures (*loc. cit.*, p. 192). Sharp notes (*Insects*, ii., p. 381) that "the pupa is remarkable from the deep cleft that exists to admit air to the first spiracle, and for a deep depression on each side of the anterior part of abdominal segments 5—7." Considerable change takes place in the dimensions of the newly-formed Sphingid pupa, a great difference occurring in a few hours. This has been worked out in considerable detail for *Sphinx ligustri* (*Ent. Rec.*, x., pp. 185 *et seq.*), and it has been found that a pupa, measuring immediately on moulting 1·87ins. in length, made up of (1) ·63in. from anterior extremity to end of wings, and (2) 1·24in. to posterior extremity, had become respectively in two hours 1·1in. and ·78in., so that the change represented (1) ·63 : 1·1, and (2) 1·24 : ·78. The most strikingly characteristic feature in the Sphingid pupa, however, is the proboscis, and we have, within the superfamily, two markedly opposite lines of evolution from an ancestor with a functional tongue of moderate length : (1) In the direction of atrophy as seen in the Amorphids. (2) In an excessive lengthening, as seen in the Sesiids (Macroglossids) and Sphingids (*sens. strict.*). Chapman writes: "One may study the evolution of the pupa from this standpoint very usefully, and, so far as the excessive length of the proboscis in some species has to be accommodated in the pupa, the keeling in the Eumorphids is the initial stage of the prominent curved pupal tongue horn of the Sphinges, in which the proboscis, near its base, projects forwards, gradually forming a loop so that the imaginal proboscis passes down the front of the horn (short or long, curved, coiled or straight), bends under at its extremity and returns along the posterior aspect of the horn and then continues the ordinary course, between and to the extremity of the wings. In *Sesia* (*Macroglossum*) the fulness hardly amounts to a keel; in most Eumorphids there is a very definite keel, and in *Sphinx* there is almost always a horn. I have no material to enable me to say how far the transition is gradual or abrupt. In *Manduca*, we have a recession from a condition probably similar to *Eumorpha*; there is some basal fulness and the pupal proboscis extends to the end of the wings, but the imaginal proboscis falls short of the pupal in length. The change in the line of the glazed eye is very curious. It probably originates in the highly-developed proboscis, involving greater development of the front of the head, and so pushing it backwards, and so far as the eyes are concerned, involving a rotation backwards on a transverse axis. No such change occurs in *Plusia* where one might expect it, if the long proboscis were the sole cause. In *Plusia*, however, the extra space required in the pupa by the long proboscis is obtained not close to the head, but at and beyond the wing apices, whilst in Sphingids, apart from the keel, the central base of the proboscis extends very far forwards, which is much the same as the head being thrown backwards, and the labrum, usually on quite the ventral aspect of a pupa, becomes situated on the anterior apex of the pupa. There is one other characteristic of a Sphingid pupa to be noticed, that is the specialisation of the lateral surfaces of the 5th, 6th and 7th abdominal segments in front of the spiracles. If we examine a pupa of a Citheroniid, say *Citheronia regalis*, we find the anterior margin of the segments presents a raised line, equally developed in all aspects. The other segments are similarly constructed, but the fact is obscured by their not having these margins free as in the 5th, 6th and 7th. In an Amorphid pupa, as that of *Smerinthus ocellata*, this line is much less definite, but is very distinct as a special ridge just in front of the spiracle. In many Sphingids it is but little different from this. Even in *Manduca* there is a strong blunt ridge just in front of the spiracles that might easily be taken as the ridge in *S. ocellata*, a little more developed. It has here, however, a strong margin opposed to it on the adjacent segment, and is clearly the product of a fuller and longer development than in *Smerinthus*. If, as an example of the Citheroniids, we had chosen *Eacles imperialis*, we should have found no regular line, but, in the prespiracular region of these segments, we should have observed that the general sculpture of the segment, which is elsewhere pitting, had here arranged itself as several parallel transverse fine sharp ridges. A precisely similar sculpturing occurs in many Eumorphids, and, progressing by the gradual increase of one ridge at the expense of the others, culminates in one strong sharp ridge anterior and slightly dorsal to the spiracle. In *Manduca*, this single ridge remains short, sharp and strong, and with still a row of minute ridges in front of it. In *Sphinx* the condition is not very different from that in *Manduca*. There are some Eumorphid pupæ in which this ridge is developed into a strong flange, and in one, at least, of these species, which escapes from the ground as a pupa before emergence, it is this flange that is probably the active agent in enabling the pupa to force itself upwards. It is very possible that similar structures to these prespiracular flanges of Sphingid pupæ exist here and there in other lepidoptera, but I have not met with them, and doubt their existing throughout whole families as in the Sphingids. Their use no doubt is to assist the pupa in getting a firm basis to resist the pressure necessary to enable the imago to break through the earth above it. Most Sphingids bury themselves in the earth for pupation, probably all do when a favourable place is obtainable, but some are not very averse to pupating under a stone or amongst surface *débris*, and some will even make something like a silken cocoon. That all prefer to "go down," if possible, is probably true. It is noted that some use these flanges to emerge as pupæ. In *Manduca* and some others the flanges very decidedly face forwards, so that their function is here probably somewhat altered, and they serve to hold the empty pupa-case back, rather than as fulcra from which the moth may push forwards. Looking to the circumstances that we already find an indication of the two forms of these flanges in the Citheroniids, and that the single projection exists in only some Amorphids, whilst in the Eumorphids there is indication of the evolution of the single deep flange from a series of small ridges, it is difficult to avoid believing that this structure arose at least twice, probably oftener, quite independently, and that what the Sphinges inherited from the ancestor they had in common with the Citheroniids, and was not the structure itself, but only a capability of or tendency to develop it." We may here note a peculiar pupal habit which is generally associated with the pupæ of the more generalised groups. The pupa of *Eumorpha elpenor* is capable of progression for some distance in its cocoon, often leaving it altogether before the emergence of the imago. Scudder states that the pupæ of the Sphingid genus, *Macrosila*, emerge from the earth for the escape of the moths, using for this purpose certain flanges in the spiracular region. As to the pupal antennæ, Poulton observes that although the difference between the male and female imaginal antennal pectinations is not excessive in the Amorphids, there is always less difference between the antennæ of the sexes of their respective pupæ. The male pupal genital organs are represented in *Sphinx ligustri* by a very well defined linear depression guarded by two lips, the one on the right the other on the left, in the sternal region of the ninth somite. These lips are tumid, broad at their centres and pointed at either extremity. The structure is best seen in individuals placed, immediately pupation has been completed, in spirit, in older living specimens the dark colour and the thickening of the pupal cuticle rather obscure the structure (Jackson, *Studies in Morph. of Lepidoptera*, pl. xv., fig. 11). The female pupal genital organs of the Sphingids are similar to those of other Heterocera. The sternal region of the ninth somite is prolonged forwards, to a greater or less extent, as a triangular plate invading the eighth sternal region, and it is, at the same time, not clearly limited from the tenth somite behind, *i.e.*, the intersegmental line between the 9th and 10th somites is not quite continuous from side to side across the ventral line. These features are shown in *Protoparce mauritii*, Butl., and *Sphinx ligustri*, L., but in *P. mauritii* it is to be noticed that there are two fine longitudinal lines or depressions, one in the 8th sternum, and a second short one, at the apex of the triangular forward extension of the 9th sternum, whereas in *S. ligustri* there is but a single linear depression situated in the sternal region of the 8th somite, enclosed, however, by triangular lines passing backwards. The single depression represents the two depressions seen in *Protoparce* (*loc. cit.*, pl. xv., figs. 10, 12). Jackson further notes that, in the cast pupal cuticle of *Sphinx ligustri* and of *Smerinthus ocellata*, he has found two bands united at their bases, which are evidently the cast chitinoid linings of the ducts of the bursa copulatrix and of the oviducal tube, whilst, on one occasion, a double linear depression was found in a pupa of *S. ligustri*, and a similar one in *S. ocellata* (*oculatus* by error), in which there is also usually only a single depression; similar variations have been found in the pupæ of *Amorpha populi*. Variations in the direction of having single or double apertures are also noted in pupæ of *Manduca atropos* and *Eumorpha* *elpenor (loc. cit.*, pp. 146—147). Poulton observes *(Morph. Lep. Pupa*, p. 200) that, in the external genital organs of the pupa of *Sesia stellatarum*, there is a median line which traverses the prolongation of the 10th abdominal. Poulton gives excellent descriptive figures of the terminal abdominal organs of the pupæ of many Sphingid species *(vide, loc. cit.*, pp. 202—206, pl. xx., figs. 1—26). [Jackson finds no external indications of sex in the larvæ of *Sphinx ligustri*, etc.]

We have already given *(anteà*, pp. 357 *et seq.)* the diagnoses of Herrich-Schäffer, Meyrick and others, of the imagines of this group. Fernald further notes *(Sphingidae New England*, pp. 96—97) the following characters :

The thorax is well-developed in all the species and has the scales appressed over the surface, or there is a short stout erect tuft from each side of the metathorax, while some species have a central ridge of scales along the middle. The abdomen is stout and tapering to the apex, and there are fine spines along the edge of the segments in some of the species, which are concealed by the scales. Some species have anal tufts more or less fan-like and small tufts along each side. The ♀ ovipositor consists of two short pieces, one on each side, rounded at the outer end, and clothed with short hairs. The external organs of generation in the male are quite complex, and, besides the intromittent organ, consist of a clasper on each side, and a central plate above, to which is attached a hook curving downward, and, beneath this, is a projection, which is generally shorter than the hook, and curves up somewhat at the end. These two may be represented by the thumb and finger separated from each other by a little space and slightly bent. They vary much in form and in their relative length in different species. The side pieces or claspers also vary very much in form and size, and often have a variously-shaped spine, hook, or clasping-organ connected with the lower and inner side. These appear to be only a modification of one part of the side-piece and not a distinct body. The legs are well-developed and of moderate and nearly equal length. The fore tibiæ have a stout spur called the tibial epiphysis on the inside, and, in some species, there are, more or less, spines all over their surface. The middle tibiæ have a pair of unequal spines at the outer end, and are also spinose in some species. The hind tibiæ are rarely spinose, but have a pair of spurs at the end, and, in most species, a second pair near the middle. The tarsi of all the legs are five-jointed, spinose, and are armed with a pair of simple claws at the end.

The specialisation of the imagines is carried to great length in some particulars, the proboscis, antennæ, wing-shape, scales, &c., being specially developed in various groups. It is remarkable that the mandibles, which can hardly be said to exist at all in the lepidopterous imago, appear to be present as obtuse projections on each side of the labrum in *Amorpha populi*, *Phlegethontius carolina*, and possibly several other species. The forewings are usually pointed at the apex, long in proportion to their width, the nervures exceedingly strong towards the base, and the hindwings small. The Amorphids again form an exception. The Sphingid abdomen is usually pointed, but in the Sesiids (Macroglossids) tufted apically, with one or two tufts of long scales capable of considerable expansion. The Sphingid proboscis is frequently developed to great length. Even in *Agrius convolvuli*, the proboscis is some 5 inches in length, and those of some South American species are double this, the specialisation enabling them to suck the nectar from long tubular flowers, and no doubt are specially modified to aid in giving effect to cross-fertilisation. On the other hand, specialisation has, in the Amorphids, resulted in reducing the tongue to a very small and almost functionless structure. Westwood has noticed that there is an interesting connection between the variation in the length of the tongue and the rapidity of flight, both depending on the habit of sucking nectar from flowers whilst the insect is on the wing. Similarly, most Sphingids have a strongly developed frenulum, which Fernald describes as being "attached to the basal part of the costa of the hindwings, and passing through a membranous loop on the underside of the forewings; the frenulum consisting of a single curved bristle in the ♂ s, but of a cluster of six very short fine bristles in the ♀ s, whilst the loop is wanting in this sex." The Amorphids, however, have this organ present in a much reduced state, whilst Sharp states (*Insects*, ii., p. 316) that, in some Sphingids, there is the unusual condition of a highly-developed shoulder to the hindwing, co-existing with a perfect frenulum and retinaculum. Griffiths observes (*in litt.*): "The *Sphingidae* exhibit the highest development of the frenulum, the spina of the male insect attaining its maximum of size and strength, and the retinaculum being powerful and capable of holding with a firm grip. In the female insect, too, the spinulæ are strong, and their extremities converge to a strong fine point, thus forming a claw or hook, which catches the fasciculus of the forewing with considerable effect. These characters hold good as regards the majority of the species of this family, but some members of the subfamily *Amorphinae* form a noteworthy exception. Of one of these, *Amorpha populi*, Giorna states (*Trans. Linn. Soc. Lond.*, i., pp. 135—146) that it is without the appliance. Such, however, can hardly be said to be the case; the male insect possesses, in the position occupied by the spina in other species, a process standing out from the margin of the wing, rounded in outline, and, in some few examples, terminated by a minute point. This process corresponds with the root or prominence which in other species carries the spina. The female has a much more largely developed apparatus; not only does she possess the root process, but also a perfectly formed group of spinulæ, which, however, are too small to be of any practical use in connecting the wings, so that the organ in both sexes may be considered abortive. The retinaculum of the male is absent, as we might expect, and its place is simply indicated by a most inconspicuous group of scales. It will be evident on consideration that the peculiar rest-position always assumed by *A. populi* would be quite impossible in a species with fully developed spina and retinaculum, inasmuch as the humeral angle of the hindwing always projects before the costal margin of the forewing, and it would be necessary for the moth to withdraw the bristle from its loop every time that it composed its wings for rest. A similar rudimentary development of the part also occurs in greater or less degree in several other allied species, notably in the fine Australian species, *Coequosa triangularis*, which has the spina very short and probably quite useless. Some other Amorphids, however, such as the genus *Mimas* of Hübner (which includes *M. tiliae*) and *Sichia (Laothoë) quercûs*, have the appliance fairly well developed. So also the very fine and remarkable South African species, *Lophostethus dumolini*, which is usually referred to the Amorphids, has the organ well and strongly developed in both sexes. The flight of many Amorphids is so different from that of the typical Sphingids, and their habits are so much more sluggish, that it is interesting and instructive to find a diversity in the perfection of this apparatus."

The specialisation of the antennæ, however, is the most characteristic peculiarity of the Sphingid imago. The Amorphid antenna has an ordinary antennal tip, but in most of the other Sphingids the tip is produced, filamentous, recurved, or otherwise specialised, although, structurally, both are the same. Sharp describes (*loc. cit.*, p. 380) the Sphingid antenna as "having a thick solid appearance, pointed at the tip, which is usually somewhat hooked and bears a few hairs. In the males the antennæ are formed in a manner specially characteristic of the family. In section, each joint shows a chitinous process on the underside, forming, with that of the other joints, a continuous ridge, and on each side of this ridge there exists a series of short, delicate 'cilia' arranged in a very beautiful manner. This structure, with some modifications, appears to be usually present in the family; it attains a very perfect development in cases where the tips of two rows of cilia bend towards one another, meeting so as to form an arched cavity. This structure is different from what occurs in the ♂s of other families of lepidoptera, for though cilia are very common, they are usually placed either on two projections from the body of the antenna (instead of on the two sides of a single projection), or there is but a single whorl or set of them on each joint (*Catocala*, &c.)." Bodine states that the Sphingid antennæ give some considerable colour to the view of a genetic relationship between the Sphingids and Ægeriids (Sesiids). He notes (*Antennae of Lepidoptera*, pp. 36—37) that, in spite of Butler's views (*Trans. Ent. Soc. Lond.*, 1878, p. 121) that the antennal structure of the Ægeriids (Sesiids) was closely allied to that of the Pyralids and Tineids, and not at all to the Sphingids, especially to *Hemaris*, yet every feature mentioned as being characteristic of the Ægeriids (Sesiids) can be paralleled, not only in the Sphingids, but in the genus *Hemaris*, and that *Hemaris thysbe* presents the very characters that he describes in *Sphecia*, except that, in both cases, the "pencil of rigid hairs" is really composed of rigid scales; the close resemblance in structure and form between the antennæ of the Ægeriids (Sesiids) and Sphingids, Bodine considers, certainly points to a genetic relationship. The large compressed ventral expansion, the fusiform or clavate shape, the peculiar distribution of sense-hairs of the third type, the relative size, development, and position of the cones, the tuft of long slender rigid scales projecting from the distal segment, the character of the chitin surface, are all features common to both the Ægeriids (Sesiids) and Sphingids, and no other forms known at present possess the whole combination of characters. The condition of the antennæ of the Ægeriids (Sesiids) is less highly specialised than it is found to be among the Sphingids; the specialisation does not differ materially in extent from that of the other Microfrenatæ, but it has proceeded further in certain directions; so, while the family is properly classed with the Microfrenatæ, it, at the same time, appears to represent an offshoot of the branch which, later on, gave rise to the Sphingids. There is, of course, he says, a possibility that the great similarity of appearance and even of structure of an organ may arise from similarity in environment and in the conditions of life, but in the case of the Ægeriids (Sesiids) and Sphingids the resemblances are more than superficial, as marked in the microscopic as in the macroscopic characters, and it is difficult to believe that such forms could arise unless there were some genetic relationship. Chapman disagrees entirely with Bodine, and writes *(in litt.)*: "The antennæ of the Sphingids present certain very distinctive characters. The female antenna of an Amorphid looks very like that of any other moth with a simple antenna—scaled dorsally, with fine hairs ventrally and sundry bristles. A closer examination, however, shows that its true axis is not its apparent one. Each joint is articulated to its neighbour, not by its whole surface, but by a small circle close to the dorsal surface, and we might call the lowest portion beneath the articulating axis a pectination, or a pair of pectinations coalesced. It is very possible that this is its real nature. The dorsal scaled area has the scales arranged in somewhat irregular transverse rows, never quite regularly, often very irregularly, in the manner usually associated with pectinations past or present. A second character of the Sphingid antenna is the terminal segment or joint, which is somewhat lengthened and of conical form in Amorphids, and becomes, in the other families, much lengthened and armed with various bristles, so as to have quite a special facies, often amounting to a sort of tassel. Another peculiarity of the Sphingid antenna is the peculiar arrangement of the long hairs of the ♂ antenna. The lower surface is divided into two lateral portions by a central longitudinal keel or ridge, often very marked, almost always observable. If an ellipse be drawn on the ventral surface of the antenna, with this keel as the shorter axis, and the extremities just touching the middle of the margin of the scaled dorsum, it would mark exactly the line occupied by the origin of the hairs, excepting that a central line by the keel is usually vacant. The longest of these hairs is nearest the central line, and they are so disposed that, looking at the antenna on its ventral aspect, those on either side of the ventral line form a pocket like the toe of a shoe, by arching across the half ellipse between their bases, those on the proximal meeting those on the distal side of this area, with the opening into the pocket directly facing the observer, the individual hairs not radiating in all directions from the ventral line of the antenna, but directly outwards from its central plane. The central line or keel and the area within these pockets are covered with very fine sense-hairs, the angles outside the lines of hairs are unclothed. In the female antenna the whole ventral surface carries these fine appressed sense-hairs. The description given above of the ellipse of hairs is not quite accurate, at least for many species; as seen from the underside, the line looks single, but, at the further end, next the scaling, it is not so; there, there are several hairs in short rows parallel with the length of the antenna, and very like the rows of hairs on the plumules of Lachneids. Still, though the Sphingid antenna is probably derived from some forms of pectinated antenna, it is difficult to understand any mutation by which these hairs could be derived from those of the Lachneids. On the line of the keel at the distal margin of each segment is a hair, not very obvious basally, but, beyond the middle of the antenna, becoming short and thick as a little baton, and projecting markedly on the convexity of the antenna, where it curves round towards the end. The characters of the Sphingid antenna are closely followed in those of *Phalera bucephala* and of other species allied to it; the terminal segments are much like those of the Amorphids; it possesses the marginal batons, and the arrangement of the hairs is very similar; the keel is not so distinct, and does not so definitely divide the hairs of the two sides as it does in most Sphingids, and the ventral projection carrying the hairs, though very similar to that of Sphinges, does not meet its neighbour, but is obviously distinct, and so does not look as in Sphingids, as if a part of the true shaft of the antenna. The antenna of Ægeriids (Sesiids) is also very like that of Sphingids, much more like, in fact, than is that of *Phalera*. Nevertheless it is essentially very different, whereas that of *Phalera* is based on a real identity of structure. In the Ægeriids the general form of the antenna is the same, though rather more clubbed, and it ends in a very similar tassel, and the arrangement of hairs is much the same. The antenna of the Ægeriids is, however, solid; it has no added ventral portion, the arrangement of hairs is a little different, they also fail completely over the club, which in both sexes carries only the fine appressed sensory hairs. A still more fundamental difference, showing the Ægeriid antenna not yet to have escaped from a low Tineid form, is that in the females of many, if not of all, species, one row of scales completely encircles the antenna. The Ægeriid antenna is, therefore, an early micro form in its essential characters, although very specialised, and specialised so largely on similar developments to those of Sphingids, and probably in view of similar requirements, that the association of the two families in classification is a result that very naturally followed. The scaleless wings of some Sesiids (Macroglossids) appeared to be so obviously a confirmatory character, that one understands how the association of these two families is still a matter of faith in many quarters. The differences between the antennæ of the different families of the Sphingids are not too well defined, that is, the forms that are commonest in each group are not always very well marked in all its members. The differences consist in the general straightness of the antenna, in its being more or less clubbed, and in the curvature and specialisation of its terminal segments. Thus—

The antenna of the Amorphids differs from those of the remainder of the Sphingids in having but little curvature at the tip, and a fairly round blunt unspecialised last segment.

That of the Ambulycids (*Ambulyx*) is a longer, more slender antenna, with a gradually diminishing curved tip ending in a last segment carrying very long scales, but not itself elongated. [In all the other groups the last segment is specialised by considerable elongation and a clothing of bristles.]

In Sesiids (Macroglossids) the antenna is straight, very thickly clubbed, and has the terminal hook consisting of half-a-dozen very short compressed segments, the last one elongated so as to be as long as two or three of these, but still very short, as compared with the following groups. [This is probably not a stage intermediate between *Smerinthus* and *Sphinx*, but a specialisation for day-flying as seen in Anthrocerids, Papilionids.]

In the Eumorphid antenna the terminal hook is long and sweeping, and involves a good many gradually diminishing segments, with a terminal segment equal in length to about three previous segments.

In Sphingids and Manducids the hook is shorter, fewer segments being involved in the dwindling tip, and the final segment is very long, equal to about six previous segments. The Manducid antenna is straighter and thicker than that of Sphingids, and the final segment is therefore proportionally more slender."

The connection between antennal structure and habits is well-marked in this superfamily. In those species that feed, both sexes fly actively and the antennæ of both sexes are very similar—Sesiids (Macroglossids), Eumorphids, Sphingids *(sens. strict.)*, etc. In those that do not feed, both sexes are comparatively sluggish, the females particularly so, the males being driven to a more active condition on account of their having to seek the females, and here there is somewhat more sexual difference in antennal structure, *e.g.*, Amorphids.

One may note with regard to the specialisation of the body scales that they are closely appressed to the body, thus forming a smooth continuous coat of mail that evidently offers less resistance to its passage through the air than a body covered with a mass of assurgent hairs. This must certainly be of advantage to a swift-flying moth, *e.g.*, *Sphinx*, *Choerocampa*, etc., whilst the protection given by such a clothing must also be considerable. Kellogg states that the scales on the forewings are usually more specialised than those on the hindwings, both in form and arrangement, and that the scale-specialisation is higher in moths of highly-specialised flight-function (indicated by cephalisation of flight) than in moths of more generalised flight-function, as, for example, the Sphingids compared with the Attacids. He then adds *(Taxonomic Value of Scales of Lepidoptera*, pp. 56-57): "The hindwings of moths, where an extreme cephalisation of flight has been arrived at, show a less specialisation of the scale-covering than is shown by the hindwings of moths whose flight-function is not so excessively cephalised, which, indeed, is to be expected, because of the lesser importance of the hindwings in cases of extreme cephalisation of flight. This is well shown within the limits of a single family in the case of *Calasymbolus myops*, a Sphingid with the hindwings large in comparison with the hindwings of *Choerocampa*, *Philampelus*, *Ellema* and others showing extreme cephalisation of flight. In *Calasymbolus*, the disk of the hindwing is uniformly covered with flat scales, only the basal third of the wing showing long, weak scale-hairs. In *Philampelus achemon*, only the marginal brown edging is composed of specialised scales, without the presence of scale-hairs, while all the discal and basal portion of the wing is covered with long, rather thickened scale-hairs, in addition to flat scales. *Choerocampa tersa* shows a similar condition, as also does *Ellema bombycoides*. The fact that a heavy flyer shows a less specialised scale-covering than a swift flyer is also illustrated among the *Sphingidae*. *Triptogon modesta*, a slow, heavy-bodied moth compared with *Philampelus*, has its forewings covered with long, thickened, two- to three-pointed, rather flattened scale-hairs thickly inserted, but rather assurgent, and not closely appressed to the wing surface. The hindwings bear elongate, single-pointed scale-hairs, and also some scales like those of the forewing, altogether a much more generalised condition of scale development than that of *Philampelus*, whose forewings are uniformly covered with broad three- to seven-pointed flat scales, becoming a little longer toward the base of the wing." We may here add that experiments on the contents of the scales of *Smerinthus ocellata*, show that if the hindwings be yellowed by HCl they afterwards recover their full natural colour; and it they be then subjected to strong HCl for an hour or so and washed, the pink is restored, and the yellow entirely removed. The colour has, however, a faded appearance which is maintained, the pink colour being dull, but the red is quite permanent (Coste).

Girard says (*Cosmos*, xvii., p. 282, and *Bull. Soc. Ent. Fr.*, 1860, pp. lxxxv—lxxxvi) that the secretions which enable certain species to emit a scent resembling musk seem to offer in some measure a generic character or evidence of affinity. He has frequently observed it in ♂s of *Agrius convolvuli*, as already remarked by previous authors, though never in the ♀, and has also detected it in *Sphinx ligustri*, though less powerfully. He thinks it would be of interest to examine the third species of the genus, *Hyloicus pinastri*, so that, if this, too, possesses it, it might be added to the generic characters. In 1880, Von Richenau recorded (*Kosmos*, iv., p. 387) that both *Sphinx ligustri* and *Hyloicus pinastri* were provided with a special scent-organ situated at the edge of the lower side of the 1st abdominal segment, which comes into view on pressure of the abdomen. It consists of two symmetrical bunches of hair-shaped scales, which may be extruded or drawn in. When extruded in a living *S. ligustri* a distinct musky scent is apparent at the distance of half-a-mètre, but ceases to be apparent when they are retracted into their fold, which occurs when the insect is at rest. Only a rudiment of this organ is present in the ♀.

Green notes (*E.M.M.*, xxxvii., p. 90) that *Hippotion celerio* was found to make a squeaking noise, much like the well-known note of *Manduca*. The peculiar noise made by *Manduca atropos* will be dealt with at length later.

Cross-pairing has been recorded between *Hyloicus pinastri* ♂ and *Mimas tiliae* ♀ (Bartel, *Palaeark. Gross-Schmett.*, ii., p. 148); Treitschke (notes *Die Schmett.*, x., 1, pp. 137—138) the pairing of *Smerinthus ocellata* ♂ with *Hyloicus pinastri* ♀, and Herfert (*Insekten-Börse*, xvi., p. 280) observed a ♂ *S. ocellata* paired with a ♀ *M. tiliae* at Linz. Although cross-pairings such as the two first-named are almost sure to prove abortive, experience has since shown that the last-named (though with the sexes reversed) may be quite fruitful. Successful cross-pairing, however, is not at all infrequent among Sphingids, and it is many years since the successful crossing of *Smerinthus ocellata* ♂ with *Amorpha populi* ♀ was first recorded, the product being named *hybridus* by Stephens (*List Br. An. Br. Mus.*, p. 26), although it had been figured by Humphreys and Westwood some years previously. Hagen notes (*Ent. Wk. Int.*, iv., p. 23) that Mützell had described in Wiegmann's *Archiv*, under the name of *phileuphorbiae*, a hybrid between *euphorbiae* and *gallii*, but this has since been queried as being simply an aberration of the latter species, whilst *vespertiloides* has been suggested as a hybrid between *vespertilio* and *gallii* or *euphorbiae*. The following are the only hybrids to which we have yet found reference in entomological literature: *Smerinthus* hybr. *hybridus*, Stephs. (*ocellata* ♂ × *populi* ♀), *Amorpha* hybr. *inversa*, Tutt (*populi* ♂ × *ocellata* ♀), *Calasymbolus* hybr. *interfaunus*, Neum. (*astylus* ♂ × *ocellata* ♀), *Smerinthus* hybr. *fringsi*, Stdfss. (*atlanticus* ♂ × *populi* ♀), *S.* hybr. *oberthüri*, Tutt (*atlanticus* ♂ × *austauti* ♀), *A.* hybr. *metis*, Aust. (*austauti* ♂ × *atlanticus* ♀), *Mimas* hybr. *leoniae*, Stdfss. (*tiliae* ♂ × *ocellata* ♀), *Theretra* hybr. *standfussi*, Bart. (*porcellus* ♂ × *elpenor* ♀), *Celerio (Deilephila)* hybr. *phileuphorbiae*, Mützell (*euphorbiae* ♂ × *gallii* ♀), *Celerio* hybr. *vespertilioides*, Bdv. (*hippophaes* ♂ × *vespertilio* ♀), *C.* hybr. *epilobii*, Bdv. (*euphorbiae* ♂ × *vespertilio* ♀), *C.* hybr. *pauli*, Mory (*euphorbiae* ♂ × *hippophaes* ♀), *C.* hybr. *eugeni*, Mory (*epilobii* ♂ × *vespertilio* ♀), *C.* hybr. *lippei*, Mory (*eugeni* ♂ × *vespertilio* ♀). We are indebted almost entirely to Standfuss* for our knowledge of these forms. He observes that, at present, only male progeny has been recorded of *Theretra* hybr. *standfussi*, and that in *C.* hybr. *epilobii*, *C.* hybr. *vespertilioides*, and *Amorpha* hybr. *inversa* males predominate, and the females are sterile, whilst in *Smerinthus* hybr. *hybridus* the offspring consisted of both sexes in normal proportions, the females, however, containing but few eggs, and these abnormal in structure. It is further remarkable that, although most of the males of these hybrids have the genitalia well-formed and functional, the females are often more or less gynandromorphous, and where this is not the case they are almost always more or less sterile. Details of the various hybrids will be given under the several families or subfamilies to which the species belong.

Gynandromorphism is not at all infrequent among the Sphingids. Schultz describes or mentions (*Illus. Woch. für Ent.*, i., p. 493, iii., p. 311) the following: *Manduca atropos* 1, *Agrius convolvuli* 6, *Celerio gallii* 1, *Celerio euphorbiae* 1, *Eumorpha elpenor* 1, *Daphnis nerii* 3, *Mimas tiliae* 3, *Smerinthus ocellata* 2, *Amorpha populi* 66, *A.* hybr. *hybridus* 7, *Sesia stellatarum* 2. There are, of course, many other examples in various collections.

Newman and others note parthenogenesis as occurring in *Manduca atropos*, *Sphinx ligustri*, *Mimas tiliae*, *Smerinthus ocellata* and *Amorpha populi* (*anteà*, vol. i., p. 29). Treviranus (*Verm. Schr.*, iv., p. 106), speaking of parthenogenesis, says, "I myself have been eye-witness of this in the case of a ♀ of *Sphinx ligustri*, which had emerged from the pupa during the night in my room. In the morning it was impaled on a pin, and, on the second day, it laid a number of eggs, from which larvæ emerged just as if a pairing with a male had taken place, which was quite certainly not the case." Burmeister says (*Handbuch der Entomologie*, p. 312 of Shuckard's translation) that his friend, Dr. A. von Nordmann, has recently observed parthenogenesis in *A. populi*, but gives no details. Baltzer, in his dissertation, "De Anatomia Sphingidarum," describes and figures numerous anatomical details in this superfamily, *e.g.*, parts of antennæ of *Smerinthus ocellata*, the intestinal tract of this species and *Eumorpha elpenor*, ♂ genitalia of *Mimas tiliae*, ♀ genitalia of *Sphinx ligustri*, *Eumorpha elpenor*, etc.

Desvoidy notices (*Essai sur les Myodaires*, ii., 1830, p. 28) that he has seen *Phryae* emerge from the imago of *Sphinx ligustri*.

The many important details found in entomological literature, relating to the habits of the Sphingids, are far too numerous to mention. Bachmetjew (*Societas Entom.*, vol. xv., pp. 171 *et seq.*) has shown that the temperature of the moth rises rapidly whilst buzzing, *Eumorpha elpenor* being one of the species on which the observations

* Mory's hybrids described (*Mitt. Schweiz. Ent. Gesell.*, x., pp. 333 *et seq.*) must be bred *ab ovo* before they can be really accepted. At present the evidence offered is very inconclusive.

were made. He defines "buzzing" as consisting of "quick, short movements made with the wings, the number of which per second may be estimated at from 6 to 8. It is not a flutter, since in a movement of that sort the wings describe a greater amplitude. The wing movements, moreover, are quite regular." He gives tables illustrating his results. The great attractive influence of light on many Sphingid moths is well known. We have seen dozens of dead *Agrius convolvuli* beneath the electric lights on the public squares in Turin. Swinhoe states (*Ent.*, xxiii., p. 22) that, by means of the electric light in Bombay, he had collected more than 300 specimens belonging to the Sphingids in a single night. Young observes that, at Mahdopoor, in the Punjaub, he collected above 30 species of Sphingids at jasmine, petunia, and marvel of Peru flowers. Green gives (*E.M.M.*, xxxvii., pp. 87 *et seq.*) some interesting details of the attractiveness of the electric light in Ceylon, in December, 1900, the Sphingids being especially numerous. He counted on a single post 39 specimens of *Pseudosphinx discistriga*, whilst *Daphnis hypothous* and *Theretra nessus* almost rivalled the *Pseudosphinx* in numbers, other species taken being *Manduca lachesis*, *Hippotion celerio* and *Agrius convolvuli*. Bethune records (*Can. Ent.*, i., pp. 47—48) his surprise at seeing on June 23rd, 1868, a very hot day, at Trafalgar, a beautiful specimen of *Amphion nessus* perched on the carcase of a little dog floating in a pool, and which gave forth a horrid odour, but to which, on being disturbed, the moth returned again and again. Some species of Sphingids are known to be attracted to the sweets spread for Noctuids. *Eumorpha elpenor* is the most frequently attracted of the British species, but the habit is a widely spread one, for the following species are noted by Bailey (*Can. Ent.*, ix., p. 240) as being taken at sugar at Center in 1877: *choerilus*, *kalmiae*, *gordius*, *hylaus*, *abbottii*, *drupiferarum*, *myron*, *sordida*, *cinerea*, *harrisii*, *lineata*, *luscitiosa*.

Meyrick says (*Handbook*, etc., p. 292) of the Sphingids: "This is a numerous family, distributed throughout the principal regions, except in New Zealand (where there is only one not truly indigenous species), but more plentifully within the tropics. The imagines are usually large insects, with stout heavy bodies, elongate-triangular forewings with very oblique termen, and relatively small hindwings; the wing-muscles are very strong and the flight exceptionally powerful."

Family: AMORPHIDÆ*.

Accepting Chapman's grouping (*anted*, p. 367) we see that the Sphingids fall into two main divisions, *Sphingidae* and *Amorphidae*, the characters being especially marked in the pupal and imaginal stages. He notes that one of the most peculiar characters of the imago is its resting attitude, which in the Amorphids is Pterophorine in general character, showing the costa of the hindwings in front of the forewings, as in certain Lachneids, *e.g.*, *Eutricha quercifolia*, whilst the frenulum is nearly obsolete; on the other hand the resting-position of the Sphingids (as apart from the Amorphids) is with

* The oldest plural form applied to this group is Hübner's *Amorphae* (*Tent.*, p. 1) in 1806. The plural form of *Smerinthus* was not used until 1818 (Hb., *Zutr.*, i., p. 4). This being so, we call the family *Amorphidae*.

the wings more or less flat or even deflexed, and these have a strong frenulum developed. Chapman accepts two subfamilies in the *Amorphidae*—*Amorphinae* and *Ambulicinae* — the latter of which Grote places among the Eumorphids. He looks upon the Ambulycids as representing the lower Eumorphids (Chœrocampids) in which the wing-proportion of the Amorphids is carried over. We are not able to assent to this position. The Ambulycids have the Eumorphine characters of form, and a slightly longer proboscis than the Amorphids *(sens. strict.)*, whilst the antennal structure is less definitely Amorphid than in *Smerinthus*, but the pupa is essentially Amorphid, although it has often facial spines as in the Sesiid (Macroglossid) pupa, and a metathoracic callosity as in the pupæ of *Sphinx* and *Manduca*. Looking at our accepted phylogeny of the Amorphids *(sens. strict.)*, it would appear that the Ambulycids branched from the Amorphid stem before the latter had separated very far from the Eumorphine portion of the Sphingid line, the Eumorphids being the lowest of the *Sphingidae*, but the subfamily is distinctly on the Amorphid, and not on the Eumorphid, side of the phylogenetic tree. We have already given *(anteà*, p. 357) Butler's diagnoses of these subfamilies.

Subfam : AMORPHINÆ.

Grote, Poulton, Packard and others have attempted to prove that the Amorphids are the most generalised of all the Sphingids. The broad wings, the rather less specialised antennæ (in Sphingid direction), the ill-developed tongue and frenulum, and the different mode of flight have all led to this result, and certain characters of the pupa support this view, but we have already shown *(anteà*, pp. 359 *et seq.)* that, in spite of some generalised characters, the loss of the tongue and frenulum really represent specialisations and prove conclusively that these authors are wrong in deriving the Sphingids from Attacids, Lachneids or Dimorphids, groups that have already lost both tongue and frenulum, whilst the presence of these organs proves that any specialisation of the Amorphids in these directions has taken place within the Sphingid phylum. With Grote's placing of the Ambulycids we have already stated our disagreement.

In the Amorphid larva, the dorsal setæ (i + ii) on the meso- and metathoracic segments are placed as pairs (i and ii) on either side of the median line, the anterior and posterior setæ of each pair having their bases close together on the same subsegment, being, in this particular, in agreement with the arrangement that pertains to the larvæ of Sphingids and Sesiids (Macroglossids), as opposed to that exhibited by the Eumorphid larvæ, in which they are placed, one on either side of the median line, as an anterior pair (i) and a posterior pair (ii), ii being directly behind i, and situated on a different subsegment. In the oval and larval stages the Amorphids are fairly normal Sphingids, and, in the larval stage, are possibly in advance of the Eumorphids. The pupa is, however, less specialised, and is not unlike, in its general features, some of those found in the allied Attacid and Lachneid superfamilies. Bacot observes *(Ent. Record*, vii., p. 230) the general resemblance between the pupæ of *Dimorpha versicolora*, *Mimas tiliae* and *Amorpha populi*. As the long-tongued Sphingids *(sens. strict.)*

have specialised from a moderate-tongued ancestor, the development has left its mark on the pupa; on the other hand, the Amorphids have specialised in the direction of loss of tongue, and, therefore, in general appearance, the pupa is much more like those of its tongueless relatives *(sens. lat.)*. In the imaginal stage, also, the habits of the Amorphids and Sphingids are so different that specialisation is again in opposite directions and considerable difference in appearance results.

Comparing the British Amorphid with the Sphingid species, Bacot gives *(Ent. Rec.*, vi., pp. 178 *et seq.)* the following interesting details: "In their earlier stadia, the larvæ of the Amorphids and of Sphingids *(Sphinx ligustri)* have many characters in common, *e.g.*, *S. ligustri*, in its first skin, has forked hairs, though these are black, and are thinly scattered compared with the 'door-mat' appearance which is characteristic of the Amorphids. The shape of the head is similar to that of *Mimas tiliae* in its earlier stages, and there are other minor points of resemblance. In the imagines, however, the only points of resemblance that I can see are that the head and eyes of *S. ligustri* are small, and that the antennæ are somewhat similar in stucture. On the other hand, the resting-position is quite different, *S. ligustri*, like *Manduca atropos*, *Agrius convolvuli*, &c., resting with the forewings sloped over the back and the hindwings folded underneath them. The resting-position of *Eumorpha* appears, at first sight, to be somewhat similar to that of the Amorphids, but the pupæ are very different. Whatever may be the right place for the Amorphids, I can see no reason for putting *Manduca atropos* next to them, for I think that, without question, *S. ligustri* is a nearer relation, and it is probably a link between the two. Turning to individual differences, the hind tibiæ of *M. tiliae* have four spurs, while those of the other Amorphid species, *A. populi* and *S. ocellata*, have only two. I find that *Manduca atropos*, *Sphinx ligustri*, *Eumorpha elpenor* and *Hemaris fuciformis* also have four spurs to their tibiæ. The males of *M. tiliae* have a frenulum*, but in the females this is only rudimentary, the loop being entirely absent, and the bristle being replaced by a number of short slender ones which are of no apparent use. The males of *Smerinthus ocellata* possess a small bristle, the females a group of small ones, but there is no trace of the loop in either sex. I examined a number of specimens of *Amorpha populi*, but could find no trace of loop or bristle in either sex, except in one female, which had a group of small bristles on one hindwing only. No doubt this was simply an instance of reversion, the frenulum apparently being, as a rule, altogether wanting in this species. A consideration of all the different characters present in the several stages leads one to think that *M. tiliae* is the oldest form, and that *S. ocellata*, though its habits and food are very different, as is also the coloration of the imago, is not really so widely removed from *M. tiliae*

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* Griffiths notes that the frenulum probably reaches its highest development among the typical *Sphingidae*, but the case is far different with the Amorphine group, many species of which, including the giant *Coequosa triangularis* from Australia, possess it either weakly developed or quite abortive. In this, as in several other respects, they approximate to the broad-winged Bombycids—*Lasiocampa*, *Attacus*, *Saturnia*, and their allies—to which they are probably nearly related.

as a superficial knowledge of the two species might lead us to suppose. *A. populi*, on the other hand, is, I believe, much farther removed from *S. ocellata* than is usually thought to be the case; it seems to have developed right away from the other British species, and to have lost many of the ancestral features that they retain*. The similarity of the eggs and of certain characters in the young larvæ of *M. tiliae* and *S. ocellata*, and the wide divergence of *A. populi* in these stages, are apparent on close comparison. I am well aware that the adult larvæ of *S. ocellata* and *A. populi* are often difficult to distinguish, but the likeness is really only a general one, and probably arises as much from the similarity of their foodplants and of the dangers to which they are exposed as from actual relationship. When we compare the imagines, the resemblance between *M. tiliae* and *S. ocellata*, as regards the shape and markings of the wings, is very close, while *A. populi* is entirely different in both respects. One very stable and, perhaps, important marking that *S. ocellata* and *A. populi* have in common, is the white lunule on the margin of the discoidal cell of the forewings; but, though no trace of this is present in any of the specimens of *M. tiliae* that I have seen, a very similar mark may be noticed in *S. ligustri*, albeit in this species it is black instead of white. Pierce, of Liverpool, who has made preparations of the genitalia writes thereupon as follows: 'I found them very difficult to manage, as they were so large, thick and strong, and I have only succeeded fairly well. As regards size, those of *A. populi* and *M. tiliae* seem much nearer, but in structure there is no doubt that those of *S. ocellata* and *A. populi* are nearer to each other than those of either of them are to those of *M. tiliae*. I am much struck with their strength in *S. ocellata* compared with what obtains in *A. populi*.' From these remarks it will be seen that the evidence of relationship, afforded by the genitalia, is not in accord with that furnished by other characters. I am not altogether surprised at this, as the genital organs would probably be among the first to undergo modification in a new species, and they are probably not so valuable a guide to the relationship between well established species as to the distinction between species that have all their superficial characters in common." Later Bacot writes (*loc. cit.*, ix., pp. 145 — 146): "The pupa of *Saturnia pyri* is not unlike that of *Mimas tiliae* in shape, only rather wider in regard to its length, and, of course, differing at head and anus. In general shape and appearance, omitting the antenna-

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* In those characters which are considered to be ancestral, *S. ocellata* and *M. tiliae* show more agreement than does either with *A. populi*. It is probable that *M. tiliae* first branched from the stirps which gave rise to our three British species, *S. ocellata* being very probably nearer to *A. populi*, in the sense that they formed an *ocellata* + *populi* branch, after *tiliae* had separated as a distinct species; but since this branch was thrown off, and after *ocellata* and *populi* had separated from their common ancestral form, the specialisation of the latter has advanced so far that it has lost many of the characters which the other two species retain. The reference (*suprà*) to *M. tiliae* as the oldest form must be taken from this standpoint. It has itself specialised no doubt in coloration, pattern, and in the larval form, but, at the same time, it is more *Sphinx*-like than either of the other species. It is, of course, possible to consider this as an instance of parallel specialisation (Bacot).

cases, it tends rather towards the Amorphid than the Saturniid shape, as typified by *Saturnia pavonia*. Some pupa-cases of a large South African Saturniid moth that I have received are very similar in shape to the pupa of *S. pyri*, with the exception that the abdominal segments 5, 6, 7 and 8 are ridged at the lower edge, and the cremaster is reduced to a blunt point, with a very stout pyramid-shaped projection on it. In fact the cremasters of this unnamed species, of *S. pyri* and of *Dimorpha versicolora* form a very good series of connecting links between the anal spike of the *Sphinx* pupa and the bristly cremaster of *S. pavonia*, the order being — *S. pavonia*, *S. pyri*, *D. versicolora*, the South African Saturniid, *Smerinthus*, *Manduca*."

Bacot, as shown above, looks upon *Mimas* as exhibiting more generalised characters than the other Palæarctic Amorphids, of which he considers the Sichiid group the base; from an ancestral form near this latter tribe he concludes that the more specialised Amorphids arose, splitting up into at least three distinct groups—the Smerinthids, Clarkiids and Amorphids *(sens. strict.)*, so that the division of the subfamily *Amorphinae*, so far as the Palæarctic and some Nearctic genera are concerned, would appear to work out as follows:

1. Mimantidi—*Mimas* (*tiliae*).
2. Sichiidi—*Sichia** (*quercûs*), *Burrowsia* (*roseipennis*), *Kayeia* (*mackii*).
3. Smerinthidi — *Daddia* (*kindermanni*), *Bellia* (*caecus*), *Smerinthus* (*ocellata*), *Nicholsonia* (*saliceti*), *Calasymbolus* (*astylus*).
4. Clarkiidi—*Clarkia* (*dissimilis*).
5. Amorphidi—*Triptogon* (*modesta*), *Amorpha* (*populi*).

The following comparisons of the eggs, larvæ, pupæ, and certain imaginal structures of our three British species, *Mimas tiliae*, *Smerinthus ocellata* and *Amorpha populi*, should prove interesting and instructive:

Ovum.—The eggs of the three species are very similar; they are all egg-shaped and of the flat type; they are laid on their flat sides, those of *Amorpha* and *Smerinthus* are fixed by a certain amount of gluey material that is not obvious on the other surfaces of the egg; those of *Mimas* are more densely covered with an india-rubber-like gum; all are pale green in colour, those of *Mimas* are darker, either actually or from the effect of the gummy coating. All are about 2·00mm. in length, those of *Amorpha* and *Smerinthus* fractionally above, of *Mimas* below, that length. In width, that of *A. populi* is the broadest, and makes the nearest approach to a spherical egg, its other diameters being about 1·7mm. and 1·6mm. respectively, that of *S. ocellata* has these 1·55mm. and 1·3mm., and those of *M. tiliae* 1·55mm. and 1·35mm. These measurements are, however, only roughly correct or are rather the maximum diameter, and are measured nearer the micropylar end, and all taper to the nadir, whether as seen from the top or from the side. Taking a diameter at the same distance from the nadir that the longest is from the micropyle, the egg of *A. populi*, seen from above, measures 1·5mm. against maximum of 1·7mm., and from side 1·45mm. against 1·60mm.; those of *S. ocellata* and *M. tiliae*, being narrower eggs, differ inappreciably as seen from above, but seen from the side the measurements are: *A. populi*—greatest height 1·6mm., height nearer nadir 1·45mm.; *S. ocellata*, 1·3mm. and 1·15mm., and *M. tiliae* 1·35mm. and 1·10mm. respectively; the egg of *M. tiliae*, therefore, tapers most in a side view. The surface sculpture of all is of hexagonal cells, tolerably regular about the equator, but towards the micropylar end becoming somewhat lengthened parallel with the length of the egg. The cells are about ·02mm. in diameter, perhaps a shade larger in *A. populi*. In *A. populi* the lines dividing the cells are fine, and the centre of each cell has a small raised boss

* Grote robbed us of *Laothoë* in 1874 by fixing *populi* as the type of the genus, and thus annulling it, as a synonym of *Amorpha*; later, in 1895, he gives us *quercûs* as the type of *Polyptychus*, but Stephens had, in 1850, made *populi* the type of *Polyptychus*, which also made this genus a synonym of *Amorpha*.

rising in the middle of a depression. In *S. ocellata* the depression is hardly to be detected. In *M. tiliae* these markings cannot be always observed owing to gum, but in one specimen, in consequence or in spite of the gum, the ridges dividing the cells were broad and flat, and left a depression marking each cell with a small, central, raised boss. The micropyle was not seen in the egg of *M. tiliae*. In *Amorpha* and *Smerinthus* it is a small rosette of about 20 narrow cells some ·04mm. in diameter, apparently with a few smaller central cells. It is to be noted that the narrower end of the egg is the nadir, the thicker the micropylar end. The measurements are—

	A. populi.	*S. ocellata.*	*M. tiliae.*
Greatest length	2·05mm.	2·05mm.	1·95mm.
Greatest breadth	1·70mm.	1·55mm.	1·55mm.
Lesser breadth (towards nadir)..	1·65mm.	——	——
Greatest height	1·60mm.	1·30mm.	1·35mm.
Lesser height (towards nadir) ..	1·45mm.	1·15mm.	1·10mm.
Diameter of cells of sculpture ..	·022mm.	·02mm.	·02mm.

There is some probability that the peculiar character of the sculpturing of the egg surface is due to the cement covering hardening and contracting in peculiar relation to what is probably the true sculpturing, *viz.*, a simple fine network, the fine lines of the network attracting some of the cement, and the remainder aggregating in the centre of each cell. These eggs present what is an almost invariable character of flat eggs, *viz.*, a depression of the upper surface, slowly increasing from day to day as evaporation goes on. That of *S. ocellata* seems to yield most readily to this change, that of *M. tiliae* comparatively little, a difference no doubt due to the great thickness of cement that clothes the latter, acting as a great check to evaporation (Chapman).

Larva.—*Newly hatched :* The larvæ of these three species are extraordinarily alike and the likeness goes into much detail. Not much short of ¼in. long, when they stretch themselves, and with large green heads, they are almost identical in size and outline as well as in colour. *A. populi* is of a paler, whiter green. To the naked eye they are distinguishable by the colour of the horn. In *A. populi* this is a green almost the same as the rest of the larva. In *S. ocellata* a pinkish-red, and in *M. tiliae* a dark fuscous shade, seen with a glass to be more marked on the upper and under aspects of the horn. A sharp eye may also detect that the larvæ of *Amorpha* and *Smerinthus* have already the lateral oblique lines distinguishable as of a slightly different shade of green, whilst that of *M. tiliae* has no trace of them, but has a broad subdorsal and a not quite so broad lateral longitudinal stripe. All have 8 subsegments to the abdominal segments, and all have forked hairs. In these there is some little difference in each species. There is also a difference in the crochets of the prolegs. Three larger hairs of the same forked character as the minute ones mark tubercles i, ii and iii, the latter being the least obvious; they are on subsegments 3, 6 and 4 respectively. On the 2nd and 3rd thoracic segments there is a subsegment rather broader than the others, and terminating by a sulcus just above the spiracular region. This is the 3rd or 4th subsegment of the 5 or 6 which seems to be the number of subsegments on these segments. This subsegment carries three tubercles which are in line with i, ii and iii. The first two (i and ii) carry two forked hairs, one in front of the other, the third (iii) carries only one. These are substantially the same in all the larvæ, but are, perhaps, a little more easily seen in *M. tiliae*. The crochets seem to be 9 in number usually, they are of a much darker brown in *A. populi* than in the others. The forked hairs differ in the three species. In all, the larger hairs have the forks less pronounced, the smaller hairs vary much in size in the same individual in different places, so that it is difficult to say that they differ in size in the different species, but the forked extremity has a specific form in each case. In *S. ocellata* there is very little enlargement at the point of forking, the hair being little more than bifurcate, the two branches leaning at an angle of 120°, and being between ⅓ and ¼ the length of the hair in length, and tapering regularly to a fine point. In *A. populi* the branches are rather shorter, spread more laterally, and have the angle between them so filled up as in some degree to make them resemble a fish's tail, especially as the central thin lamella is marked with radial lines, and even slightly notched at the margin. In *M. tiliae* the two branches spread nearly at right angles to the stem, and so there is little room between them to fill up, yet there is a central portion that actually projects at the angle between the branches, and is marked by a few radial lines. The branches are perhaps proportionally a little longer than n *A. populi* *. The horns are of almost exactly the same length in all three species, *viz.*, 2·2mm., and terminate in two hairs, each about 0·14mm. long. *S. ocellata* has a larger number of long hairs on it than the others. On *M. tiliae* the fine hairs are much shorter than on the other species, and with insufficient magnification look as if they were merely simple hairs; they are, however, forked as in the other species. The horn of *A. populi* is rather shorter than in the others. *Fullgrown (in 1st instar)*.—When the three larvæ are fullgrown in this (first) instar, they present decided differences. *S. ocellata* is rather over $\frac{3}{8}$in. long, and of much the outline and proportion of the larva in its last instar. *A. populi* is much the same, but appreciably longer and a little more slender, whilst *M. tiliae* is longer and more slender to a remarkable degree, being almost exactly ·5in. long, but not more bulky than the others. The markings also differ. *A. populi* has the oblique lines bright yellow on a green ground, the two colours only, each definite and distinct, and with no intermediate shades; half-way down these there is a longitudinal yellow line, of about the same width as the oblique lines, and of the same colour; this extends right up to 1st segment. The dorsal tubercles of the thoracic segments are also yellow. The dorsal ends of the oblique lines are indistinct on the two posterior subsegments, and appear to terminate with square ends (on 6th subsegment) at some distance from the dorsal line. *S. ocellata* is very similar, but the anterior margin of the oblique lines is sharp, whilst the posterior rather shades off into the ground colour; the upper margin of the longitudinal line does the same, and between them they invade nearly the whole of the ground colour in the triangle between them; the oblique lines further continue backwards just below the dorsal line, along the whole of the next segment behind, and so cut off a very definite dark green dorsal line; below the longitudinal line, the oblique ones are narrower and more definite, and stretch forwards for two or three subsegments of the preceding segment, but less distinctly than they do in *A. populi* for nearly the whole segment. *S. ocellata*, instead of the two colours yellow and green, has deep blue-green (dorsal line), green, yellowish-green, and yellow (and the red horn). *M. tiliae* has the longitudinal line much broader than in either of the others, and at first sight the oblique lines are wanting; they may, however, be traced as very narrow lines, most visible below the longitudinal line, but also through it. The longitudinal line is much less a line than in the others, but a broad shade, fading above and below into the ground colour. The dorsal line is dark blue-green. The longitudinal line is whitish- or yellowish-green rather than yellow. The whole larva of more uniform aspect than the others, and of a bluer and whiter general tone. *Second instar.*—In *M. tiliae*, the larva, in colour, etc., is not very different from that of the first instar, but the subsegments have now each one row of rather large mammillæ (Poulton's "shagreening" = cone-shaped bases of secondary hairs) so large that their bases occupy the whole width of the subsegment; at the date of moulting and before the larva has grown, these are tall and end in a hair or spine, slightly thickened at the end, and carrying several fine points. They are no longer bifurcate or fish-tail hairs, but these are still represented by a few very small hairs between and beside the mammillæ. In *A. populi*, second instar, the larva is green, slightly paler horn, 1st and last oblique line much stronger than others, longitudinal line narrow and very distinct. It presents the same mammillæ as in that of *M. tiliae*, ranged in one row along each subsegment, but a condition hardly observable in *M. tiliae* is here very pronounced, *viz.*, that the mammillæ are yellow on the green ground colour, and are very large and pronounced in the yellow oblique and longitudinal lines, and indeed form these lines, whilst elsewhere they are much smaller, and, in the greenest areas, are practically absent. The hairs with which they are crowned are shorter than in *M. tiliae* and have the same thickened spiculate summit. The very small bifurcate hairs distributed amongst the mammillæ are, owing to the open spaces, more numerous than in *M. tiliae*. In *S. ocellata*, second instar, the conditions resemble *A. populi* in the great variations in the size of the mammillæ, and the way they form the markings. The mammillæ are nearly white, their terminal hairs are as finely bifurcate as in the first instar, and the fine intermediate hairs are so similarly. The head in first instar is rounded, in the second it possesses in *S. ocellata* a pair

* Perhaps it would be more accurate to say that the forked hairs of the smaller sort do not differ in the three species quite so much as described above, but that they do differ in the directions stated, fairly fish-tailed forms occur among the smaller hairs of *S. ocellata*, the fine acutely branched form described is distinctive of *S. ocellata*, but affects the larger hairs. The larger hairs of *A. populi* and *M. tiliae* are not bifurcate but only a little thickened and slightly spiculate at top.

of very definite little horns, side by side, in which the two halves of the epicranium terminate above and in front. In *M. tiliae* these also exist, but are not very obvious unless looked for. In *A. populi* they are absent unless two points, not close together, and just like the other minute tubercles of the head, though a little larger, represent them. The comparative form of the larvæ of *M. tiliae* and *S. ocellata* may be shown by the measurements of specimens fullgrown in second stage: *S. ocellata*—length, 14mm., thickness, 2·5mm. *M. tiliae*—length, 18mm., thickness, 2·1mm. *Third instar*.—The larva of *A. populi* in third instar has the hairs crowning the now very numerous tubercular or mammillary spots extremely minute, and apparently with no terminal branchings or dilatations. The bases of the bristles on thoracic legs are raised into mammillæ, but not to the degree found in *S. ocellata*. The larva of *S. ocellata* in third instar has the very numerous tubercular dots or mammillæ white, and these mark out the stripes by their larger size along their lines of direction. They carry very small pale hairs, and these are still very distinctly bifid at their extremities, as also those on horn, which is bifid at extremity, but without hairs; these mammillæ also invade the surface of the thoracic legs, which are usually so smooth (apart from ordinary bristles), as well as the very pronounced double red frontal horn, which is a specialisation of the tubercles. The larva of *M. tiliae* in the third instar has minute hairs on mammillary points apparently simple as well as those upon caudal horn; true legs slightly tubercular. It reserves its long slender facies (Chapman).

Larval head.—The head of the larva of *A. populi* in 1st stadium appears to be triangular in comparison with those of *S. ocellata* and *M. tiliae*. It is not actually triangular, but has a decided tendency to lengthen and to become pointed at apex when viewed from the front. It is worthy of note that it is less angular in adult stage than are those of *M. tiliae* and *S. ocellata* (Bacot).

Pupa.—The pupæ of *M. tiliae* and *S. ocellata* are enclosed in a frail cell or cocoon, composed of earth, spun together with a few slight silk threads. In the case of *A. populi*, I could find no trace of silk, nor were the pupæ enclosed in a cell, although they were supplied with the same material as the others in which to pupate. As a rule, those of *A. populi* are only just beneath the surface, while the larvæ of *M. tiliae* and *S. ocellata* may burrow to a depth of several inches. The difference between the pupæ of the Amorphids and those of the rest of the *Sphingidae* is very striking; the chief points are the shortness of the wing-cases and the complete absence of the sheath of the tongue, in addition to which, they are thicker and more rounded, the head is small and does not project so far, and the small size of the eye-cases is very noticeable. On the surface, the pupæ of *M. tiliae* and *A. populi* are much alike, the latter being rather the rougher of the two. The bosses on either side of the anus are very distinct in both species. In colour, the pupa of *M. tiliae* is of a deep red-brown, while that of *A. populi* is of a dead black with, when quite dry, a slight greyish tint on the antenna-cases and other raised surfaces. In shape, that of *M. tiliae* is more like that of *S. ligustri* than that of *A. populi*, which is by far the shortest and dumpiest of the three. The pupa of *S. ocellata* comes between the other two as regards shape, but is much more rounded at the anal end, the bosses on either side of anus being, as a rule, hardly visible; it has a smooth polished surface, and is of a deep brown or black colour. The anal spike is largest and thickest in *M. tiliae*, in *S. ocellata* it is smooth and relatively smaller, while in *A. populi* it is much smaller, and generally sharp and slender (Bacot).

Imaginal frenulum.—The imago of *M. tiliae* possesses the loop and bristle fairly well developed, and certainly quite effective, as the ♂ has a well-defined loop, and the bristles of the ♀ are sufficiently long to interlock with the scales of the forewing. In *S. ocellata* the male has a very short bristle, and the female a cluster of very small ones; the loop of the male is absent, and the whole appliance is probably useless, or nearly so. The male of *A. populi* possesses the prominence on the hindwing from which, in other species, the bristle proceeds; this is rounded in outline, and, in some few examples, terminates in a minute point, which can hardly be called a bristle; all the female specimens which I have examined microscopically, have a very small but perfectly formed bunch of bristles lying close to the edge of the wing, but clearly in both sexes the appliance is quite useless and is merely a survival. [Although for the sake of simplicity, it may seem well to follow the usual course of uniting our three British Amorphids in one genus, yet, taking into account the allied European and Exotic species there is probably good ground for considering *tiliae* at least to be generically distinct from the other two, even if they are not all three representatives of different genera, not in respect of diversities of the frenulum alone, but in view of many other points] (Griffiths).

GENITALIA.—(1) *A. populi* ♂. The superior harpes are rounded and full, having an acute angle on the inner margin. The inferior harpes bifurcate at the extremity, the inner hook being elongated, the outer hook short and abrupt. The uncus is elongated and rounded at the tip. The flap is large, gently tapering to a point. The penis is irregularly curved, surmounted by about 30 or 40 spines (*Ent. Rec.*, x., pl. iii., fig. 3). (2) *S. ocellata** ♂.—The superior harpes broad and rounded, having an acute angle at the inner margin. The inferior harpes short and toothed on the inner margin and terminated by a single pointed hook. The outer margin is indented just past the middle, and again nearer the extremity, forming an acute angle. The uncus is abruptly elongated, terminating in a point or beak. The flap is gently pointed, almost forming a right angle, with the tip slightly rounded. The penis is bulbed, slightly produced at the base, it then ascends almost parallel, having a sharp hook on the lip, and is surmounted with a large number of short, thin spines (*loc. cit.*, pl. iii., fig. 2). (3) *M. tiliae* ♂.—The superior harpes are short and square. The inferior harpes are bifurcate at the extremity, with two equal projections. The uncus is broad and rounded, slightly indented at the lip. The penis is long and slender, widening at the base into two lobes, surmounted by two short spines (*loc. cit.*, pl. iii., fig. 1). (4) *A. populi* ♀.—The organs consist of two lobes, covered with tubercles, each of which emits a short, stiff hair, and have somewhat the appearance of a spider's spinneret ; there is also the ovipositor, which consists of a short tube ; this is placed about three parts of the way down the final segment (*loc. cit.*, pl. iii., fig. 6). (5) *S. ocellata* ♀.—The female of this species has so nearly similar organs to those of the last, that further description is unnecessary (*loc. cit.*, pl. iii., fig. 5) (Pierce).

Gynandromorphism is very prevalent in *Amorpha populi* and *Smerinthus* hybr. *hybridus*. Schultz notes the following (*Ill. Woch. für Ent.*, i., pp. 367—368; ii., pp. 393—395; iii., pp. 135—137): *Mimas tiliae*, 3 examples; *Smerinthus ocellata*, 2; *S.* hybr. *hybridus*, 7; *Amorpha populi*, 66.

Parthenogenesis is reputed to have occurred in *Mimas tiliae* and *Smerinthus ocellata* (see *Ent. Rec.*, vi., p. 71).

One of the most interesting features of the Amorphid genera is the comparative ease with which some of the species hybridise. The best known hybrid is *Smerinthus* hybr. *hybridus* (*ocellata* ♂ × *populi* ♀), the reciprocal cross *Amorpha* hybr. *inversa* (*populi* × *ocellata*) being much more rarely obtained. The crossing of *Amorpha austauti* ♂, the large north African representative of *A. populi*, with

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* *S.* hybr. *hybridus* (*ocellata* ♂ × *populi* ♀), ♂.—The superior harpes are narrower, rounded, and have the acute angle on the inner margin. The inferior harpes are long and simple, gently tapering into a long thin point, straight on the outer margin. The uncus is abruptly elongated, terminating in a pointed beak. The flap is produced, roundly tapering to a point. The penis is almost bulbed at the base, proceeds in a parallel direction, and is surmounted with about 20 small spines bunched together. In point of size, there is very little difference in the three (*ocellata*, *hybridus* and *populi*) (*Ent. Rec.*, x., pl. iii., fig. 4) (Pierce). I would point out that the genitalia of the male hybrids differ from those of the males of both parental species, but the organs of the ♀ hybrid tend towards gynandromorphism. On the other hand, the sexual organs of the pupæ show no tendency whatever towards a confusion of the sexes, nor do they differ in any respect from those of *S. ocellata* or *A. populi* in this stage. This is, I suppose, only what might have been expected, as the imaginal characters are subjected to the influences of both natural selection and intra-selection, while the rudimentary pupal organs escape all these influences, except the slow reducing action of intra-selection in the embryonic stage (Bacot). It will be noticed that in no point does the ♂ genital structure of the hybrid agree with that of ♂ *M. tiliae*, but we find the male hybrid, to a certain extent, agreeing with *S. ocellata* in the uncus, the hook on the lip of the penis, and in the rounded portion of the apparatus at the base. The flap rather approaches (*vide*, *loc. cit.*, pl. iii) to that of *A. populi*, the lower portion of the penis being divided between the two parent species, and partaking of the characters of both. It will thus be seen that the apparently male specimens possess distinctly male organs, all of which are highly developed and different from those of the parents (Pierce).

S. atlanticus ♀, the north African representative of *S. ocellata*, is practically identical with the last-named hybrid form (*A.* hybr. *inversa*), whilst the crossing of *S. atlanticus* ♂ with *A. populi* ♀ (=hybr. *fringsi)* must be considered as being little more than a repetition of the more common crossing *S.* hybr. *hybridus*, although Standfuss states that there is a physiological difference between *ocellata* and *atlanticus*. The crossing of the American *Calasymbolus astylus* with *S. ocellata* is exceedingly interesting, but that of *Mimas tiliae* with *Smerinthus ocellata*, to the student of Palæarctic lepidoptera, is even more so. Grover records (*Ent. Rec.*, ix., p. 233) the pairing of *A. populi* ♂ and *M. tiliae* ♀, on the evening of June 18th, 1897; ova were deposited during the afternoon and evening of June 19th, the ♀ dying during the night. The eggs proved fertile, but no further details were published*. Pickett also notes (*loc. cit.*, xii., pp. 215—216) cross-pairing between (1) *ocellata* ♂ × *populi* ♀; (2) *populi* ♂ × *ocellata* ♀; (3) *ocellata* ♂ × *tiliae* ♀. The first couple were paired 48 hours, and the ♀ laid 90 eggs. The second only remained paired about an hour, and the ♀ laid 56 eggs. The third only remained paired half-an-hour, and the ♀ only laid 6 eggs, all on the underside of lime leaves. The more important available details on the subject of hybridity in the Amorphids, and the various crosses that have been obtained, appear to be as follows:

1. MIMAS hybr. LEONIÆ, Stdfss. (*tiliae* ♂ × *ocellata* ♀).—Only ♀s obtained. This hybrid resembles *M. tiliae* much more than the robust *S. ocellata*. (*a*) The peculiarities in which it resembles *M. tiliae* are as follows: "Les antennes peu fortes, mais mesurant presque la moitié de la longueur des ailes antérieures, la finesse du thorax et de l'abdomen, la forme étroite allongée des deux paires d'ailes, les contours gracieusement ondulés du bord externe des ailes antérieures, donnent la caractéristique de l'aspect d'ensemble de ce nouvel hybride. Ce papillon dans ses dessins ressemble aussi sensiblement davantage à la *S. tiliae* qu'à la *S. ocellata*, en ce que l'aile antérieure porte en dessus, vers son milieu environ, une tache triangulaire très accentuée. Cette tache, dont le côté extérieur a une forme légèrement arquée à sa partie la plus large près de la côte, va de là en se rétrécissant vers le bord inférieur, et s'affaiblit parfois tellement qu'elle finit par disparaître dans la couleur plus claire du fond. Chez la *S. tiliae* ce dessin central de l'aile antérieure ne forme pas en général une tache compacte, mais cette tache est coupée le plus souvent, à peu près au milieu, par une bande plus ou moins large de la couleur du fond, ou du moins elle est distinctement étranglée. Entre cette large tache triangulaire et le bord externe, mais plus près de la tache, l'aile antérieure de notre hybride est traversée du haut en bas par la ligne ondulée qui n'est pas très nettement marquée, et qui, d'une manière générale, suit une direction parallèle au bord externe de l'aile. Cette ligne ondulée n'existe que rarement chez la *S. tiliae*, et même alors elle est très indistincte, tandis que chez la *S. ocellata* on trouve toujours une double ligne ondulée, étroite, mais bien marquée. D'après cela nous devons reconnaître dans cette ligne ondulée de l'hybride l'origine de la *S. ocellata*." (*b*) The peculiarities in which it most nearly resembles *S. ocellata* are as follows: "La large bande foncée sur le sommet du thorax, qui ne présente chez la *S. tiliae* qu'une ligne assez étroite, mais c'est surtout une tache noirâtre de forme arrondie en dessus de l'angle anal des ailes postérieures, à l'endroit, depuis lequel une ombre foncée s'étend jusqu'à l'angle anal. Le plus souvent cette tache noire porte à son bord supérieur une bande arquée d'écailles d'un gris bleuâtre qui se dirige vers la racine de l'aile. C'est là un faible souvenir du brillant œil bleu de la *S. ocellata*, qui lui-même est ramené par là à un degré primitif de son développement, tel qu'il se trouve par exemple chez la *S. kindermanni*, Ld., du Pont (Asie Mineure). Entre cette tache ronde et la racine de l'aile postérieure se montre, chez quelques individus, une teinte obscure, de couleur rouge cerise, rappelant encore la provenance de la *S. ocellata*; tandis que

* Bacot states that he had some of these eggs, that they produced normal *M. tiliae* larvæ, and that one perfected a normal imago of *M. tiliae*, so that pairing with a ♂ *M. tiliae* had probably previously taken place (*in litt.*).

d'autres individus, par la teinte brun clair de cette même tache, s'éloignent à peine de la *S. tiliae*. La coloration générale varie beaucoup d'un individu à un autre. Les tons gris verdâtre, ou gris brun, sont la règle chez le peu d'individus obtenus jusqu'ici. Le coloris ne passe au brun rouge que chez un seul exemplaire. De même la couleur des ailes postérieures en dessus varie sensiblement, entre le brun clair et le gris brun foncé. L'envergure moyenne des ailes n'est guère que de 60 mill. tout au plus, elle est donc sensiblement plus petite que celle de la *S. tiliae*, laquelle atteint près de 70 mill. Les ailes de ces hybrides ne se développent souvent pas du tout, d'autres fois seulement très imparfaitement, et même, chez les individus les mieux formés, il se présente fréquemment, çà et là, de petites lacunes au bord externe des ailes" (Standfuss, *Bull. Soc. Ent. Fr.*, 1901, p. 86).

2. CALASYMBOLUS hybr. INTERFAUNUS, Neum. (*astylus* ♂ × *ocellata* ♀).—The imagines look remarkably alike, and are nearly all of the normal large size of *S. ocellata*, measuring from 67mm.—73mm. across the wings. The shape of the primaries is more of the peculiar cut of *Calasymbolus astylus* on an enlarged scale, while the secondaries are those of *S. ocellata* with less dentation of outer margin near the anal angle. The following characters are uniform in all examples: A large, brown, thoracic central stripe from head to body, as in *astylus*. Entire absence of the scalloped outer margin of primaries so prominent in *ocellata*. Only faint traces of discal spot; transverse lines on primaries much less undulated than in *ocellata*, and the basal space of the triangular appearance of that of *astylus*, formed by the diagonal line from basal part of costa joining marginal dash on submedian. Coloration of primaries a mixture of *ocellata* and *astylus*, with a fresh rosy hue prevailing. Secondaries light chestnut, with basal area of light rose; the ocellated spot, although smaller than in *ocellata*, is about twice the size of that of *astylus*, with a heavy black rim and centre. Below, both wings as in *ocellata*, with the entire absence of discal dot in primaries. Abdomen light chestnut, with an overcast of light rose; 12 ♂ examples (Neumoegen).

Pupæ of *S. ocellata* imported from Germany by Rix, of New York, disclosed, among others, in 1893, a ♀ which was tied to a twig of syringa to see whether she would attract an American "beau." The next morning a ♂ *Calasymbolus (Paonias*) astylus* was found in copulation with her. The eggs, which she afterwards laid were fertile, and many of the larvæ from them pupated in the autumn of 1893. In the summer of 1894, 25 ♂s emerged, whilst some 20 more apparently healthy pupæ, went over a second winter (*Entom. News*, v., p. 326).

3. SMERINTHUS hybr. HYBRIDUS†, Stphs. (*ocellata* ♂ × *populi* ♀).—Five examples, 4 ♂s, 1 ♀.—They are almost perfectly intermediate between the two species. The forewings have all the characters of both species, the basal line as in *A. populi*, but with distinct traces of a shade, showing the angulation of the basal line seen in *S. ocellata*, the hindwings have the fulvous basal patch of *A. populi* (no red colour) and indistinct eye-spot, characteristic of *S. ocellata*. Ova laid May 31st, 1890, larvæ appeared in due course and pupated between July 20th—27th. Ten imagines appeared three weeks later (Tutt, *Ent. Rec.*, i., p. 203).

Standfuss observes (*Handbuch*, etc., p. 54) that this hybrid has repeatedly been bred in captivity in many places, and has also been observed in a state of nature in Schilling, Saarau, Silesia; according to outward appearance, this cross results in an intermediate between the two species, the blind grey-blue ocellated spot strongly suggesting, on superficial examination, *S. ocellata*, but in the form of the wing coming much nearer *A. populi*; the extremely rare ♀s of this hybrid have the ocellated spot, as a rule, very ill-developed, sometimes almost entirely wanting, so that this sex reminds one more of *A. populi*; the ♂ of this hybrid is said to

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* The type of the genus *Paonias* was fixed as *ocellata* by Stephens in 1850, and therefore falls as a synonym of *Smerinthus*. *Calasymbolus* had *astylus* fixed as type by Grote, in 1874, and must stand for this species.

† Treated at length later in the volume (see *posteà*).

produce, when crossed back with *populi* ♀, or wild *ocellata* ♀, a reversion to the physiological peculiarities, etc., of the pure species. We know nothing of the crossing of these ♂ hybrids with the parent ♀s, nor can we find any references to any literature on the subject. Standfuss further notes (*in litt.*) breeding some 500 specimens of S. hybr. *hybridus* in 1901.

4. SMERINTHUS hybr. OBERTHUERI, Tutt (*atlanticus* ♂ × *austauti* ♀).—I have only once, out of many attempts, successfully reared imagines, in which *atlanticus* was the ♂ and *austauti* the ♀ parent. The imagines do not differ sensibly from *A.* hybr. *metis*, the cross in which the sexes are reversed. The general characters of the cross are very nearly the same; it is, however, larger, without doubt because the ♀ *austauti* is larger than ♀ *atlanticus*. Thus the reversal of the sexes in crossing these African Amorphids, produced no such marked differences on the resulting progeny as those recorded in the progeny of *A. populi* and *S. ocellata* by reversing the sexes (Austaut, *in litt.*, April 4th, 1902).

We are indebted to the kindness of M. Oberthür in obtaining for us from M. Austaut a note on the breeding of this cross. If, as appears very probable, *atlanticus* be only a form of *S. ocellata*, and *austauti* a form of *A. populi*, the hybrid will of course rank merely as a variety of *S.* hybr. *hybridus*. We give them separately, however, for purposes of reference and future work.

5. SMERINTHUS hybr. FRINGSI, Stdfss. (*atlanticus* ♂ × *populi* ♀).—Ce nouvel hybride, de belle taille et vif coloris, provient du croisement de la *S. atlanticus* ♂ et de la *S. populi* ♀. Cette belle forme de Smérinthe se rapproche sensiblement plus de la *S. populi* que de la *S. atlanticus*. Bon nombre d'entomologistes voient dans cette *S. atlanticus* une espèce spéciale, en tous cas on pourrait l'envisager comme étant la forme locale nord-africaine, sud-oranaise, etc. (*cfr.*, Standfuss, *Handbuch*, &c, p. 55) correspondante à notre *S. ocellata*. Au reste, ce sont précisément ces croisements qui nous montrent que la *S. atlanticus* (abstraction faite de ses particularités morphologiques et biologiques dont nous n'avons pas à nous occuper ici) est aussi physiologiquement différente de la *S. ocellata*. (1) La *S.* hybr. *fringsi* tient de la *S. populi*—la largeur de ses ailes, lesquelles sont toutes visiblement ondulées à leur bord externe, puis d'une manière générale le dessin et le coloris du ton, tantôt plus gris, tantôt plus rougeâtre. (2) D'autre part l'influence de la *S. atlanticus* se montre—dans un œil gris bleuâtre clair, sur champ foncé, devant l'angle anal des ailes postérieures. Cet œil toujours plus ou moins vague disparaît parfois presque entièrement. En outre, le dessous des ailes antérieures est lavé de rouge dans sa première moitié. Enfin on remarque parfois une teinte foncée sur le milieu du thorax qui très souvent ne s'aperçoit qu'à peine. (3) Quant à la forme bien connue de *S.* hybr. *hybridus* qui est le produit de *S. populi* ♂ avec *S. ocellata* ♀*, notre hybride s'en distingue: (*a*) Par sa grandeur plus considérable, envergure moyenne 78mm.—82mm. tandis que *S.* hybr. *hybridus* ne mesure en général que 70mm. à 75mm. (*b*) Par une plus grande largeur des ailes. (*c*) Par les dessins plus fortement marqués des quatre ailes tant en dessus qu'en dessous. (*d*) Par l'apparition plus fréquente d'individus femelles normalement développés (d'après mes expériences faites sur 7 pontes, 10 per cent., tandis que les 22 pontes de *S.* hybr. *hybridus* que j'ai élevées jusqu'ici ne m'ont donné que 2 per cent. d' individus femelles). En outre, en examinant les choses de plus près, on s'aperçoit que ces insectes ne sont jamais normalement développés quant aux caractères secondaires de leur sexe. Leurs antennes sont en général bien plus fortes que chez les femelles des deux types, et, de plus, ces antennes ont souvent, non seulement des dents, comme les antennes mâles, mais elles portent même des cils. Plusieurs de ces derniers individus présentent même des pinces du mâle. Il ne m'a pas encore été possible de faire des recherches anatomiques sur la structure interne de leur corps, et je ne pense pas non plus qu'un pareil essai ait été tenté ailleurs. Si l'on compare cette nombreuse présence d'individus femelles normalement développées parmi les *S.* hybr. *fringsi*, avec le rendement du croisement de *S.* hybr. *hybridus*, on en vient à conclure à une différence physiologique entre *S. atlanticus* et *S.*

* Standfuss is here in error. *S.* hybr. *hybridus*, Stephs., is the cross *ocellata* ♂ × *populi* ♀.

ocellata (*cfr.*, Standfuss, "Exper. Zool. Studien," *Denkschrift. der allgem. schweiz. Gesellsch. für die gesammt. Naturwissenschaften*, 1898, pp. 43—44). Ceci étant, nous sommes forcés de reconnaître que la *S. atlanticus* est sous certains rapports physiologiques moins avancée que la *S. ocellata.* (4) M. Austaut a déjà souvent introduit le produit du croisement de *S. atlanticus* avec *S. austauti*. Cette *S. austauti* est la forme locale gigantesque du Nord de l'Afrique qui correspond à la *S. populi* de nos régions. Notre *S.* hybr. *fringsi* se distingue dudit hybride de M. Austaut par les caractères suivants: (*a*) L'envergure des ailes, 78—82mm., qui reste en dessous de l'envergure de la *S.* hybr. *metis*, qui atteint 95mm. et davantage encore. (*b*) Des ailes relativement plus larges. (*c*) Des couleurs plus vives, des dessins plus fortement marqués, ce qui n'est pas le cas chez la *S.* hybr. *metis* qui conformément à la *S. austauti*, dont il provient, n'a que des lignes ondulées assez peu distinctes. (*d*) Les proportions entre les individus mâles et les individus femelles normalement développés semblent être à peu près les mêmes entre les deux formes hybrides. En effet M. Austaut a eu l'obligeance de m' informer qu'il obtint, en tout, de ses magnifiques hybrides, 45 individus mâles et 5 individus femelles (Standfuss, *Bull. Soc. Ent. Fr.*, 1901, pp. 87—89).

This is also, of course, if *atlanticus* be really only the north African form of *S. ocellata*, a variety of *S.* hybr. *hybridus*, Stephs. Standfuss, however, in his description, suggests some physiological differences between *ocellata* and *atlanticus*, so that we have retained the name, which otherwise, perhaps, should sink as a synonym of *S.* hybr. *hybridus*, Stephs.

6. Amorpha hybr. metis, Aust. (*austauti* ♂ × *atlanticus* ♀) and ab. deleta, Aust.—Size of medium-sized examples of *A. austauti*, and general form of wings nearly like that of this latter species, that is to say, rather broad and hardly dentated along the outer margins. Upperside of forewings of a reddish tint, analogous to that of ab. *incarnata*, with the pattern arranged as follows: 1st, a basal area of rosy-grey, traversed by a brown transverse line, sinuate, and bounded externally by another transverse line, which is lighter and slightly arcuate or convex; 2nd, a broad median area of a darker grey, uniform, slightly lighter on the costa, marked with a small white cellular spot, and bordered by two narrow parallel bands, the one grey, the other brown, not much sinuated, and very slightly undulated; and 3rd, another terminal area, rather narrow, of a rosy-grey, marked towards the middle of the outer margin by a "semilunar" brown spot. The outer angle is marked with a blackish spot. Finally, a dark brown line, almost straight, traverses the middle of the wing a little beyond the cellular white spot. The upperside of the hindwings is of a rather bright amaranth-red, darker at the base than towards the opposite extremity. Anal region of the wing covered by a very large fuliginous black ocellated spot, subtriangular, with outline not much interrupted, and of which the centre is occupied by a whitish pupil. Anterior margin of the wing of a sombre grey, showing the following transverse markings: 1st, a dark grey band margined on each side by a pale grey border; 2nd, a line of an obscure dark red descending obliquely from the anterior margin to the abdominal margin, after having, by a flexuous movement, gone round the summit of the large ocellated black spot. Body relatively long, of a rosy-grey, with the abdominal incisions paler; a longitudinal spot of a very pale brown, and very straight, on the middle of the thorax. Antennæ whitish as in those of most Amorphids. Palpi tawny on the edges, adorned with some brown hairs. Tibiæ of the first two pairs of legs pale brown. All these characters, except as below noted, are invariable in the 6 examples, all ♂s, which I have before me. But the general tint is not reddish in 3 of them, but cinereous-grey analogous to that of typical *A. austauti*. In these latter, also, the amaranth-coloured spot which covers the lower part of the secondaries has become replaced by a pale brown, while that which normally occupies the disc of the reverse side of the superiors is completely wanting. This modification is so decided that I consider it an aberrant form, deserving a separate name. I call it *deleta*. Its aspect is nearer that of *austauti*, while the reddish type, especially on account of the amaranth-coloured wash of the secondaries, more resembles *atlanticus*. From more than 150 eggs, almost all fertile, only 32 larvæ were obtained, of which only 6 reached pupation. The larva is intermediate between those of the parents (Austaut, *Le Nat.*, xiv., p. 230).

Austaut writes (*in litt.*, April 4th, 1902): "I have only obtained imagines of this cross three times in fifteen years. The imagines of this crossing are exceedingly difficult to obtain. It is, in the first place, necessary to sacrifice many couples to get eggs; the eggs are, then, for the most part, infertile, and the larvæ when obtained are extremely delicate, a combination of circumstances that makes the obtaining of imagines very problematical."

7. AMORPHA hybr. INVERSA, Tutt (*populi* ♂ × *ocellata* ♀*).—The intermediate form only appears with the cross *ocellata* ♂ × *populi* ♀. The reciprocal cross, *populi* ♂ × *ocellata* ♀, produces an insect indistinguishable from the ♂ parent according to the observations (probably insufficient) already made (Staudinger, *Berl. Ent. Zeits.*, xviii., p. 149). The cross *populi* ♂ × *ocellata* ♀ shows in the specimens, which I have *thus far seen*, an insect which cannot be distinguished from a very aberrant *A. populi;* it is, however, very doubtful whether the form is constant throughout, for *S. austauti* ♂ × *atlanticus* ♀ produces likewise a form with blind ocellated spots on hindwings (*Le Nat.*, 1893, pp 230—231); *S. austauti* is, however, probably the Algerian local form of *A. populi*, and *S. atlanticus* the corresponding race of *S. ocellata* (Standfuss, *Handbuch*, &c., p. 55).

This is, of course, if *austauti* be simply the north African form of *populi*, and *atlanticus* the form of *ocellata* from the same district, merely a variety of *A.* hybr. *metis.* It has, however, been so long under discussion that we give the various notes referring to it separately from the account of *metis.* Thus, House records (*Trans. Ent. Soc. London*, 1842, p. 194) obtaining a pairing between *populi* ♂ × *ocellata* ♀, but the eggs laid did not hatch; similarly, Bacot records (*Ent. Rec.*, ix., p. 299) a pairing of *populi* ♂ × *ocellata* ♀, the ♀ laying 78 eggs, on which some slight colour-changes took place, but none hatched, and he further calls attention (*loc. cit.*, vi., pp. 180—181; x., p. 190) to the fact that, so far as experiments in Britain had been conducted, larvæ had not been obtained from this cross, *i.e.*, in which *ocellata* was the ♀, and makes some interesting remarks on the possible reason of this result. Bacot's statement as to larvæ of this cross not having been obtained would appear to be not quite accurate, for Williams writes (*Ent.*, vii., p. 21): "This year, 1873, I bred out specimens of *Smerinthus ocellata* and *S. populi*, which I was lucky enough to cross, male *populi* with female *ocellata.* In about 24 hours the female began to deposit her batch of eggs, the eggs being laid in batches differing in number, and all unattached; the number deposited was 170, laid at intervals, more so after being disturbed. The duration of the egg stage was 15 days; the colour, at first bluish, changing in a few days to light flesh colour. The larvæ fed on apple leaves, but, after feeding for three weeks, began to wander from their food, and died with diarrhœa." Other pairings between these species have also been noted (see *Ent. Rec.*, xii., p. 215). As Standfuss and Staudinger refer to imagines of this cross, and we can find nothing of such in the entomological literature that we have searched, excepting Staudinger's and Standfuss' references (*suprà*), we wrote Standfuss, who replied (*in litt.*): "As Staudinger, some years ago, offered examples of this cross in his price list, I obtained a ♂ from him, which I still possess, and which I cannot distinguish from *A. populi;* further, Staudinger wrote to me that

* We cannot tell on what authority Dale makes the statement that "when a cross between a ♂ *populi* and a ♀ *ocellata* is effected, there is a slight difference between the hybrid thus produced and that above described (by Westwood) *ocellata* ♂ × *populi* ♀" (*Hist. Brit. Hawk Moths*, p. 25, 1893). Such crosses are quite unrecorded in Britain.

none of the moths of this crossing were distinguishable from *A. populi*. I was not able to learn from Staudinger whence he obtained the moths; I further received, as from this crossing, a ♀ from a Herr Rosenhagen of Posen, which I still possess, and which I am also unable to distinguish from *A. populi*. During 1900 and 1901, I obtained a large number of pairings of *populi* ♂ × *ocellata* ♀; those of 1900 all failed, in 1901 one out of many pairings gave a few eggs which produced larvæ; most of these died without feeding, but I obtained from the others a few pupæ which are going over the winter, and I hope at last to breed it myself. The pupæ lead me to expect a moth that will be quite distinguishable from *A. populi*" (March 3rd, 1902). It is to be observed that Austaut's hybr. *metis* is from *austauti* ♂ × *atlanticus* ♀ (=*populi* ♂ × *ocellata* ♀), whilst Standfuss' hybr. *fringsi* is from *atlanticus* ♂ × *populi* ♀ (=*ocellata* ♂ × *populi* ♀), that is, in the first case, the parentage of *S.* hybr. *inversa*, and, in the second case, the parentage of *S.* hybr. *hybridus*. It is further to be noticed that, in crossing *austauti* ♂ × *atlanticus* ♀ (=*populi* ♂ × *ocellata* ♀), Austaut really has obtained the reciprocal cross to *S.* hybr. *hybridus* in these local races, although, at present, detailed evidence is wanted as to the actual breeding of the cross of *populi* ♂ × *ocellata* ♀, from typical forms, to the imaginal stage. In 1901, in his account of *S.* hybr. *fringsi* (*anteà*, p. 393), Standfuss misquotes *S.* hybr. *hybridus* as *populi* ♂ × *ocellata* ♀, although he had, in 1896, quite correctly given it (*Handbuch*, p. 54) as being *ocellata* ♂ × *populi* ♀. Frings notes (*Soc. Ent.*, xv., p. 164) that he, himself, had never succeeded in obtaining a single larva from the eggs of the cross *populi* ♂ × *ocellata* ♀.

Of the habits of the British species, Bacot says: "*Mimas tiliae* emerges in the afternoon, in which respect it is very constant. Beales states (*Ent. Rec.*, vol. xiv., p. 165) that his specimens, whether forced or not, almost invariably emerged between twelve and two. The other two species usually emerge about midnight, although I have had some out as early as 9.30 p.m., and others as late as 8 a.m. Prout tells me that, when forced, they usually emerge between 5 p.m. and 7 p.m. *M. tiliae* is out during May and June. Barrett says there is no second brood, but Bellamy stated at one of the meetings of City of London Entomological Society, that he had seen a specimen as late as November 22nd. The other two species are also out during the same months. *Smerinthus ocellata* is partially double-brooded, and occurs again in August or September. *Amorpha populi* is said to be regularly double-brooded, the second brood coming out at the end of July and in August, and the rearing of three broods in one year has been recorded. The second brood of *A. populi* is, however, I fancy, only a partial one, the greater portion of the early pupæ going over the winter before emerging. Out of about forty larvæ that went down at the end of June, 1892, only five or six yielded imagines the same year; one of these was crippled, and the others rather undersized. I have frequently raised broods, no members of which emerged before the winter. The emergence of the first brood would seem to be spread over a considerable space of time; in 1894 I 'assembled' a perfectly fresh male on June 22nd, and a specimen is recorded (*Ent. Rec.*, vol. i., p. 180), as having been taken in a moth trap on July 8th. The well-known position assumed by the moths, when at rest, is undoubtedly protective so far as our British species are concerned. *M. tiliae* is said to rest on the young shoots that spring directly from the trunk of the lime, and to simulate a group of small leaves. I have seen one hanging from the top of a split oak fence, and it so exactly resembled a withered leaf that none but a practised eye could detect the difference. *S. ocellata* rests on bushes or hedges, and is said to exactly resemble a withered leaf or spray of leaves. I have never found one at large, but even in a breeding-cage, notwithstanding its large size and rich coloration, it is by no means a conspicuous object. That the ocellated spots are of some special use to the moth, is very evident, because they are such a constant character, and moreover, are well developed in the many allied species that are distributed over nearly the whole of the North Temperate Zone. *A. populi* is said to rest during the day on the trunks of poplars or on hedge-banks. I have only once found the moth at rest, and then it was on the trunk of a poplar, where it was not at all well protected. All three species are said to fly slowly and heavily at dusk, and again later in the night. I have never seen any of them on the wing spontaneously, but have thrown up *A. populi* and *S. ocellata* during the day; they had a feeble and fluttering flight, something like that of a bat, but slower. Bred specimens of both species are usually lively and active about dusk, and the males again from about 10.30 p.m. to midnight."

Of the distribution of the British species, Bacot says: "*Mimas tiliae* is much less common than either of the other two species. It is fairly plentiful and widely distributed in the south and south-east of England, scarce in the midlands, and very scarce, if not altogether absent, in the north of England, Scotland, Ireland and Wales. On the Continent, according to Kirby, it is common except in the extreme north and south; it also occurs in Siberia, and there is a specimen in the British Museum collection from Sierra Leone (!). *S. ocellata* is commonly distributed in the south and east of England, less commonly in the north of England and south of Scotland, in Ireland it is scarce but widely distributed. It occurs throughout Europe and northern Asia, and closely allied forms are found over nearly the whole of the North Temperate Zone. *A. populi* is found throughout Europe, except in the extreme north and south, and also in northern and western Asia. Barrett says: 'It appears to occur in all parts of the United Kingdom excepting the west of Scotland. It is scarce in the west of England and Wales, and in Ireland it is found wherever poplar is common. Formerly it was abundant in the south of England and even in London . . . now, however, it is rarely seen in the suburbs of London, and seems to be generally less common throughout the country.' My own experience is quite the reverse of that of Barrett. I have always found it common in the suburbs of London, in fact, much more plentiful in and around London than in any part of England that I have visited. In the City of London Society's 'ten-mile list,' Dr. Buckell tells me that it is recorded as occurring over the whole area. It also occurs in the west of Scotland."

Tribe: Mimantidi.

This tribe was separated by Hübner (*Verzeichniss*, p. 142) under the name *Mimantes*, and *tiliae* was made the exponent of the only genus, *Mimas*, placed in the group. It is possibly, in some respects, the most generalised of the Palæarctic *Amorphinae*, although in wing-shape, colour and markings, the imago may be said to be highly specialised. The larva, however, is longer and more slender than those of the Smerinthids and Amorphids (*sens. strict.*), and is much nearer, in this respect, to the larvæ of the more generalised species on the Sphingid side of the phylum. The cocoon of *M. tiliae*, also, often shows a considerable amount of silk, much more, usually, than one finds in the cocoons of Smerinthids or Amorphids (*sens. strict.*). The Mimantid pupa, too, is longer and more slender in outline, approaching more the typical Sphingid form than do the pupæ of the other Amorphids (*sens. lat.*), it is also somewhat rougher, and the anal spike is larger and thicker. The imago further shows characters that are rather Sphingid than Amorphid, *e.g.*, the frenulum is fairly well-developed and effective in *M. tiliae*, differing much in this respect from *Amorpha*, *Smerinthus*, etc.

Genus: Mimas, Hübner.

Synonymy.—Genus: *Mimas*, Hb., "Verz.," p. 142 (*circ.* 1822); Steph., "List Br. An. Br. Mus.," v., p. 26 (1850); Butl., "Tr. Zool. Soc. Lond.," ix., pt. 10, p. 568 (1876); Grote, "Journ. N. Y. Ent. Soc.," iii., p. 132 (1895); "Ent. Rec.," vii., p. 56 (1895); Prout, "Ent. Rec.," xiii., p. 346 (1901). *Sphinx*, Linn., "Sys. Nat.," 10th ed., p. 489 (1758); 12th ed., p. 797 (1767); "Fn. Suec.," 2nd ed., p. 287 (1761); Poda, "Ins. Mus. Græc.," p. 79 (1761); Scop., "Ent. Carn.," p. 183 (1763); Hufn., "Berl. Mag.," ii., p. 188 (1766); Fab., "Sys Ent.," p. 537 (1775); "Spec. Ins.," ii., p. 141 (1781); "Mant. Ins.," ii., p. 93 (1787); "Ent. Sys.," iii., pt. 1, p. 358 (1793); Schiff., "Schmett. Wien.," 1st ed., p. 41 (1775); Esp., "Schmett. Eur.," ii., p. 38, pl. iii (1779); Bergstr., "Sphing. Eur. Larv.," p. 4 (1782); Bkh., "Sys. Besch.," ii., p. 110 (1789); Brahm, "Ins.-Kal.," ii., 1, p. 420 (1791); Hb., "Eur. Schmett.," fig. 72 (*circ.* 1800); text, p. 100 (1805); "Larv. Lep.," ii., Legit. D *b* 2 (*circ.* 1800); Schrank, "Faun. Boica," ii., 1, p. 222 (1801); Haw., "Lep. Brit.," 1, p. 64 (1803); Ochs., "Die Schmett.," ii., p. 249 (1808). *Spectrum*, Scop., "Introd. Hist. Nat.," p. 413 (1777). *Smerinthus*, Latr., "Hist. Nat.," iii., p. 401 (1802); xiv., p. 134 (1805); "Gen. Crust.," iv., p. 210 (1809); Ochs., "Die Schmett.," iv., p 45 (1816); Sam., "Ent. Comp.," p. 243 (1819); "Ent. Cab.," i., no. 3, fig. 5 (1832); Hb., "Franck Cat.," p. 88 (1825); Godt., "Hist. Nat.," iii., p. 65 (1821); Stephs., "Illus.," iv., 1, p. 113 (1828); "Cat. Br. Ins.," pt. 2, p. 31 (1829); "List Br. An. Br. Mus.," v., p. 26 (1850); Bdv., "Eur. Lep. Ind. Meth.," p. 34 (1829); "Gen. et Ind. Meth.," p. 49 (1840); "Sp. Gén. Lép. Het.," i., p. 44 (1875); Wood, "Ind. Ent.," pl. 12, fig. 8 (1839); Dup., "Hist. Nat.," supp. ii., p. 145 (1835); "Icon. Chen.," pl. viii., fig. 2 (*circ.* 1840); "Cat. Méth.," p. 45 (1844); Humph. and Westd., "Brit. Moths," p. 8 (1841); Evers., "Faun. Volg.-Ural.," p. 114 (1844); H.-Sch., "Sys. Bearb.," ii., p. 91 (1846); Heydenr., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Sta., "Man.," i., p. 87 (1857); Spey., "Geog. Verb.," i., p. 324 (1858); ii., p. 280 (1862); Hein., "Schmett.-Deutsch.," p. 150 (1859); Humph., "Gen. Br. Moths," p. 8 (1860); Staud., "Cat.," 1st ed., p. 16 (1861); 2nd ed., p. 37 (1871); Wallgrn., "Skand. Het.," i., p. 15 (1863); Snell, "De Vlind.," p. 101 (1867); Berce, "Faun. Franç.," ii., p. 27 (1868); Nolck., "Lep. Fn. Estl.," i., p. 90 (1868); Newm., "Brit. Moths," p. 5 (1869); Mill., "Cat. Lép. Alp.-Mar.," i., p. 119 (1872); Bang-Haas, "Nat. Tids.," (3), ix., p. 403 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 41 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 112 (1875); Kirby, "Eur. Butts. and Moths," p. 73 (1879); Frey, "Lep. Schweiz," p. 58 (1880); Buckl., "Larvæ, &c.," ii., p. 105, pl. xx., fig. 3 (1887); Minà-Pal., "Nat. Sic.," vii, p. 135 (1888); Auriv., "Nord. Fjär.," p. 43 (1889); Clark, "Ent. Rec.," i., pp. 327-329, pl. A., figs. 1—12 (1890); Bacot, "Ent. Rec.," vi., pp. 173 *et seq.* (1895); Griffiths, *loc. cit.*, p. 257 (1895); Barr., "Lep. Brit.," ii., p. 11 (1895)

Lucas, "British Hawk Moths," p. 131 (1895); Tutt, "Brit. Moths," p. 23 (1896); Bartel, "Palæark. Gross-Schmett.," ii., p. 146 (1900). *Laothoë*, Fab., "Ill. Mag.," vi., pp. 287—288 (1807). *Laothöe*, Leach, "Edinb. Enc.," ix., p. 130 (1815); Oken, "Lehrb. Zool.," i., p. 753 (1815). *Dilina*, Dalm., "K. Vet. Ac. Handl.," p. 212 (1816); Zett., "Ins. Lapp.," p. 916 (1840); Kirby, "Cat.," p. 709 (1892); "Handbk.," iv., p. 56 (1897); Meyr., "Handbk.," &c., p. 300 (1895); Leech, "Trans. Ent. Soc. London," 1898, p. 278 (1898); Prout, "Ent.," xxxii., p. 60 (1899); Staud., "Cat.," 3rd ed., p. 100 (1901). *Merinthus*, Meig., "Eur. Schmett.," ii., p. 149 (1830). *Minias*, Stph., "Ill. Haust.," iv., app. p. 5 (1835).

The genus *Mimas* was eliminated from the remaining Amorphids by Hübner, about 1822 (*Verzeichniss*, p. 142), where he diagnoses the genus as follows:

The palpi fairly moderate in length. The forewings with deep inlets and blunt angle; banded—*Mimas tiliae*.

Meyrick diagnoses (*Handbook*, p. 300) the genus as follows:

Tongue short, imperfect. Antennæ less than ½, stout, thickest towards middle, not lamellated. Abdomen stout, with appressed scales, pointed. Tibiæ with appressed scales, all spurs present.

Dalman's *Dilina* has come into pretty general use for this species, but he expressly makes *ocellata* the type of his genus, so that it becomes synonymous with *Smerinthus*. Dalman's original description shows that his *Dilina* is really a diagnosis of our family *Amorphidae*. It reads (*Vetenskaps Academiens Handlingar*, 1816, pp. 205—206) as follows:

DILINA. — *Caput* parvum retractum, palpis brevissimis obtusis oculos clypeumve ultra non assurgentibus. *Lingua* brevissima, spuria, aut vix ulla. *Antennae* sublineares flexuosæ; maris prismaticæ subtus scobinæformes, ciliatæ; feminæ simplices subfiliformes. Alæ margine angulatæ, l. dentatæ, l. emarginatæ. . . . *Larva* scabrosa capite triangulari supra acuminato; cornu anali. *Puppa* nuda, terra sepulta. GENERIS TYPUS: *D. ocellata*.

According to Staudinger (*Cat.*, 3rd ed., p. 100) there are only two species included in the genus—*tiliae* and *christophi*—the latter an eastern species recorded from the southern Ussuri district and Japan. The following note by Leech (*Trans. Ent. Soc. Lond.*, 1898, p. 278) is interesting:

Christophi, Staud., "Rom. Mém.," iii., p. 162, pl. ix., figs. 3*a*, *b*, pl. xi., fig. 1 (1887); "Cat.," 3rd ed., p. 100 (1901); Kirby, "Cat.," p. 709 (1892); Leech, "Trans. Ent. Soc. Lond.," 1898, p. 278 (1898).—This species, which is closely allied to *D. tiliae*, can be readily separated by the absence of any green coloration, by the contour of the central fascia, and by the uniform dark brown colour of the thorax. A series of 165 specimens of *D. tiliae*, comprising all the known aberrations, shows nothing among them that could be mistaken for *D. christophi*. Larva, on *Alnus incana*, is said to resemble that of *D. tiliae* very closely. Amurland; Japan; Yesso (Leech).

The series (1 ♂, 3 ♀s) in the Leech collection, shows *M. christophi* to be a species closely allied to, but distinct from, *M. tiliae*. It appears from the imagines to be a more specialised form than the latter. The whole tendency of the coloration is to become darker in *christophi*, inclining to an olive-brown tint, with shades of purple-grey in some examples; the hindwings duller and darker than those of *M. tiliae* (Bacot).

MIMAS TILIÆ, Linné.

SYNONYMY.—Species: *Tiliae*, Linn., "Sys. Nat.," 10th ed., p. 489 (1758); 12th ed., p. 797 (1767); "Faun. Suec.," 2nd ed., p. 287 (1761); Poda, "Ins. Mus. Græc.," p. 79 (1761); Scop., "Ent. Carn.," p. 183 (1763); "Introd. Hist.

Nat.," p. 413 (1777); Hufn., "Berl. Mag.," ii., p. 188 (1766); Fab., "Sys. Ent.," p. 537 (1775); "Spec. Ins.," ii., p. 141 (1781); "Mant. Ins.," ii., p. 93 (1787); "Ent. Sys.," iii., pt. 1, p. 358 (1793); "Ill. Mag.," vi., pp. 287—288 (1807); Schiff., "Schmett. Wien.," 1st ed., p. 41 (1775); 2nd ed., p. 7 (1801); Esp., "Schmett. Eur.," ii., p. 38, pl. iii (1779); Bergstr., "Sph. Eur. Larv.," p. 4 (1782); Bkh., "Sys. Besch.," ii., p. 110 (1789); Brahm, "Ins.-Kal.," ii., 1, p. 420 (1791); Hb., "Eur. Schmett.," fig 72 (*circ.* 1800); text p. 100 (1805); "Larv. Lep.," ii., Legit. D *b* 2 *a* (*circ.* 1800); "Verz.," p. 142 (*circ.* 1822); "Franck Cat.," p. 88 (1825); Schrk., "Faun. Boica," ii., 1, p. 222 (1801); Haw., "Lep. Brit.," 1, p. 64 (1803); Latr., "Hist. Nat.," iii., p. 401 (1802); xiv., p. 134 (1805); "Gen. Crust.," iv., p. 210 (1809); Ochs., "Die Schmett.," ii., p. 249 (1808); iv., p. 45 (1816); Leach, "Edinb. Enc.," ix., p. 130 (1815); Oken, "Lehrb. Zool.," i., p. 753 (1815); Dal., "K. Vet. Ac. Handl.," p. 212 (1816); Sam., "Ent. Comp.," p. 243 (1819); "Ent. Cabt.," i., no. 3, fig. 5 (1832); Godt., "Hist. Nat.," iii., p. 65 (1821); Stephs., "Ill.," iv., 1, p. 113 (1828); "Cat. Br. Ins.," pt. ii., p. 31 (1829); "List Br. An. Br. Mus.," v., p. 26 (1850); Meig., "Eur. Schmett.," ii., p. 149 (1830); Bdv., "Eur. Lep. Ind. Meth.," p. 34 (1829); "Gen. et Ind. Meth.," p. 49 (1840); "Sp. Gén. Lép. Het.," i., p. 44 (1875); Wood, "Ind. Ent.," pl. 12, fig. 8 (1839); Dup., "Icon. Chen.," pl. viii., fig. 2 (*circ.* 1840); "Cat. Méth.," p. 45 (1844); Zett., "Ins. Lapp.," p. 916 (1840); Humph. and Westd., "Brit. Moths," p. 8 (1841); Evers., "Faun. Volg.-Ural.," p. 114 (1844); Herr.-Sch., "Sys. Bearb.," ii., p. 91 (1846); Heydenr., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Sta., "Man.," i., p. 87 (1857); Speyer, "Geog. Verbr.," i., p. 324 (1858); ii., p. 280 (1862); Hein., "Schmett. Deutsch.," p. 150 (1859); Humph., "Gen. Brit. Moths," p. 8 (1860); Staud., "Cat.," 1st ed., p. 16 (1861); 2nd ed., p. 37 (1871); 3rd ed., p. 100 (1901); Wallgrn., "Skand. Het.," i., p. 15 (1863); Snell., "De Vlind.," p. 101 (1867); Berce, "Faun. Franç.," ii., p. 27 (1868); Nolck., "Lep. Fn. Estl.," i., p. 90 (1868); Newm., "Brit. Moths," p. 5 (1869); Mill., "Cat. Lép. Alp.-Mar.," i., p. 119 (1872); Bang-Haas, "Nat. Tids.," (3), ix., p. 403 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 41 (1874); Praun, "Erg.," pl. i., fig. 10*a*—*b* (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 112 (1875); Butl., "Tr. Zool. Soc. Lond.," ix., pt. 10, p. 568 (1876); Kirby, "Eur. Butts. and Moths," p. 73 (1879); "Cat.," p. 709 (1892); "Handbook, &c.," iv., p. 56 (1897); Röss., "J.-B. Nass. Ver. Nat.," xxxiii-xxxiv., p. 36 (1880); Frey, "Lep. Schweiz," p. 58 (1880); Hofm., "Schmett.," &c., ii., p. 30, pl. xviii., fig. 3 (1893); "Raupen," &c., p. 30, pl. viii., fig. 4 (1887); Buckl., "Larvæ," etc., ii., p. 105, pl. xx., fig. 3 (1887); Minà-Pal., "Nat. Sic.," vii., p. 135 (1888); Auriv., "Nord. Fjär.," p. 43 (1889); Clark, "Ent. Rec.," i., pp. 327—329 *et seq.*, pl. A., figs. 1—12 (1890); Barr., "Lep. Brit.," ii., p. 11 (1895); Meyr., "Handbook," &c., p. 300 (1895); Bacot, "Ent. Rec.," vi., pp. 173 *et seq.* (1895); Griffiths, "Ent. Rec.," vi., pp. 256—257 (1895); Lucas, "Brit. Hawk Moths," p. 131 (1895); Tutt, "Brit. Moths," p. 23 (1896); Bartel, "Palæark. Gross-Schmett.," ii., p. 146 (1900).

ORIGINAL DESCRIPTION.—*Sphinx tiliae*, alis angulatis: superioribus griseo fasciatis; posticis testaceis. Merian, *Eur.*, 2, t. 24. Wilk., *Pap.*, 10, t. 1, b. 4. Frisch, *Ins.*, 7, t. 2. Alb., *Ins.*, t. 10. Roes., *Ins.*, i., phal. t. 2. Habitat in *Tilia* (Linn., *Sys. Nat.*, xth ed., p. 489). [Linné later modifies this to: *Sphinx*, alis angulatis virescenti-nebulosis saturatius subfasciatis; posticis supra luteo testaceis (ed. xii., p. 797).]

IMAGO.—56mm.—71mm. Anterior wings curved at apex; outer margin somewhat deeply sinuate, the inner margin concave towards anal angle; rosy-grey in colour, green on the outer area, with a very variable median greenish-brown transverse band; a submarginal undefined dark band from costa to anal angle, and an ill-developed double basal band; a white apical patch, sometimes continued as an irregular white line to the anal angle. Posterior wings rounded at apex, emarginate on the outer margin, just before the anal angle; yellowish-grey in colour, with an undefined dark transverse band from apex to anal angle, and a dark basal patch, outer margin sometimes quite yellow-ochreous. Head and thorax of the same hues as forewings; abdomen usually grey-green with rather darker segmental marks.

Sexual dimorphism.—In a series of specimens, the ♂s and ♀s have a somewhat different facies, due chiefly to the greater robustness of the body of the ♀, which is perhaps more marked in this species and *Amorpha populi* than in most other Sphinges, affecting the thorax as well as abdomen. In the ♂ the wings are also shorter and narrower basally, and wider at the hind margin than in the ♀. In *A. populi*, the notches between the nervures of the forewing are nearly equal, except that nervure 5 is short and the notch here is from 4 to 6. In *M. tiliae* the notch is enlarged into a deep sinuation by 4 retreating as well as 5. This condition is more pronounced in the ♂ than in the ♀. The ♂ coloration is darker than in the ♀, but the range of variation in races and specimens is so great that individual series may show the females the darker. The antennæ differ as in all other Sphinges, in the ♂s having the usual cups of cilia well marked, while the ♀ shows only a small median lateral bristle at margin of scaled area. The ♂ antenna has about 54 joints, that of the ♀ about 52, but there is some variation. In the ♂ the anterior tibial spur reaches nearly to the end of tibia; in the ♀ it falls decidedly short of this point; the posterior tibial spurs are larger in the ♂ than in the ♀ (Chapman).

Gynandromorphism.—Very few gynandromorphous specimens of this species have been recorded. The following are the only ones we trace:

α. Left ♀, right ♂. Coloration on the right side olive-green with dark median band; lighter on the left side, and more yellow-green, with median band correspondingly lighter. The patagia and underside of the wings correspond with this coloration. Right antenna ♂, left ♀. Abdomen ♂. Captured near Berlin. Coll. Wiskott, Breslau (Wiskott, *Festschr. Schles. Ver. Ins.*, p. 109).

β. Referred to by Schultz as described in *Russ's Isis*, iv., 1879, no. 20 (*Woch. für Ent.*, i., p. 367). We have quite failed in our attempts to get the description.

γ. A gynandromorphous example in coll. Staudinger (*in litt.*) (Schultz, *Woch. für Ent.*, ii., p. 393).

Variation.—The species is very variable, both in colour and in the amount of development of the median transverse band; rarely are two specimens exactly alike, and they are very frequently asymmetrical, the colour and markings of the left wings differing from those of the right. Clark's plate (*Ent. Rec.*, i., pl. A) exhibits this peculiarity well. Turner notes (*Proc. Sth. Lond. Ent. Soc.*, 1894, p. 50) an asymmetrical specimen taken at Greenwich, in which the right side is of a deep green and rich ferruginous-brown, whilst the left side is of a much paler green and brown, the latter being smoky in places; also the lower of the two blotches on the left forewing is very narrow, the corresponding one on the right forewing being very large. Bartel notes rare aberrations of a very bright yellow colour (=ab. *lutescens*, n. ab.), and says that the progeny of such individuals as have been inbred for many years in captivity are usually much more distinctly and prominently marked than the normal imagines taken wild, and are distinguished also by the hindwings being exceptionally heavily-marked with black (=ab. *suffusa*, Clark). Very dark greyish-green individuals with almost completely black hindwings are recorded by Caradja as being found in the Department of the Haute-Garonne in October, and bred from larvæ collected at the commencement of the same month, and the same author also asserts that larvæ living on lime produce brighter-tinted moths, whether green or brown, whilst those on elm give quite dark specimens. Standfuss says the green form is bred from *Ulmus campestris*. Hoffmann and Keller note that at Stuttgart the brown form appears commoner than the green. Richter says that in Dessau those reared on birch produce brown aberrations. With regard to the variation in the transverse band, Bartel observes that it varies greatly in width and ground-colour, whilst the outward angulation is sometimes pointed, and at other times blunt; in some green examples the band is lightly edged with darker coloration; when complete it extends from the front margin to the inner edge, in most examples it is interrupted and broken up into two spots, of which the upper is the greater and may be separated from the costal margin, whilst the lower one is usually just away from the inner margin; in some examples the spots are only just separated by the nervure running between them, whilst in others the ground colour extends for a considerably greater width separating the two spots much more completely; the costal spot runs much below the middle of the wing, and is connected occasionally on its lower edge with the small spot of the same colour extending from the inner margin, the latter (small spot) being extremely narrow and almost like a stroke, the upper, however, also sometimes becomes very small. The area in front of the twice-angulated outer edge is usually dark-coloured and inwardly edged with a lighter border; the band is sometimes only indicated in outline or is reduced to mere traces; in others it shades off into the ground-colour. Some of the most marked aberrations have been described and figured by Clark (*Ent. Record*, i., pp. 327—328, pl. A., figs. 1—10). Speaking of the general variation, he writes: "If we look at our three British Amorphid species, we note that *Amorpha populi* has a more or less developed band passing transversely across the centre of the anterior wings; *Smerinthus ocellata* has a fairly developed dark blotch on the costa of the anterior wings, followed by a smaller blotch on the inner margin, these two blotches undoubtedly showing the origin of a central band in the genus; whilst in *Mimas tiliae* the central band is always dark on a pale ground, and hence stands out conspicuously. Perhaps the most common form of the band in this species consists of a large costal blotch, and a large blotch on the inner margin just united at the centre of the wing, as in pl. A., fig. 10. Sometimes this band, however, is quite complete, and occasionally entirely absent, as pl. A., fig. 1, will show. The most interesting feature with regard to this is the occasional asymmetrical character of the band as in figs. 2, 4 and 6, whilst figs. 3, 5, 7, 8 and 9, although all showing some abnormal condition of the band, are perfectly symmetrical. A structural point to which I would also draw attention is the variation in the outline of the anterior wings. This species always appears to unite the sinuous outline of *A. populi* with the centrally concave outline of *S. ocellata*, the latter feature being generally strongly developed, but, in the specimens figured, it will be noticed that figs. 1 and 4 have this character reduced to a minimum, whilst fig. 8 has it very strongly developed. There is a considerable amount of variation also in the width of the double transverse basal line (compare figs. 1 and 3); that of fig. 7 is, however, practically obsolete, and fig. 10 also shows some variation in direction. In the basal space between this line and the thorax there is also considerable difference (compare figs. 6 and 8). Figs. 9, 8, 6, 3, 2 and 1 show especially the variable character of the transverse line outside the central band, although no two are alike, and fig. 6 exhibits a most abnormal, asymmetrical shape of the pale apical blotches. Careful comparison shows that there is some variation in the shape of the hind margin of the posterior wings." Kane observes that several Galway specimens that he has seen have the central band of forewings large and continuous and the green replaced by olive-brown; the hindwings very pale russet. James records an aberration with the usual markings present but subdued, and the whole wings of a dull olive-brown, with no trace of terra-cotta or green. Crewe notes an imago bred in May, 1857, at Stowmarket with a most beautiful purple tinge. South describes (*Ent.*, xxv., p. 249) two forms: (1) Pale brown forewings marked with reddish spots of usual shape, hindwings fuscous grey-brown. (2) Greenish-white forewings, the usual central markings dark green, and some touches of an intermediate shade of green, between the central band and base of wing and on the outer third; hindwings fuscous-brown, outer and abdominal margins pale, the former edged with blackish. Occasional small specimens are sometimes met with; these Boisduval seemed in some way to have connected with elm-feeding larvæ, naming the form *ulmi*, in 1840 (*Gen. et Ind. Meth.*, p. 49), with the illuminating diagnosis "valde minor." Colthrup records (*Ent.*, xxxiv., p. 260) an example, the ground-colour of the forewings pale brown, with indistinct markings, the hindwings with a pinkish tint, and another with the forewings dark brown in colour, with very intense green markings, the band represented only by a small spot. Clark states (*Ent. Rec.*, iv., p. 257) that colour variation is not specialised in any brood, extreme red and green forms being reared from the same batch of eggs. Schultz records (*Berl. Ent. Zeits.*, xliv., Sitz. p. 29) rearing a brood of *M. tiliae* on oak, the moths being fawn-coloured, the hindwings much darker, whilst the wings appear to be narrower than usual. Wells records two aberrations (*Ent. Rec.*, iii., p. 313) from pupæ dug at Cambridge, one of a dark slaty-grey colour, with the posterior wings nearly black; the other with quite normal markings, but with all the wings much suffused with bright crimson, the usual dark-green blotches on the anterior wings standing out like crimson velvet. In some examples of both sexes the outer margin is very pale. The hindwings of the ♂ vary much—from orange to blackish—some with a good band; those of the ♀ are, on the whole, paler, often suffused, but rarely so dark, as in the darker ♂s.

For such a variable species some tabulation seems necessary. After some trouble the following has been made to cover the variation known to us:

Ground-colour pale-grey or fawn-grey (without green tinge).

1. With complete transverse median band=ab. *pallida-transversa*, n. ab.
2. With band broken medially into costal and inner-marginal parts=ab. *bipunctata*, Clark.
3. With only costal part of band, inner-marginal part obsolete=ab. *pallida-costipuncta*, n. ab.
4. With only inner-marginal part of band, costal part obsolete=ab. *pallida-marginepuncta*, n. ab.

5. With the costal part reduced to median spot, the inner-marginal part obsolete=ab. *pallida-centripuncta*, n. ab.

6. With the band entirely obsolete=ab. *pallida-obsoleta*, n. ab.

GROUND-COLOUR REDDISH-GREY OR RED (STRONGLY TINGED WITH GREEN).

1. With complete transverse median band=*tiliae**, Linn.

2. With band broken medially into costal and inner-marginal parts=ab. *maculata*, Wallgrn.

3. With only costal part of band, inner-marginal part obsolete=ab. *costipuncta*, Clark.

4. With only inner-marginal part of band, costal part obsolete=ab. *marginepuncta*, n. ab.

5. With the costal part reduced to median spot, the inner-marginal part obsolete=ab. *centripuncta*, Clark (=ab. *ulmi*, Bartel).

6 With the band entirely obsolete=ab. *obsoleta*, Clark.

GROUND-COLOUR ENTIRELY RED OR RED-BROWN.

1. With complete transverse median band=ab. *brunnea-transversa*, n. ab.

2. With band broken medially into costal and inner-marginal parts=ab. *brunnea*, Bartel.

3. With only costal part of band, inner-marginal part obsolete=ab. *brunnea-costipuncta*, n. ab.

4. With only inner-marginal part of band, costal part obsolete=ab. *brunnea-marginepuncta*, n. ab.

5. With the costal part reduced to median spot, the inner-marginal part obsolete=ab. *brunnea-centripuncta*, n. ab.

6. With the band entirely obsolete=ab. *brunnea-obsoleta*, n. ab.

GROUND-COLOUR ENTIRELY GREEN (OR VERY FAINTLY TINGED MEDIALLY WITH REDDISH).

1. With complete transverse median band=ab. *virescens-transversa*, n. ab.

2 With band broken medially into costal and inner-marginal parts=ab. *virescens-maculata*, n. ab.

3. With only costal part of band, inner-marginal part obsolete=ab. *virescens-costipuncta*, n. ab.

4. With only inner-marginal part of band, costal part obsolete=ab. *virescens-marginepuncta*, n. ab.

5. With the costal part reduced to median spot, the inner-marginal part obsolete=ab. *virescens-centripuncta*, n. ab.

6. With the band entirely obsolete=ab *virescens-obsoleta*, n. ab.

The following appear to be the described forms of this species:

a. ab. *obsoleta*, Clark, "Ent. Rec.," i., p. 328, pl. A., fig. 1 (1891); Ckll., "Ent. Rec.," ii., p. 16 (1891). *Tiliae* var., Newm., "Ent.," viii., p. 194, fig. (1875). *Immaculata*, Bart., "Die Palæark. Gross-Schmett.," ii., p. 149 (1900). *Exstincta*, Staud., "Cat.," 3rd ed., p. 100 (1901). — Anterior wings of a delicate fawn-colour, with the basal area and transverse lines slightly darker, the central area having the faintest tinge of pink, without the trace of a transverse band; the extreme outer area strongly tinged with green. Posterior wings orange-coloured, with a dark brown central band, united to the dark scales of the base (Clark). BELGIUM (*teste* Bartel). FRANCE: Indre—La Châtre (Sand). GERMANY: Saxon-Altenburg—Altenburg. RUSSIA: Kasan Govt. (*teste* Bartel).

Staudinger's diagnosis, under the name *exstincta* reads: "Al. ant. sine fasciis nec maculis, sæpius fere unicoloribus" (*Cat.*, 3rd ed., p. 101). Bartel's diagnosis runs: "♂, ♀. In examples of this aberration, the small dark spot in the middle of the upperside of the forewing and found in ab. *ulmi* is entirely wanting. In place of it there is a light-coloured area which occupies the median area of the wing and extends somewhat towards the margin of the wing." Robson records (*Proc. South Lond. Ent. Soc.*, 1895, p. 41) an example with no trace of the usual dark band across the forewing.

* Linné's original description (ed. x., p. 489) defines the type as "fasciatis"; in his xiith ed. he calls it "subfasciatis," which we suspect is Wallengren's ab. *maculata* (see *anteà*, p. 400, and *posteà*, p. 406).

Another obsoletely banded one is noted from Hammersmith (*Ent.*, xxxii., p. 284) by Betteridge, and Nicholson records another (*Ent. Rec.*, iv., p. 257). Clark figures and describes (*Ent. Rec.*, i., pl. A., fig. 2) an asymmetrical form (ab. *semiobsoleta*) as follows: "The left anterior wing is identical with ab. *obsoleta*, as also is the right hand, except that small central and inner marginal blotches remain as traces of the original band. The ground colour of the hindwings is much like that of the forewings, the dark band also ill-developed." Rothschild figures (*Ent.*, xxvii., p. 50) an aberration, of the form *obsoleta* on the left side and *centripuncta* (ill-developed) on the right side; bred June, 1893, from a Tring larva. It is a ♂ 2·35 in. in expanse; the basal part of forewings pinkish-grey, the apical portion dark green; the apical marking of normal shape and colour; the hindwings almost entirely black, very faintly tinged with buff on the nervules. Bate notes a specimen having the right forewing without the usual dark central blotch and with the whitish apical mark larger and more distinct than that on the left forewing, which was normal. James notes an olive-coloured aberration at Crouch End, with central spots missing on one forewing (ab. *virescens-obsoleta*) and reduced to a point on the other.

β. ab. *centripuncta*, Clark, "Ent. Rec.," i., p. 329, pl. A., fig. 7 (1891); Ckll., "Ent. Rec.," ii., p. 16 (1891); Frohk., "Ent. Rec.," iii., p. 312 (1892). *Ulmi*, Bartel, "Die Palæark. Gross-Schmett.," ii., p. 149 (1900); Staud., "Cat.," 3rd ed., p. 100 (1901). *Tiliae* ab., Fletch., "Ent. Rec.," xiii., p. 254 (1901); Colthrup, "Ent. Rec.," xiii., p. 297 (1901).—Anterior wings, with the whole of the central and basal areas deep reddish; the outer area normal, greenish-olive; one small central spot is the only trace of the transverse band; the hindwings yellowish, with the band rather ill-developed (Clark). AUSTRO-HUNGARY: Hungary—Epiries (Husz). BELGIUM: Huy (*teste* Bartel). FRANCE: Haute-Garonne, rather the commoner form (Caradja), Aix-les-Bains, singly (*teste* Bartel); Douai (Foucart), dept. du Nord, rare with type (Paux). GERMANY: Very rare with the type; Saxony-Altenburg—Roda, Carlsruhe (*teste* Bartel), Prussia, singly (Grentzenberg). SPAIN: Bilbao (Seebold).

Staudinger diagnoses this aberration (*Cat.*, 3rd ed., p. 100) as: "Al. ant. macula unica, non fasciatis." Bartel describes it (*Palaeark. Gross-Schmett.*, ii., p. 149) as: "♂ and ♀. The dark central band crossing the upper side of the forewings, which, in the type, consists of two spots more or less connected, is represented in ab. *ulmi* only as a small dark spot, at some distance from the costa and more or less towards the centre, of the wing. The aberration varies in colour as does the type, and is found in the same localities, but is generally rare." Fletcher bred, from a Streatham larva, on May 22nd, 1901, an example in which the ground-colour of the forewings is rather lighter than usual, and the fascia absent, except a small dark green spot in the centre of the wing just anterior to the junction of the upper and median nervules. Colthrup notes one bred on May 18th, 1901, very similar to Clark's fig. 7, but the ground-colour of a darker brown, and the markings near the tip of the forewing of an intense green. Hampson records an example in the British Museum collection in which the right forewing has the median band reduced to a dentate spot at lower angle of cell. Imms notes another from Northampton, with the central band reduced to a small spot. Newman bred one from a Bexley larva in 1899. Adamson (*Ent.*, xv., p. 161) captured, June 8th, 1882, a fine *centripuncta*, with a large dark green pear-shaped spot in centre of wing.

γ. ab. *pechmanni*, Hartmn., "Mitt. Münch. Ent. Ver.," iii., p. 35, pl. iii., figs. 1—3 (1879); Bartel, "Die Palæark. Gross-Schmett.," ii., p. 150 (1900); Staud., "Cat.," 3rd ed., p. 100 (1901).—Head, thorax and abdomen brown or green, the lighter markings on the thorax and form of the wings typical. The usual central transverse band quite obsolete; on the other hand a claviform spot, which is to be seen in no other Sphingid, appears distinctly. The forewings uniformly green or brown in colour as far as the paler band at the outer margin; on the apical part of the costa the usual light claviform spot. The underside of both wings cinnamon-brown, with a lighter band at the outer margin. All the specimens somewhat smaller than the type (Hartmann).

A number of specimens were inbred by Pechmann, emerging in 1878, most of the individuals showing the normal range of variation, but others, of both sexes, were peculiar in being without the median band, but with a well-marked claviform spot towards the base. Prout notes: "The figures show a very distinct and interesting form, quite agreeing with the description—ground-colour uniform dark brown or green nearly to outer margin, the marginal part, which is normally green or olive, being of a sort of violet-grey tint. The ambiguous reference to a 'claviform' spot seems to have no reference to any remnant of a central band, for the figure shows (as the description says) that that is absolutely wanting. The figures have a lead-coloured or bluish claviform spot close to the base of forewings." No doubt it is a peculiar modification of Clark's ab. *obsoleta*, with much darker ground-colour and an unusual spot developed towards the base of the wing. Staudinger diagnoses it (*Cat.*, 3rd ed., p. 100) as: "Minor, al. ant. fere unicoloribus brunnescentibus, margine exteriore dilutiore grisescente." Hartmann notes the aberration as coming from Nymphenburg, near Munich. Bartel adds that "a specimen recorded from Crefeld is possibly only ab. *obsoleta*, Clark, whilst the record that it occurs at Erfurt with the type is open to doubt."

δ. ab. *bipunctata*, Clark, "Ent. Rec.," i., p. 328, pl. A., fig. 3 (1891); Ckll., "Ent. Rec.," ii., p. 16 (1891).—The ab. *bipunctata*, has the ground colour slightly more tinged with pink than figs. 1 and 2, and the outer margin rather grey; the transverse band is represented by a central spot and a smaller one on inner margin; hindwings tinged with yellowish, band not very distinct (Clark).

Clark's aberration only differs from ab. *maculata*, in having a small central spot, and an extremely small inner-marginal spot, whilst the usual green tint is practically wanting. Voelschow notes (*Soc. Ent.*, xv., p. 122) a ♀ in which the hindwings have a complete black transverse band, whilst the forewings have the central area light ashy-grey, the normal transverse band being broken into two quite small spots, the upper of which does not touch the costa.

ε. ab. *maculata*, (Mützel *in litt.*) Wallgrn., "Skand. Het.," p. 15 (1863); Lampa, "Ent. Tids.," vi., p. 27 (1885); Buckell, "Ent. Rec.," v., p. 276 (*nec* reference to ab. *centripuncta*) (1894); Staud., "Cat.," 3rd ed., p. 100 (1901). *Tiliae* ab., Clark, "Ent. Rec.," i., p. 329, pl. A., fig. 9 (1891).—Fascia media alarum anticarum in maculis dissoluta (Wallengren).

Staudinger diagnoses (*Cat.*, 3rd ed., p. 100) the form as: "Al. ant. fascia media latius interrupta in duab. maculis dissoluta." Clark notes (*Ent. Rec.*, i., p. 329) of his specimen (fig. 9): "Basal and central area red, as in figs. 7 and 8, but of a more purplish tinge, the paler outer parts of the wing well-developed, outer area greenish-olive; central band broken into two spots, one central, and the other on inner margin, better developed than in fig. 3 (ab. *bipunctata*); hindwings almost identical with those of fig. 5."

ζ. ab. *costipuncta*, Clark, "Ent. Rec.," i., p. 329, pl. A., fig. 8 (1891); Ckll., "Ent. Rec.," ii., p. 16 (1891).—Almost identical in coloration with fig. 7 (ab. *centripuncta*), but with the transverse band represented by a large costal blotch (Clark).

Clark figures (*loc. cit.*, pl. A., fig. 5) another example almost intermediate between ab. *costipuncta* and ab. *centripuncta*, which he describes as having "the ground colour of the central area redder than any of the preceding, and with the outer area greener. The spot is intermediate in development between the costal one in fig. 8, and the central one in fig. 7, and is not quite symmetrical, reaching fully to the costa on the right, but not quite on the left; hindwings dark greyish-fuscous from the band to the base, the outer margin tinged with reddish."

η. ab. *brunnea*, Bartel, "Die Palæark. Gross-Schmett.," ii., p. 149 (1900); Voelschow, "Soc. Ent.," xv., p. 122 (1901). *Brunnescens*, Staud., "Cat.," 3rd ed., p. 100 (1901).—♂ and ♀. Marked as in the type, but the green coloration entirely wanting. A dark reddish-brown is the prevalent ground-colour, especially of the forewings. This aberration is found everywhere with the type (Bartel). AUSTRO-HUNGARY: Upper Austria not rare (Himsl); Bukovina (Hormuzaki); Galicia—Lemberg (Garbowski); Hungary—Epiries (Husz), Tavarnok, Buda-Pesth (*teste* Bartel). BELGIUM: Huy (*teste* Bartel). FRANCE: Haute-Garonne (Caradja), Montmorency, near Paris. GERMANY: Stuttgart, more common than the type (Hoffmann and Keller), Schwerin-Mecklenburg (Voelschow), Crefeld, rare, Leipzig, very rare, Thuringia (Krieghoft), Würtemberg, Baden, rarer than the type, Nassau, Bavarian Palatinate (Spuler), Alsace (Peyerimhoff). ROUMANIA: Comanesti, Grumazesti, abundant in 1895, etc. (Caradja). RUSSIA: St. Petersburg, etc. (*teste* Bartel). SWITZERLAND: Aigle (Lowe).

This was originally a trade name of Staudinger's, which obtained general usage without being described until Bartel diagnosed it. A year later Staudinger himself renamed it *brunnescens* and noted it as "brunnescens, nec viridescens." Riding criticises (*Ent. Rec.*, ix., pp. 150-151) Barrett's assertion that the red colour of this species is generally due to changes produced after emergence, and observes that this is incorrect as a general statement, . . . that he has a bred ♂ and ♀ entirely reddish and yellow-brown and without a trace of green. Clark's plate (*Ent. Rec.*, i., pl. A) should have prevented Barrett's statement. Voelschow observes that, in June, 1900, he put out a ♀ and she was found in the morning paired with a ♂ ab. *brunnea*, which was remarkable for its black-coloured hindwings, the area of the forewings between the uninterrupted brown central band and the marginal area being densely sprinkled with black scales. Lowe captured a beautiful rust-brown specimen, without a tinge of green, at Aigle, July 3rd or 4th, 1898. The following notes refer to this aberration: Not rare with the type in Upper Austria, bred by Angele on February 21st, 1896 (Himsl); rarer than the green form in Baden (Spuler), dark red-brown aberration bred from Sutton in June, 1888 (Lee). Frohawk (*Ent.*, xv., p. 130) bred April 23rd, 1882, one specimen remarkable for entire absence of green; all the markings usually green, are light burnt sienna-red, the usual whitish blotch at tip of forewing pink; ground colour also pink, in places slightly tinged with grey; thorax and abdomen also of same colour.

θ. ab. *suffusa*, Clark, "Ent. Rec.," i., p. 329, pl. A., fig. 10 (1891); Ckll., "Ent. Rec.," ii., p. 16 (1891).—Anterior wings dark olive-green, with central area tinged with pink, crossed by a deep olive-green band, almost joined at one point on the right-hand wing; hindwings, except on margin bordering the abdomen where the colour is pale, deep fuscous-black (Clark).

Egglaying.—The eggs appear to be normally fastened to the underside of the leaves of the foodplant, either singly or in pairs (Bacot); eggs laid on lime leaf at Chiswick fastened by a tenacious gum (Sich); discovered a ♀ ovipositing on the trunk of a small lime tree, on May 26th, 1895, at Crouch End (James); ♀ laid 39 eggs on a stone step quite five yards from a lime tree at Sydenham (Swain).

Ovum.—Oval in form, plump, with shining pale green shell, about 1·75mm. in length and 1·4mm. in width (Hellins); of the same shape and size as that of *S. ocellata*, but of a darker and duller green (Bacot). [See description by Chapman, *anteà*, p. 386.] Graber has described and figured (*Denks. Ak. Wien*, lv., pp. 148—149, pl. vi., figs. 39—41) embryological details from the ova of this species. Brown notes (*Ent.*, v., p. 395) parthenogenesis as having occurred in this species, but gives no data.

Habits of larva.—The larvæ appear usually to feed high up in large elm-trees in Kent, and hence are rarely observed until they come down for the purpose of pupation, and therefore one knows but little of their habits in nature. Bacot observes that in their earlier stages the larvæ usually rest on one of the veins on the underside of a leaf, but, in the later stages, choose a twig or leafstalk for the purpose; they seem to dislike the light, and, when their food is changed, get underneath the leaves as soon as possible. In confinement they do well on fresh young shoots of lime until the 3rd moult; they then want less succulent food, and feed best on the smaller dark green fleshy leaves from the upper branches of the tree. It is stated (*Ent. Wk. Int.*, vii., p. 109) that larvæ obtained from moths that emerged from pupæ dug at elms, feed up twice as fast on lime as on elm. The following notes show that the larvæ are obtainable in Britain from June to September, dependent on the season, possibly, often, from late May to September, as the egg-stage rarely lasts more than 14 days, and the imagines are frequently observed in early May. Thus we have: August and September at Bristol (Prideaux); at Tunbridge Wells in September (Nicholson); August 24th, 1856, at Notting Hill, July 17th, 1895 (A. H. Clarke); larvæ at Ramsgate, August 30th, 1856 (Powell); September 22nd, 1858, and 1st week of September, 1875, at Emsworth (Hellins); September 10th, 1870, at Greywell, September 1st, 1879, at Caversham, September 16th, 1880, at Henley, September 5th, 1884, at Tilehurst, August 30th, 1888, at Hartley Row, September 12th, 1891, at Reading (Holland); August 15th, 1871, September 4th, 1872, August 10th, 1873, September 16th, 1879, September 3rd, 1883 fullfed, September 29th, 1892, fullfed on lime, September 2nd, 1898, at Lee (Bower); September 5th, 1871, at Wanstead, July 19th, 1887, at Brentwood (Burrows); August 24th—September 24th, 1875, September 14th, 1885, fullfed at Lee, ova laid June 14th, 1895, hatched June 24th, larvæ fullfed July 20th (Fenn); fullfed September 16th, 1883, August 13th, 1892, at Bristol (Bartlett); August 21st—29th, 1890, August 8th, 1898, fullfed at Chiswick (Sich); August, 1891, on elm at Bedford (Steuart); September 13th, 1891, August 24th, 1892, August 6th, 1893, September 1st, 1898, at Oxton (Studd); eggs laid May 27th, 1892, hatched in a week, the first fullfed larva went down July 18th, the rest followed at intervals for three weeks longer, at Hartley Wintney (Claxton);

July 23rd, 1893, larva in about 2nd skin on lime, August 6th, 1895, fullgrown on lime, July 12th, 1896, in last skin on fence at Crouch End (James); larvæ on elm, plentiful, all sizes, July 30th, 1894, at Worcester Park (Kaye); September 12th, 1894, fullfed at Sudbury (Ransom); July 5th, 1895, fullgrown larva at Chelmsford (Miller); July 6th, 1896, at Chichester (Anderson); larvæ on lime, July 20th, 1896, July 22nd, 1897, at Whitwell (Freeman); August 8th—14th, 1897, at Brentwood, August 6th, 1900, on lime at Hazeleigh (Raynor). Himsl gives July to September as the best time for larvæ at Pöstlingberg, in Upper Austria.

Larva*.—*First stadium:* Very long and slender in form; the head rounded, quite unlike the pointed head of mature larva; the caudal horn (about one-fourth or one-fifth length of larva) colourless on emergence but soon darkens, a result brought about by the hairs with which it is covered turning black; the only trace of anal plate consists of a few prominent tubercles on 10th abdominal segment. *Second stadium:* The head more triangular, but not quite of the mature shape; the tubercles on it give it a very rough appearance, at the apex two prominent yellow processes; a dark dorsal line and oblique stripes are very faintly marked in this skin; the caudal horn is dark red or crimson in colour, the mammillæ or shagreen hair-bases giving it a thorny appearance; the setæ at the tip of each fork shorter. *Third stadium:* Head more pointed and the processes at apex larger; the yellow lateral lines of the head visible but not yet distinct, each segment apparently divided into eight subsegments, the mammillæ being arranged in eight rings on each segment; the anal plate now composed of 3 or 4 mammillæ, tinged with dark red or brown; oblique stripes stronger, the 7th pair not running up the caudal horn as in larvæ of *Amorpha populi* and *Smerinthus ocellata*. *Fourth stadium:* Larva stouter but still long and slender compared with that of *S. ocellata*. The apical head-processes tall and bearing 2 or 3 simple setæ; the mammillæ large, tall, conical, carrying short thick unforked hairs; also a few hairs arising from the general body surface; the oblique stripes well-marked, yellow, bordered anteriorly with darker green than the rest of the body; the 7th pair very strongly developed, the 6th pair faint. [Some slight variation in caudal horn, in some both the horn and hairs are unforked, in others both hairs and horn slightly forked.] *Fifth stadium:* The processes on apex of head have almost disappeared; the apex slightly notched; the surface of the head smooth; the shagreen points only appearing as pale dots, the anal scutcheon, now dark crimson, bordered with yellow; the caudal horn quite changed in appearance, bright blue in colour, looks stiff and corneous; is sharply pointed and curved backward. [Larvæ of *S. ocellata* and *A. populi* also have this stiff curved caudal horn in final stage, but not so well-developed as in *M. tiliae*, which approaches larva of *Sphinx ligustri* in this particular, although, in the latter, the horn is larger and black.] The mammillæ or shagreen points on body surface, smaller, flatter, and carry simple hairs. Considerable variation in colour, some with deep crimson blotches bordering stripes anteriorly, sometimes before all, at other times before only some, of the stripes; the 6th pair

* Already described in detail, *anteà* p. 387. See also p. 367.

of stripes least strongly marked; shagreen points maintain yellow colour even in red areas; the colours dull before pupation (Bacot). The young *larva, before its first moult*, has the head rounded, the subdivisions of the segments already marked, the skin covered with small two-pronged hairs, not so conspicuous as those of *S. ocellata* and *A. populi*, the horn 2mm. in length, black, thickly set with short two-pointed bristles, its end with two points; the colour yellowish-green, more full green on the back; the figure is slender. The *first moult* takes place when the larva is about 11mm. long; the horn becomes 3mm. long; yellowish in colour, with dark short spines; the lobes of the head become pointed, with yellow tips, the eight subdivisions of each segment set with rough points *; the colour yellowish-green, and the seven yellow lateral stripes slanting appear plainly. The *second moult* comes when the larva is about 18mm. long; the tips of the lobes of the head become reddish, the rough points on the skin yellowish. The *third moult* finds the larva about 25mm. long and the yellow scutcheon on the thirteenth segment appears. The *fourth moult* is passed when the larva is about 35mm. long; up to this time the figure has been very much more slender than that of *S. ocellata* or *A. populi*, but now it begins to grow stouter. The biggest larva I had this summer grew to be something less than 50mm. in length, stout, but tapering forwards a good deal, the skin smooth, the dots remain but are not rough; the face triangular, the horn short and rough, a rough oblong patch on the anal flap; the back light yellow-green, the belly duller green, the dots above the spiracles yellow, below them whitish; the face glaucous-green, slightly dotted with white, the lobes broadly bordered with opaque white outside, tips of the lobes slightly reddish; the seven slanting lateral stripes are pale yellow, edged in front with bright green, six of them begin just at the level of the spiracles, but the seventh is longer and goes through segments 11 and 12 running up to the horn. As the larva matures there comes a red tinge in these stripes; the horn is blue above and red with yellow dots, below; the rough spots on the anal flap are red edged with deep yellow; the spiracles are yellowish-white broadly ringed with red; the thoracic legs pale yellowish ringed with delicate pink, the ventral and anal prolegs coloured like the belly (Hellins).

VARIATION OF LARVA.—The fullgrown larvæ of *M. tiliae* vary a good deal in coloration. Some of mine had red blotches bordering the front of the stripes; one or two had red borders to all the stripes, others only to some of them. I particularly noticed that the weak stripe (the 6th) always came off worst, the blotch being either faint or altogether absent from this stripe, even when it was strongly marked on all the others. Another thing that struck me was that the colour of the tubercles persisted more than that of the surrounding surface, the yellow colour showing up plainly in the midst of the red blotches. It is probable that these red blotches

* Réaumur first applied (*Mém.*, i., p. 77) the term "shagreened" to the rough skin of this and the allied species. He writes: "Leur peau peut être comparée à celle du chien de mer, et le nom qui semble le mieux leur convenir est celui de chenilles chagrinées." He says that the rough points are arranged with method, are coarse to the touch, formed of corneous matter, appearing under a microscope as tiny "mamelons" springing from a circular base.

are remnants of an ancestral character similar to the bright borders of the stripes in the larva of *Sphinx ligustri*. Just before pupation the colours of the larvæ get dull; in some the back darkens and becomes bronze-green or -blue, the tubercles showing up as bright specks. In the brood I reared, this change was not general; most of the larvæ became dirty-white previous to going to earth, and I found, when changing their food, that the dark ones were much more easily passed over than the light ones (Bacot). The larva of *M. tiliae* varies considerably. In some the oblique lines almost disappear. Occasionally, on either side of the body, six large, round, black and white centred spots appear, those on the fourth segment being the smallest, the remainder gradually increase, that on the ninth segment being the largest; an aberration of this kind is figured by Esper (*Die Schmett.*, t. 45); this larva has also a faint spot on one side of the third segment (Bartel). Larvæ are not uncommon, blotched with crimson on the borders of the oblique stripes. Buckler gives (*Larvae*, &c., ii., pl. xx., figs. 3, 3*a*, 3*b*) figures of three very fine forms of larva—fig. 3 of a fine bright pea-green tint with grey segmental and subsegmental incisions, whitish oblique lateral stripes shaded with dark grey anteriorly, caudal horn pale blue; fig. 3*a* yellow-green, with the subsegments of each segment marked transversely with minute yellow dots, the oblique lateral stripes yellow, slightly edged with reddish anteriorly, spiracles red-edged, caudal horn blue with red tip; fig. 3*b* bright green laterally, dorsum of abdominal segments strongly yellow, oblique lateral stripes yellow, with a heavy red blotch anteriorly in contact with each, spiracles red-rimmed, anal flap red. Anderson notes (*Ent. Rec.*, ii., pp. 200—201) a larva taken at Chichester, August 25th, 1891, which, instead of the normal green colour, was of a dingy violet shade.

Pupation.—The larva generally goes underground for pupation, but I have found the pupa hidden in rough chinks of the elm bark, sometimes as high up as six feet from the ground (Hellins); the larva spins a frail cell or cocoon, composed of earth spun together with a few silk threads, the larva often burrowing to a depth of several inches (Bacot); near Strood, a hollow in an old elm, full of decayed leaf-material, was always certain to contain several pupæ, rarely enclosed in any very definitely made puparia (Tutt); the larvæ pupate just beneath the surface of the ground, forming a very fragile cocoon, such spinning as there is being very slender and delicate (Ransom); found high up on elm in crevice of bark at Cirencester (Harmer); at foot of elm- and lime-trees (Bartlett); dug September at Winchester and Southampton (Moberly); pupæ dug at the roots of large elms (Russell); mostly under elm-trees, but discovered a pupa on April 14th, 1892, embedded in the wood of a fallen elm-tree, like an egg in an egg-cup, or an acorn in its cup, and another embedded in a stem of ivy growing on a tree at about 10 feet from the ground (Studd); barely covered with earth (Phillips); pupæ at roots of elm at Painswick (Watkins); under elm and lime in Bucks (Peachell); pupate in the ground 2 inches deep at Namur (Lambillion); pupæ dug at elms on canal bank at Hythe, October, 1891 (Brown); common in October, 1859, at roots of elm (Fenn); at Taunton, pupæ beneath the bark of elm 10ft.—12ft. up, but never more than a single pupa found at root beneath any one tree (Buckland); pupæ often most abundant by digging about elms in the avenues and parks in the Reading district (Holland); a pupa under bark of plane-tree 4 feet from ground in a firm silken cocoon produced imago June 2nd, 1856, the pupa less rugose than usual (Cox, *Ent. Wk. Int.*, i., p. 28); a pupa, March 2nd, 1857, in a cocoon of gnawed bark and wood under bark of old willow, and from 4ft.—5ft. from ground, the pupa smoother than usual, with a most beautiful purple tinge, produced moth May, 1857, other pupæ under piece of bark on elm 4ft.—5ft. from ground, at Stowmarket (Crewe); more commonly dug under elm than lime, once under sycamore, but other trees near; a very hardy pupa in confinement, have known injured specimens to emerge successfully (Prideaux); 3 inches under ground, near trees (J. A. Clark); common under elm towards end of September at Calne (Eddrup); pupa spun up in an old decayed mat in a garden, 3 pupæ in a flowerpot in a toolshed under lime tree, most found by tearing up the grass roots from 12ins. to 18ins. from the trunk (James); pupæ to be taken freely at the roots of elm in the autumn near Honiton (Riding); common in the Cheltenham district at roots of elm and lime, some 70 pupæ dug in 1898 principally at elms (Robertson); found commonly at birch and elm, prefers the narrow angles formed by the roots, getting in as far as possible (Greene).

PUPA.—♂. Length 26mm.—35mm., width 8·5mm. — 9·6mm. [This difference in width in two specimens of the same sex may appear trifling, yet the two pupæ look, one as if it were a ♀ pupa, the other quite a starveling.] Some pupæ of both sexes have a brilliant shining black aspect, others a dull grey-brown appearance. The majority have more or less of this dull grey-brown muddy and muddled appearance. One specimen gives some clue to the nature of this appearance. In this specimen, a fine superficial scale can be picked off the pupa in small flakes. It is of equal density all over, and extends right down to the bottom of the intersegmental incisions. It is something belonging to the pupa, not, that is to say, any extraneous dirt or other coating picked up. Under the microscope it is of very uniform density, but shows in every detail the surface sculpturing of the pupa. It would appear that the black pupæ are those in which this scale is perfectly adherent rather than wanting, and that the brownish coloration is due to its being more or less loose. On pupating, the new pupa is moist with fluid; this fluid appears to contain chitin, which solidifies as the fluid dries up and forms part of the outer surface of the pupa. I imagine this brown scale is this chitin, which in this species for some reason fails to absolutely consolidate itself with the pupa-skin in a large proportion of cases. The idea that there is a double pupa-skin (as in *Ephemera*, &c.) seems an impossible one. The pupa is nearly straight and cylindrical in the sense of having everywhere a circular section, *i.e.*, not anywhere flattened. It is widest at the 4th and 5th abdominal segments; hollowed at the 3rd thoracic and 1st and 2nd abdominal segments, so as to have a certain amount of waist. Still it is of very nearly the same size from the middle of mesothorax to the 6th abdominal; the anterior extremity is rounded dorsally but is fairly straight in front; the posterior extremity tapers from the

5th abdominal more rapidly at each segment; but the 10th abdominal still possesses a diameter of 3·5mm., with a strong spike at its dorsal margin so as to preserve the appearance of straightness to the whole pupa, although the abdominal segments are really slightly curved forwards. The general characters are ordinary Amorphid, *i.e.*, obtect, the 5th and 6th abdominal only movable, face as in most obtect pupæ, labrum ventral, eyes with convexity pointing ventrally, etc. From labrum to end of wings is 15mm., for the last 4mm. of this the wings meet closely in the middle line, quite close to their apices and without showing 3rd tarsi, they reach to quite posterior border of 4th abdominal segment. The proboscis reaches to the point where the wings meet, the 2nd pair of legs is just outside the proboscis and all but reach this point; the antennæ are again outside the legs and fractionally shorter; the 1st legs between maxilla and 2nd legs are 3mm. short of reaching this point; the maxillæ are basally broad as is very usual; the 1st legs have a base against the eyes and an equally long margin against the antenna. The general surface is rough and dull, but all these appendages—maxillæ, legs, antennæ—are separated from each other by a line of smooth shining surface, as if a fractional margin of what ought to have been opposed surfaces were exposed; this glazed surface is slightly wider at a point between maxilla and 1st leg, where, in some pupæ, a portion of first femur is exposed. There is no trace of labium; the bases of maxillæ narrow forwards to an angle in the middle line, terminated by a small button which appears to be labrum; mandibles not expressed. The other features of the pupa fall rather under the head of surface-sculpturing, since it is not easy to describe them altogether apart from what is really a separate matter, the development of the wrinkles, etc., of the chitinous surface. The pupa has the whole surface of the abdominal segments at least (except the intersegmental subsegment) covered with scattered minute hairs or bristles of a length of 0·06 mm., usually on the summits of the wrinkles; the general surface is rough, taking, on the wings, the form of a series of fine blunt points, arranged, not very clearly, in transverse rows or ridges, broken by a longitudinal arrangement related probably to the nervures, which are not otherwise so clearly expressed; the middle of the hind margin of wing on 4th segment is, not very deeply, sinuate about its middle; Poulton's line is clearly marked, by the rows of rough points being, on it, in very definitely longitudinal regular rows; behind the forewing, a narrow strip of hindwing extends to middle of 3rd abdominal segment, and is divided longitudinally into two nearly equal strips by a clearly-marked Poulton's line; at the base of the wing, about half-way between 1st spiracle and base of hindwing, is a rather stronger group of rough points, and on some specimens, two or three of these combine to make a definite, but rudimentary, spine or horn. The other appendages have fine rough points indefinitely arranged, except on antennæ, where they are in fine transverse lines, with a more marked series along each margin. The glazed eye is a definite smooth line, with convexity directed ventrally, and has the surface-points fading into it in radiating grooves. The inter-antennal portions of the head and of the clypeus in front of these tend to form slight elevations covered with the usual rough points. The prothorax faces half-way between dorsally and forwards, and is roughly sculptured with small points. The opening over first spiracle is a narrow slit with sharp lips, and slightly finer sculpturing along margin. The long, broad dorsum of mesothorax is rough, with irregularly but closely disposed points, and has a longitudinal central line of suture, marked, especially at its centre, by similar smoothed surface to that noted in connection with the appendages. The surface roughnesses look as if arranged, in some degree, with reference to this point as a centre, but elude any definite description of radiating from it or being in circles round it. This dorsal suture passes forwards as a definite, fine groove through the prothorax and the interantennal headpiece, and is even seen, not as a suture, but a line of central division, between the rough surface even on the clypeus; it extends backwards through the metathorax, and as an indicated central line rather than a suture through the first three abdominal segments. Another suture on the dorsum of the mesothorax is unusually obvious, *viz.*, that marking off the wing-bases; this starts at the anterior margin of the segment, half-way between the middle line and the antenna, at a point where the prothorax projects backwards with something of an angle, and reaches the posterior margin of the segment just where it curves round into the inner margin of the wing. The metathorax is very narrow on the extreme dorsum. The first abdominal segment is narrow, and narrower laterally where it passes under the hindwings. The 2nd and 3rd abdominal segments are again rather narrow; the 4th, 5th and 6th abdominals being one-and-a-half times to twice the width of those in front, their width differing considerably according to plumpness of pupa and stretching or otherwise of intersegmental membrane; the 7th and 8th again are narrower, and the 9th very narrow; the 10th is unusually well developed. The subsegmentation of these abdominal segments is obvious to a degree rare in pupæ. To take the fifth abdominal segment on the dorsum, five successive zones are present, four being subsegmental, the fifth the intersegmental membrane. The first is a little the largest and slightly fuller and more rounded, and more boldly sculptured; the fourth is very narrow; tracing these round the segment, the first three become indistinguishable at the spiracle, but the fourth is more marked in the lateral region than elsewhere; it seems to be the portion I have in the Rhopalocera called the intersegmental subsegment; its sculpturing is different from the others, instead of being of bold rough points, it is a fine shagreened texture, much like intersegmental membrane; the line marking it off from the anterior subsegments is very marked laterally and fades rather suddenly ventrally at the scars of the prolegs, but on the 7th abdominal segment it passes right round the segment very distinctly; this line is really a fall of the pupal surface to a lower level on this subsegmental surface, a circumstance that seems to make it structurally something different from the others, possibly, as I have surmised, part of what is properly intersegmental surface; the line is not straight round the segment, but has a distinct angle upwards in front of the spiracle, and is waved twice again in front of this; in one specimen there is a tendency to a range of nodules in this subsegment, very marked on the 3rd abdominal segment. The sculpturing of the abdominal segments, *i.e.*, of their three anterior subsegments, deserves special attention. The roughness of the mesothorax consists of a set of minute raised islets, closely packed together, the top of each having several small rounded projections, this is somewhat modified on the metathorax and in the 1st abdominal; they consist of a maze of waved ridges, of fairly uniform size and height, running into one another, or as it were dropping under each other; when we reach the 3rd abdominal segment, these ridges are larger towards the front of the segment, smaller behind, and this character they preserve through the rest of the abdominal segments; they have also very largely arranged themselves into a set of minute semicircular ridges, all with the convexity forwards and all highest on the forward edge, the points of the cusps fading down beneath the crests of those behind them; these get larger and more pronounced as we pass backwards; on the 5th abdominal segment, a large number of them are complete raised rings, with central cups, reminding one of a set of volcanic craters or a lunar landscape; on the 7th abdominal they are very large and numerous and packed together, but retain the character of being larger on the anterior portion of segment, and with their posterior lips lower, but rarely wanting; on the 8th abdominal they are large and crowded so as to interfere with each other here and there; on the 9th and 10th this tendency is much greater, so that on the 10th the condition is rather one of high irregular ridges, with deep pits between them; the same sculpturing occurs all round the segments, but is less pronounced and smaller ventrally, so that these ridges, in front of the spiracles of the 5th, 6th and 7th abdominal segments, are raised semicircles, as described on the 3rd abdominal dorsally, but the individual crescents are more distinct, from having little other sculpturing along with them. Ventrally, on the 5th and 6th abdominal segments, are the scars of the prolegs; these are depressions surrounded by a low, rounded elevation, the bottom of the depression is more or less smooth and flanged, from which radiate, over the surrounding elevation, fine ridges which lose themselves in the general sculpturing of the segment. On the dorsum of the 8th is a very similar scar of the larval horn; this (like the scar of the prolegs) varies a good deal, it is usually a slight elevation, with a depression behind it; the ordinary sculpturing radiates from the top of this elevation, as if a bit of it had been cut out and the rest drawn together from all round to fill the vacancy; sometimes the elevation has a central depression that is smooth and glazed; in some specimens it is almost obscure, but is never quite absent, so that this pupa does not range itself with those that only present such scars when weakly or not well-developed. The 9th abdominal segment has a small depressed circle in which are, side by side, two rounded elevations (♂ parts); the 10th segment has, as already noted, a wide end, the dorsal portion of which has a cremastral spine, conical, very rough, ending in a minute bifid point; the larger ventral portion has a depressed central line, with a rounded boss on either side; these bosses are roughly sculptured, as noted above; the depressed central line has, on either side, a flatter area with longitudinal grooves or ribbing, it ends in front in a minute pit or foveola, and, behind, in a depression at the base of the cremastral spine, which has a ridge and two grooves (or rather three ridges) radiating back from this point. The abdominal spiracles are oval, double, raised lines, within which is a flat area with a narrow central slit. The margin of the 4th subsegment, which bends forwards in front of the spiracle, does so so markedly on the 3rd abdominal as to produce a small pit at that point; there is no trace of alteration of the surface sculpturing in front of the spiracles, still less any trace of flanges as in the Sphingids *(sens. strict.)*. The ♀ pupa is rather larger and more robust; it may be 11mm.—12mm. or more in width, otherwise it differs from the ♂ pupa in no respect, antennal or otherwise, except in the configuration of the terminal segments. From the foveola, noted at anterior end of groove in 10th abdominal segment, a suture proceeds forward to anterior margin of 8th segment. This forms a wide, smooth, longitudinally striated area on the 9th abdominal, which encroaches on the 8th by an angular prolongation, and terminates between two small mammillæ on the middle of the ventral line of the 8th abdominal. There is much difference as to the obviousness or otherwise of these sculpturings; in a well-marked one, the prolongation of the 9th into the 8th abdominal stops just before a definite foveola in the 8th, between two slight elevations (Chapman). Poulton describes and figures *(Ext. Morph. of Lepidopterous Pupa*, p. 204, pl. xx., figs. 12—14) the terminal abdominal segments of this pupa. Viewed ventrally, the ♀ pupa shows the median prolongation of the 10th abdominal to be distinct, and the median slit in front of its apex represents one or both generative openings. A ♂ pupa, viewed from the left side, showed the scar of the caudal horn distinctly in profile.

Extended duration of pupal stage.—The pupal stage rarely extends over more than one winter; occasionally, however, an odd pupa in a brood will do so in confinement, but the records of such are very few. We have the following noted: Imago emerged May 18th, 1867, from a pupa of July, 1865, at Brighton (Image); May 1881, from an 1879 pupa (Lowrey); four imagines between May 18th and 27th, 1888, from 1886 pupæ at Lee (Fenn); April 8th, 1894, a ♀, from an 1892 pupa at Hartley Wintney (Claxton); May 2nd, 1894, a ♀, also from an 1892 pupa at Mitcheldean (Searancke). It will be observed that all these examples are from localities south of the Thames.

Parasites.—*Ichneumon flavatorius*, Fab. (Stephens), *Pimpla instigator*, Panz. (Marshall), *Microplitis ocellatae*, Bouché — the larvæ are gregarious, leave their host in September, when they spin their rough, greyish-brown cocoons, closely agglutinated together, and remain thereon until the following May or June (Bignell). [Slater exhibited certain parasites found externally on larva of *M. tiliae*, which Waterhouse believed to be an Acarid—*Uropoda vegetans* (*E.M.M.*, vol. xxiii., p. 115).]

Foodplants.—Lime (Linné), elm (Tutt), hazel (Bacot), sallow (Fowler), willow (Crewe), honeysuckle (Simes), birch (Dollman), alder (Briggs), oak (Speyer and Snellen), all varieties of *Ulmus* (Snellen), ash (Caradja), once on walnut (Rössler), *Tilia platyphyllos*, *T. microphylla* (Chaumette), *T. ulmifolia*, *Ulmus campestris*, *Betula verrucosa*, *Alnus glutinosa*, *Quercus robur*, *Castanea sativa*, *Juglans regia*, *Fraxinus*, *Pyrus communis*, *Prunus avium* (Bartel).

Habits.—Beales observes (*Ent. Rec.*, iv., p. 165) that the imagines, whether forced or not, almost invariably emerge between noon and 2 p.m.; Clark finds them newly-emerged on the trunks of lime-trees in the afternoon, but James discovered a ♀ just disclosed, the wings undeveloped, on a lime trunk, at 10.30 a.m., on May 12th, 1895, at Crouch End; Russell states that the imagines emerge during the daytime. During the day they are to be found on elm trunks (Raynor); on lime-trees and palings at Wimbledon, &c., on elm-trees at Oxford (Briggs); on lime-trees in gardens and meadows at Sudbury (Ransom); on palings and once on a bay-tree at Chiswick (Sich); on dark-coloured barricades and fences at Namur (Lambillion). The well-known position taken up by this moth when resting on a fence or tree-trunk is highly protective, and it is said* often to rest on the young shoots that spring directly from the trunk of a lime-tree, and to simulate a group of small leaves; I have seen one hanging from the top of a split oak fence, and it so exactly resembled a withered leaf that none but a practised eye could detect the difference (Bacot). Meyrick compares the imago at rest to a pair of half-expanded lime leaves. In the evening Dillon has observed the imagines at Clonbrock flying about lime and privet at dusk, and Kaye (*Ent. Rec.*, xii., p. 313) observed one at dusk, on July 15th, 1900, hovering at honeysuckle, at Worcester Park. Hewett notes an example taken at night on a sugared tree at Winchester (*Ent. Rec.*, ii., p. 133). The imagines are occasionally attracted by light. We have taken it clinging to lamps at Strood and Peckham; captured at light on Wicken Fen (Studd); very common at electric light at Berne, May 2nd—10th, 1893 (Knecht); frequently at light at Worcester (Rea); at light at Cheltenham (Winterbotham); at Aigle, 7 examples, from 9.15 p.m.—10.20 p.m., on July 3rd and 4th, 1898 (Lowe); at the electric light at Chester (Arkle). The males are readily attracted by a newly-emerged ♀; Burrows and others record the capture of several ♂s in this manner, and Carter writes (*Ent.*, xxxiii., p. 202) that a ♀, hanging on the lower branch of a lime-tree on May 17th, 1900, and following days, attracted ♂s as follows: May 17th, 3 ♂s; 18th, 7 ♂s; 19th, 4 ♂s; 20th, 3 ♂s; 21st, none; 22nd, 2 ♂s; 23rd, 2 ♂s. He concludes, from his observations on this and other occasions, that the ♂s never arrive before 9 p.m., nor has one been observed after 9.30 p.m. Jenner observed several males attracted at 8.30 p.m. by a newly-emerged ♀ in a window at Carshalton, on June 15th, 1857. Bacot obtained 4 ♂s between 8.50 p.m. and 9.25. p.m. at Clapton, on May 7th, 1896, with a fresh ♀. Prideaux obtained 3 ♂s, attracted to a bred ♀, between 9 p.m. and 9.30 p.m. at Bristol. Lee took a dozen ♂s one evening in June, 1888, at

* The small leaves breaking out from the buds here and there on lime-trunks nearly always appear in pairs, and point obliquely downwards, so that they form a curious resemblance to the wings of the imago of *M. tiliae;* they are placed at precisely the same angle, and when only half expanded have the same straight costal edge and scalloped margin (Barrett).

Sutton, Surrey, flying around a captive ♀. Battley observes that an imago emerged at 10 a.m. on March 13th, the wings not expanding until the afternoon of March 14th (*Ent. Rec.*, ii., p. 54).

Habitat. — Generally distributed in our southern counties in a variety of situations—trees growing in parks, gardens, hedges, and even in streets, are usually chosen by the moth on which to lay its eggs. It occurs on the lime-trees that frequently line the streets in various parts of London, or grow in the small gardens in front of suburban houses. We have not observed it in dense woods, but suspect that it occurs even there.

Time of appearance.—In Britain, from April to early June, largely dependent on the season, also occasionally late specimens that are not from eggs of the year, *e.g.*, Hellins notes a larva found September 22nd, 1858, that disclosed an imago August 8th, 1859. Occasionally one gets a second-brooded individual developed, *e.g.*, an emergence on November 22nd, 1894 (Bellamy, *Ent. Rec.*, ii., p. 302). Fritsch gives dates for Austria from May 4th—July 20th, but not many in July, also as early as March 20th at Neusohl, and April 24th at Pressburg; middle of April in the Roman Campagna; April and May at Budapest; April to July at Fünfkirchen; May in Bremen, Cassel, Wiesbaden, Augsburg, Istria and Transylvania; May 10th—25th at Namur; May and June in the Inn Valleys, Mecklenburg, Eutin, Crefeld, Upper Lusatia, Thuringia, Baden, Epiries and Sarepta; May to July in Brunswick and Leipzig; June in Lombardy, mid-June in Kissingen; commencement of June to mid-June at Mülhausen; June and July in Roumania (Caradja); July 2nd at Groesen in the Baltic Provinces (Nolcken); July in Loire-Inférieure, Mehadia, St. Petersburg and Transcaucasia; July 3rd and 4th, 1898, at Aigle; end of July and commencement of August in the Visp Valley; July and August at Aix-les-Bains. Possibly some of these last-named records indicate a second brood; the following certainly do so—spring and summer in Tuscany (*teste* Bartel); May-June and again from August-October, usually in two, often in three, broods a year in the Haute-Garonne (Caradja); June and again in September in the Eure-et-Loir dept. (Guénée); May-June and occasionally in August in Silesia (Assmann). The following dates indicate the vagaries of its appearance in Britain; April 15th, 1719, from a larva obtained July 17th, 1718, and that pupated July 22nd, 1718 (Albin). May 5th, 1857, and following days at Faversham (Stowell), May 27th, 1857, at Wandsworth, fullfed larvæ common from August 11th the same year (Blackmore); June 15th, 1857, at Carshalton (Jenner); July 20th, 1858, July 25th, 1867, at Emsworth (Buckler); May 5th-June 9th, 1860, larvæ September 24th, from Benson, produced imagines May 25th and 26th, 1861, imagines taken May 3rd—16th, 1862, May 19th, 1866, May 11th — 22nd, 1876, June 4th, 1885, at light, May 8th—18th, 1886, June 12th—July 11th, 1887, May 18th—27th, 1888 (two years in pupa), June 2nd, 1891, June 17th, 1892, June 12th, 1893, June 27th, 1894, June 12th, 1895, April 28th—June 23rd, 1896, all at Lee (Fenn); June 15th, 1860, at Mansfield (Brameld), April 30th, 1861, May 1st, 1865, at Worcester (Edmunds); April 30th, 1861, at Colchester (Harwood); June 14th, 1862, on Wandsworth Common, June 29th, 1862, near Brompton Cemetery, May 24th, 1869, at Wimbledon Common, June 10th, 1881, at Twickenham, bred May 14th, 1889, from larva found August 29th, 1888 (T. Briggs); May 5th, 1866, from eggs hatched last week in May, 1865, which produced larvæ that pupated July 7th—14th, 1865, at Brighton, one of same brood emerged May 18th, 1867, June 10th, 1898, from Sydenham (Image); May 26th, 1866, at Northleach (Todd); May 4th, 1868, ♂ captured at Bromley (Jenner-Fust); 1st week in May, 1868, at Painswick, imago emerged May 8th, 1869, from a larva obtained July 30th, 1868, at Painswick (Watkins); May 16th, 1870, June 11th, 1876, June 12th, 1877, June 7th, 1878, June 6th, 1879, June 19th, 1880, May 19th, 1884, May 27th, 1885, June 12th, 1887, May 21st, 1889, all at Lee, at rest on fence on July 2nd, 1871, at Eltham, on tree-trunk, May 27th, 1893, others taken May 25th, 1894, May 18th, 1896, May 31st, 1897, May 27th, 1898, May 13th, 1900, all at Lee (Bower); May 28th, at light at Odiham, June 9th, 1875, at Henley, May 20th, 1886, at light, June 1st, 1889, in signal-box at Reading (Holland); May 25th, 1871, at Wanstead, June 3rd, 1886, at Brentwood, May 1st, 1891, June 10th, 1893, May 1st, 1894, June 6th, 1895, assembled at Rainham (Burrows); June 11th, 1878, June 17th, 1879, at Rugby (Wilson); May 25th, 1886, at Guildford (Grover); June 3rd, 1886, June 17th, 1891, at Brentwood, May 25th, 1897, at Witham, June 22nd, 1898, at Hazeleigh (Raynor); June 16th, 1888, ♂ at light, May 15th, 1893, May 12th—26th, 1895, June 29th, 1898, latest date I have taken it, all at Crouch End, June 18th, 1896, a worn male and fresh female respectively from Norwood and Croydon, June, 1900, scarce at electric lamps on Highgate Hill (James); June, 1888, at Sutton (Lee); June 17th—24th, 1888, June 13th, 1893, June 12th, 1899, at Chiswick (Sich); July 7th, 1888, June 17th, 1899, at Croydon (Sheldon); three pupæ forced, put on mantelpiece, June 1st, 1889, one emerged February 24th, another March 8th, the last March 21st, 1890 (Arkle); June 8th—27th, 1889, May 14th, 1893, at Clapton and Crouch End (J. A. Clark); June 24th, 1890, May 14th—30th, 1893, May 31st, 1895, clinging to bases of lime-trees, planted about the town at Ealing (Montgomery); June 18th, 1891, at Tuddenham (Christy); April 25th—May 14th, 1892, April 9th, 1893, April 3rd—6th, 1894, April 20th—May 7th, 1896, April 3rd, 1898, February 26th, 1898 (forced), June 4th, 1900, at Oxton, June 14th, 1898, at Wicken at light (Studd); May 19th—23rd, 1892, at Shorncliffe (Brown); May 24th and 29th, 3 ♂ s assembled to bred ♀ at Bristol, ♂ May 16th, 1898, on a fence, ♂ June 16th, 1900, on a lime trunk, both at Reigate (Prideaux); June 1st, 1892, at Cheltenham (Brooke); June 21st, 1892, larvæ August 13th, 1899, gave imagines that emerged June 21st, 1900, at Bristol (Bartlett); July 2nd, 1892, at Brentwood, May 28th, 1895, ar Forest Gate (Mera); April 26th, May 27th, 1893, July 4th, 1900, at West Dulwich (Fletcher; ♀ emerged April 8th, 1894, from a pupa that changed 1892, all the rest emerged May, 1893, from Hartley Wintney (Claxton); April 26th, 1894, at Blackheath (Smith); ♀ bred May 2nd, 1894, from a two-year-old pupa from Forest of Dean, retarded specimens appear usually to be ♀ (Searancke); May 27th, 1894, May 15th—28th, 1895, May 14th, 1896, at Wisbech (Glenny); April 14th, 1895, April 23rd, 1896, June 5th, 1899, June 20th, 1900, at Worcester (Rea); May 5th, 1895, at Worcester Park, Surrey (Kaye); June 1895, June 6th, 1896, at Bath (Greer); May 19th, 1896, May 31st, 1897, at Chelmsford (Miller); June 7th, 1896, 4 ♂s assembled to ♀ between 8.50 p.m. and 9.45 p.m. at Clapton (Bacot); April 22nd—30th, 1897, at Cheltenham (Winterbotham); May 7th, 1897, May 11th, 1898, at Reading (Butler); May 14th—17th, 1897, from pupæ taken at Fleet in September, 1896, May 16th—21st, 1898, from pupæ taken at Otford on October 22nd, 1897; May 23rd, 1899 from pupæ taken at Fleet on October 1st, 1898, imagines May 15th—June 1st, 1899, from pupæ taken at Faversham on December 23rd, 1898 (Russell); June 24th, 1897, freshly emerged on a beech trunk (wych elm near) at Chalfont Road, May 29th, 1899, at Dalston (Prout); January, 1898, 1 indoors at Gloucester (Merrin); January 31st, March 9th, 12th, 13th, April 1st, 6th, 1898, at Cambridge (Thornhill); June 6th, 1898, bred at Corsemalzie from southern pupæ (Gordon); May 6th, 1899, from West Drayton, May 27th, 1899, from Hampstead, June 15th, 1901, on Hampstead Heath (Phillips); May 10th, 1899, emerged from Cheltenham pupæ (Robertson); May 29th, 1899, at Iver, February 28th, 1901, from pupa dug at High Wycombe on June 11th, 1900 (Peachell); ♂ June 3rd, ♂ June 15th, 1899 at Sydenham, ♀ June 6th at Forest Hill, July 8th ♀ at Dulwich, the latter had laid 39 eggs on the side of some stone steps which were quite 5 yards from a lime-tree (Swain); 2 ♂s emerged May 29th, also 1 ♀, 1 ♂ June 1st, 1901, all from pupæ obtained from Northampton (Hewett); imagines, May 29th, 1901, larvæ June 4th—29th, pupæ July 7th—27th in the Dorking district (Oldaker); June 25th, 1901, at Sudbury (Ransom).

LOCALITIES.—The northern limits of this species in Great Britain are hardly known with certainty. It is exceedingly rare in Lancashire, Yorkshire and Lincolnshire. Records in these counties and north of them appear to be of single specimens only. AYR: Kilmarnock (Dunlop). BEDFORD: Bedford (Steuart). BERKS: Reading (Butler), Tilehurst (Holland). BRECON (Tutt coll.). BUCKINGHAM: Hanbury Park (Wynn), Iver, High Wycombe, Hughenden (Peachell), Chalfont Road (Prout), Halton, Wavendon (Stainton). CAMBRIDGE: common throughout Fen district (Balding), Cambridge (Hunter), Wisbech (Glenny), Wicken Fen (Studd). CHESHIRE: very rare (G. O. Day), Sandbach (Heap), Chester (Quinton). CUMBERLAND: Keswick, rare (Beadle). DERBY: Cubley, Burton district (Brown). DEVON: Starcross (Mitchell), Teignmouth (Stainton), Exeter (Hellins), Oxton, common (Studd), Sidmouth (Majendie), Plymouth (Basden-Smith), Buckerell, abundant (Riding). DORSET: common throughout (Dale), Blandford, Dorchester (Stainton). ESSEX: generally common (Harwood), Epping, common (Stainton), Chingford (James), Wanstead, Brentwood, Rainham (Burrows), Witham, Hazeleigh (Raynor), Ilford (Adams), Chelmsford (Miller), Eastwood, Southend (Whittle), Colchester (Harwood), Forest Gate (Mera), Hale End (Prout), Feering Bury (Reid). FLINT: Erbistock (Perkins). GALWAY: Clonbrock, common (Dillon). GLOUCESTER: fairly common (Griffiths), Northleach (Todd), Gloucester (Merrin), Tewkesbury district, common (Fox), Bristol district, rather common (Bartlett), Forest of Dean (Searancke), Prestbury, Cheltenham, common (Robertson), Cirencester (Harman), Painswick (Watkins), Clifton (Prideaux), Lower Guiting (Stainton). HANTS: Isle of Wight, Long Benton (Ingram), Basingstoke (Holdaway), Gosport, scarce (Pearce), Ringwood (Fowler), Fareham (King), Emsworth (Buckler), Odiham, Greywell, Hartley Row (Holland), Portsmouth (Jones), Hartley Wintney (Claxton), Winchester, Southampton (Moberly), Fleet (Russell), New Forest, Boscombe, Bournemouth (Robertson). HEREFORD: Leominster (Hutchinson), Tarrington (Wood). HERTFORD: Hertford (Stephens), Hitchin, Knebworth (Griffith). HUNTS: St. Ives (Norris). KENT: Rochester and Chatham districts, not uncommon (Chaney), Greenwich, Strood, common (Tutt), Rosherville (Andrews) Ramsgate (Willson), Wye district, common (Theobald), Otford, Faversham, Ashford (Russell), Eltham (Jones), Greenwich Park (West), Lee (Bower), Sydenham (Image), Halstead (Tutt coll.), Shorncliffe, Hythe (Brown), Forest Hill (Swain), Blackheath (Smith), Penge (Norman), Tunbridge Wells (Nicholson), Brockley, common (Turner), Northfleet (Andrews), Lewisham (Fenn), Bexley, common (Newman), Bexley Heath (Carter), Bromley (Jenner-Fust). KERRY: Killarney, one (Salvage). LANARK: near Hamilton (Lang *teste* Chapman). LANCASHIRE: very rare in north Lancs., single specimens only taken (Murray), Bolton (Tutt coll.) Hulme (Adamson). LEICESTER: Loughborough (Wieldt), Earl Shilton (Vice), Gumley (Matthews). LINCOLN: Lincoln district, very rare (Carr), Brocklesby (Musham), Brant Broughton (Stow). MIDDLESEX: generally common (Godwin), Ealing (Montgomery), Harrow district, common (Rothschild), Kingsbury (Bond), Notting Hill (Clarke), Stamford Hill, very common in 1888 (Milton), Chiswick Park (Cockerell), Upper Clapton district, very common in 1888 (Ogden), Brentford (Fenn), Mill Hill, St. John's Wood, Hendon (South), Isleworth (Meyers), Bedford Park (Gray), Paddington, Hampstead, West Drayton (Phillips), Brompton cemetery, Twickenham (T. Briggs), Hackney, one only, Dalston, Crouch End (Prout), Totteridge (Peachell), Kensington Gardens (Bacot), Ham Common (Ashdown), Fulham (Dawe), Canonbury (Buckell), Maida Vale (Tremayne), Waltham Cross, Enfield, rare (Bowles). NORFOLK: Whitwell (Freeman), Yarmouth (Knights), Norwich (Harris). NOTTINGHAM: Mansfield (Brameld). NORTHAMPTON: Northampton (Hensman), Daventry (Green), Kettering (Sturgess), Peterborough, common (Morley). OXFORD: Enstone (Tutt coll.), Chinnor (Spiller), near Oxford (Briggs), Benson (Fenn), Henley, Caversham (Holland). RENFREW: Houston (*teste* Dalglish). ROXBURGH: Caverton district (Elliot). RUTLAND: Uppingham (Bell). SOMERSET: Bristol coalfield district, generally distributed, not common (Hudd), Castle Cary, common (Macmillan), Wellington (Wilson), Taunton (Farrant), Weston-super-Mare (Smallwood), Bath (Greer). STAFFORD: Trentham (Jahn), Market Drayton (Laing). SUFFOLK: common (Bloomfield), Waldringfield (Jones), Sudbury, somewhat rare (Ransom), Tuddenham (Christy), Ipswich (Pyett), Stowmarket (Crewe). SURREY: Guildford (Grover), Wimbledon (Whittle), Sutton (Lee), Barnes (Sich), Reigate (De Mattos) Worcester Park (Kaye), banks of river Mole, West Horsley, Wandsworth Common (T. H. Briggs), Croydon (Sheldon). Carshalton (Jenner), Kingston-on-Thames (Cooper), Norwood (James), Chipstead (Carr), Banstead (Adkin), Dorking (Oldaker), Streatham, Tulse Hill, Caterham, Brixton Hill, Mitcham (Henderson), Dulwich (Swain), West Dulwich (Fletcher), Peckham (Tutt), Nunhead, Camberwell (Barrett). SUSSEX: rare in eastern Sussex—Hayward's Heath. etc. (Jenner), Brighton (Image), Burgess Hill (Dollman), Bersted, Worthing (Fletcher), Chichester (Anderson), Rye (Henderson). WARWICK: Rugby (Wilson), Stanbury Park (Wynn), Birmingham (Imms). WILTSHIRE: Calne (Eddrup). WORCESTER: generally common in Worcester district—Spetchley Park, etc. (Rea), Malvern Wells (Mason). YORKS: York once (Hewitson), Cottingham (Lowther, *Nat.*, 1900, p. 227).

DISTRIBUTION.—Distributed over the whole of Europe to Transcaucasia and Siberia. Its occurrence, however, in southern Spain, the most southerly part of Italy and the Balkan peninsula has not been positively ascertained. ASIA: Siberia (Pallas), Govts. of Uralsk, Turgai, Tobolsk, Akmolinsk, Semipelatinsk, Tomsk; Turkestan (*teste* Bartel). AUSTRO-HUNGARY: Tyrol, not rare (Hinterwaldner), Ratzes (Heller), Taufers, Innsbruck (Weiler), Botzen (Bartel), Lavantthal (Hofner), Fiume—Cástua (Mann), Upper Carinthia—Salzburg, Bohemia, not rare (Nickerl), Carinthia—Friesach, Karlsbad, Lower Austria—Vienna, Moravia—Mährisch-Trübau, Ungarisch-Brod (*teste* Bartel), Brünn (Müller), Galicia, common (Garbowski), Cracow (Zebrawski), Sambor, Lemberg (Nowicki), Tarnów (*teste* Bartel), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Hungary, everywhere common (*teste* Bartel)—Hermannstadt (Czekelius), Epiries, common (Husz), Kikulahegy, Kocsocz (Vángel), Gölnitz (Hudák), Transylvania, Kaschau, Leutschau, Rosenau, Neusohl, Raab, Budapest, Heveser Comitat (*teste* Bartel), Bukovina, very rare compared with western Europe (Hormuzaki), Pressburg (Rozsay), Upper Styria—St. Lambrecht (Kodermann), Fünfkirchen, Josefsthal, Croatia, Mehadia (*teste* Bartel), Upper Austria—Inn Valley, Pöstlingberg, Heitham, very common (Himsl). BELGIUM: rather common (Donckier), Namur, very common, etc. (Lambillion), Mons, Flénu, Marche-les-Dames, very common (Derenne). DENMARK: rare, Lolland, Frederiksborg, Vordingborg, Nykjöbing, Mariebo (Bang-Haas), Falster, Sjaelland (*teste* Reuter). FINLAND: Abo, Nyland, St. Karins, Sjundeå (Reuter). FRANCE: common (Berce), Boulogne (Timins), dept. du Nord, common (Paux), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne (Sand), Eure-et-Loir (Guénée), Haute-Garonne (Caradja), Puy-de-Dôme (Guillemot), Var (Cantener), Morbihan (Griffith), Gironde (Trimoulet), Doubs—Chamors (Bruand), Aude (Mabille), Saone-et-Loire (Constant), Seine-Inférieure—very common, Rouen, etc. (Viret), St. Quentin (Dubus), Deux-Sèvres (Maillard), Sarthe (Desportes), Paris (Walker), Loire-Inférieure, common—Chapelle-sur-Endre, Nantes, Savenay, Montmorency, near Paris, common (Bonjour), Le Havre (Dupont), depts. Meurthe-et-Moselle, Meuse (*teste* Bartel), Aix-les-Bains, common (Agassiz), GERMANY: common (Heinemann), northwest Germany, generally distributed (Jordan), everywhere in Silesia (Assmann), Rhine Palatinate, rare (Bertram), Wurtemberg (Seyffler), Giessen (Dickore), Lower Elbe district (Zimmermann), Waldeck (Speyer), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Chemnitz (Pabst), Halle (Stange), Munich, not common (Kranz), Hildesheim, common (Grote), Rudolstadt (Meurer), Mecklenburg (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia, common (Schütze), Dresden (Steinert), Thuringia—in the plains and lower mountains not rare—near Erfurt, Gotha, common (Krieghoff), Prussia, common (Grentzenberg), Upper Lusatia, common everywhere (Moeschler), Ratisbon (Schmid), Pomerania, not rare (Hering), Dessau (Richter), Frankfort-on-Oder (Kretschmer), Hanover, moderately common (Glitz), Wernigorode (Fischer), Alsace (Peyerimhoff), Brunswick (Heinemann), Eutin (Dahl), Stuttgart (Hoffmann and Keller), Baden district, generally—Constance, Carlsruhe, very common (Reutti), near Heidelberg (Baker), Heligoland (Gätke), Berlin, Holstein—Plön, Crefeld, Barmen, Elberfield, somewhat common, Cassel, Leipzig, Friedewald, common, Fichtel-Gebirge, Kissingen, Augsburg, not rare, Kempten, Nassau, Frankfort-on-Main, Wiesbaden, Wetterau, Bavarian Palatinate (*teste* Bartel). ITALY: fairly common except Sardinia and Corsica (Curò), throughout Tuscany—Roman Campagna—Monte Rotondo, near Rome (Calberla), Modena (Fiori), Naples district—Castellammare di Stabia on the Gulf of Naples, Lombardy, Piedmont, Liguria (*teste* Bartel), Madonie, somewhat rare (wrongly noted by Staudinger as not occurring in Sicily) (Minà-Palumbo). NETHERLANDS: in all provinces, common (Snellen), Breda, very common (Heylaerts). PORTUGAL (*teste* Bartel). ROUMANIA: quite rare, Grumazesti (abundant in 1895), Kloster Neamtz, Slanic (Caradja), Comanesti (Leon), Ciucorova in the Dobrudscha (Mann). RUSSIA: Moscow govt. (Albrecht), Volga district, not rare (Eversmann), Transcaucasia—Borjöm, Manglis, Lagodekhi (Romanoff), St. Petersburg (Erschoff), Baltic Provinces, very rare—Sessau (Voigt), Mitau (Bienert), Groesen (Rosenberger), govts. Archangel, Oblonez, Oranienbaum, Narwa, Pskow, Mogilew—Gorki, Wolynien, Kijew, Bessarabia, Cherson, Jekatinerinoslaw, Poltawa, Charkow, Orel, Kaluga, Tambow, Kasan, Simbirsk, Ufa, Orenburg, Samara, Saratov, Astrachan—Sarepta, not rare; Tawritschesk, Stavropol, north Caucasus (*teste* Bartel). SCANDINAVIA: not rare in south, northern limits Upland and south Finland (Aurivillius), Norway—Christiania, Drammen, Odalen, Naes Vaerk (Siebke); southern Sweden to Upland, southern Norway (Lampa). SPAIN: Teruel—Rubielos de Mora (Zapater), Galicia (Macho-Velado), Barcelona—Besós, Calella (Cuní y Martorell), Catalonia (Martorell y Peña), Bilbao (Seebold). SWITZERLAND: Weissenburg (Huguenin), Grisons, rather rare—Chur, Bergell, etc. (Killias), Visp valley (Jordan), Aigle (Lowe), Zermatt, Gadmenthal from 2000ft.—2500ft., canton Glarus (*teste* Bartel), Bern, common (Knecht), Bechburg (Riggenbach-Stehlin), Zurich district—Mettmenstätten, Zürichberg (Dietrich).

Tribe: SMERINTHIDI.

This appears to be the most extensive tribe of the Amorphids. It is a higher branch of this phylum than the Sichiid or "*quercûs*" group, and very distinct from the Amorphid (*sens. strict.*) or "*populi*" group. The tribe is exceedingly well-developed in the Nearctic region, and contains a number of closely-allied and interesting genera. The characteristic marking of the imagines is the ocellated spot on the hindwings. Bacot notes that *Smerinthus (ocellata)* and *Amorpha (populi)* appear to have arisen from a form possessing the characteristic anal angle wing-mark very much as is now seen in *Sichia quercûs*, through a long series of less specialised forms now represented by *occidentalis* and *modesta* towards *Amorpha populi* and through another series now represented by *Burrowsia roseipennis* and *Daddia kindermanni* to *Smerinthus ocellata*. The anal-angle hindwing marking and colouring of the species of the *quercûs*-group, *e.g.*, *B. roseipennis*, become in *D. kindermanni* a double series of blue and black bars (black, blue, black, blue); these bars, strengthened vertically, and the black encroaching on the blue at the ends and below the last blue streak, produce the ocellated spots of such forms as *Bellia caecus* and *geminatus*. Following this, we have the central black bars detached at the ends, forming a central black spot or pupil in the blue iris as in *vancouverensis*; then the black centre becomes suffused with blue scales, and the whole ocellated area enlarged, as in *ocellata*. A further development, or a separate line of evolution, from a form similar to *Nicholsonia saliceti*, in which the upper portion of the double blue spot as seen in *B. caecus* tends to increase at the expense of the lower, produces the ocellated spot of such species as *myops* and *astylus*, in which it consists of a small central blue spot, surrounded by a broad black margin.

The Smerinthid egg (as represented by *S. ocellata*) is green, with a faint polygonal reticulation, and a depression on the upper surface. The newly-hatched larva is almost of the same outline and proportions as the adult, but with rounded head, which, in the second instar, however, becomes triangular and is provided with a pair of well-developed apical points. The larva spins a frail earthen puparium with few or no silken threads. In shape, the pupa falls between that of the Mimantids and Amorphids, being more rounded than the former at the anal end, the bosses on the underside of the anus being scarcely visible; the surface smooth and polished; the anal spike smooth and relatively small. The imaginal frenulum, in the ♂, has a very short bristle and the loop is absent, whilst in the ♀ it consists of a cluster of small bristles; the whole appliance probably useless.

Genus: SMERINTHUS, Latreille.

SYNONYMY.—Genus: *Smerinthus*, Latr., "Hist. Nat.," iii., p. 401 (1802); xiv., p. 135 (1805); "Gen. Crust.," iv., p. 210 (1809); "Consid.," p. 440 (1810); Ochs., "Die Schmett.," iv., p. 45 (1816); Sam., "Ent. Comp.," p. 243 (1819); Godt., "Hist. Nat.," iii., p. 68, pl. xx., fig. 2 (1821); Stephs., "Ill. Haust.," iv., 1, p. 112 (1828); "Cat. Br. Ins.," pt. 2, p. 30 (1829); "List Br. An. Br. Mus.," v., p. 26 (1850); Bdv., "Eur. Lep. Ind. Meth.," p. 34 (1829); "Gen. et Ind. Meth.," p. 49 (1840); "Sp. Gén. Lép. Het.," i., p. 17 (1875); Wood, "Ind. Ent.," pl. xi., fig. 7 (1839); Westd., "Gen. Syn.," p. 88 (1840); Dup., "Icon. Chen.," pl. vii., fig. 1 (*circ.* 1840); "Cat. Méth.," p. 45 (1844); Humph. and Westd., "Brit. Moths," p. 7 (1841); Evers., "Faun. Volg.-Ural.," p. 114 (1844); H.-Sch., "Sys. Bearb.," ii., p. 91 (1846); Chaum., "Zool.," ix., p. 3244 (1851); Heydenr., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Sta., "Man.," i., p. 87 (1857); Speyer, "Geog. Verb.," i., p. 325 (1858); Hein., "Schmett. Deutsch.," p. 150 (1859); Humph., "Gen. Brit. Moths," p. 7 (1860); Staud., "Cat.," 1st ed., p. 16 (1861); 2nd ed., p. 37 (1871); 3rd ed., p. 99 (1901); Wallgrn., "Skand. Het.," i., p. 17 (1863); Rbr., "Cat. Lép. And.," ii., p. 136 (1866); Snell., "De Vlind.," p. 101 (1867); Berce, "Faun. Franç.," ii., p. 27 (1868); Nolck., "Lep. Fn. Estl.," i., p. 90 (1868); Newm., "Brit. Moths," p. 4 (1869); Mill., "Cat. Lép. Alp.-Mar.," i., p. 120 (1872); Bang-Haas, "Nat. Tids.," (3), ix., p. 403 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 41 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 113 (1875); Butl., "Tr. Zool. Soc. Lond.," ix., p. 590 (1876); Kirby, "Eur. Butts. and Moths," p. 74 (1879); "Cat.," p. 711 (1892); "Handbook, &c.," iv., p. 60 (1897); Frey, "Lep. Schweiz," p. 58 (1880); Hellins, "Buckl. Larvæ," &c., ii., p. 99, pl. xx., fig. 1 (1887); Auriv., "Nord. Fjär.," p. 43 (1889); Bacot, "Ent. Rec.," vi., p. 174 (1895); Meyr., "Handbk.," p. 299 (1895); Barr., "Lep. Brit.," ii., p. 3 (1895); Lucas, "British Hawk-Moths," p. 123 (1895); Tutt, "Brit. Moths," p. 20 (1896); Lamb., "Ent. Rec.," xi., pp. 330 *et seq.* (1899); Bartel, "Palæark. Gross-Schmett.," ii., p. 171 (1900). *Sphinx*, Linn., "Sys. Nat.," 10th ed., p. 489 (1758); 12th ed., p. 796 (1767); "Faun. Suec.," 2nd ed., p. 286 (1761); "Mus. Ulr.," p. 341 (1764); Poda, "Ins. Mus. Græc.," p. 80 (1761); Scop., "Ent. Carn.," p. 182 (1763); Müll., "Fn. Frid.," p. 37 (1764); Hfn., "Berl. Mag.," ii., p. 178 (1766); Fab., "Sys. Ent.," p. 536 (1775); "Spec. Ins.," ii., p. 139 (1781); "Mant. Ins.," ii., p. 92 (1787); "Ent. Sys.," iii., pt. 1, p. 355 (1793); Schiff., "Schmett. Wien.," 1st ed., p. 41 (1775); 2nd ed., p. 5 (1801); Esp., "Schmett. Eur.," ii., p. 27, pl. 1 (1779); Berg., "Sphing. Eur. Larv.," p. 4 (1782); Retz., "Gen. Spec.," p. 35 (1783); Bork., "Sys. Beschr.," ii., p. 104 (1789); Brahm, "Ins.-Kal.," ii., 1, p. 430 (1791); Hb., "Eur. Schmett.," fig. 73 (*circ.* 1800), text p. 99 (1805); Lamk., "Syst. Anim. sans Vert.," p. 282 (1801); Schrank, "Faun. Boica," ii., 1, p. 221 (1801); Haw., "Lep. Brit.," 1, p. 63 (1803); Ochs., "Die Schmett.," ii., p. 249 (1808). *Laothoë*, Fab., "Ill. Mag.," vi., pp. 287—288 (1807). *Laothöe*, Leach, "Edinb. Enc.," ix., p. 130 (1815); Oken, "Lehrb. Zool.," i., p. 753 (1815). *Dilina*, Dalm., "K. Vet. Ac. Handl.," p. 212 (1816); Zett., "Ins. Lapp.," p. 915 (1840). *Paonias*, Hb., "Verz.," p. 142 (*circ.* 1822); Stephs., "Illus. Haust.," iv., app. p. 5 (1835). *Merinthus*, Meig., "Eur. Schmett.," ii., p. 148 (1830). *Bebroptera*, Sodoffsky, "Bull. Mosc.," x., no. 6, p. 11 (1837). *Copismerinthus*, Grote, "Journ. N.Y. Ent. Soc.," iii., p. 132 (1895); "Ent. Rec.," vii., p. 56 (1895); viii., p. 18 (1896).

Latreille gives (*Hist. Nat. Crust. Ins.*, iii., p. 401) the following diagnosis of the genus:

Trompe très-courte ou nulle. Antennes en scie ou pectinées, terminées en pointe crochue, sans filet au bout. Ailes dentées ou anguleuses—*Sphinx tiliae, ocellata.*

Latreille fixed, in 1810 (*Consid. Ord. Nat. Animaux*, &c., p. 440), the type of the genus as *ocellata.* Grote erected (*Hawkmoths North America*, p. 35) the genus *Copismerinthus*, in 1886, for *cerisii*, Kirb. Later he states (*Journ. New York Ent. Soc.*, iii., p. 132; *Ent. Rec.*, vii., p. 56) that *ocellata* and *ophthalmicus* are congeneric with *cerisii*, all agreeing in having a blunt spine at the extremity of the fore tibiæ, and, as he erroneously believes that Latreille has indicated *populi* as the type of *Smerinthus*, he sinks *Amorpha*, Hb., before *Smerinthus*, and employs *Copismerinthus* for *ocellata.* This spine is a very striking and characteristic structure, being, in *S. ocellata*, a distinct prolongation of the first tibia, and sufficiently large to be readily seen and examined under a low power lens.

SMERINTHUS OCELLATA, Linné.

SYNONYMY.—Species: *Ocellata*, Linn., "Sys. Nat.," xth ed., p. 489 (1758); xiith ed., p. 796 (1767); "Faun. Suec.," 2nd ed., p. 286 (1761); Poda, "Ins. Mus. Græc.," p. 80 (1761); Scop., "Ent. Carn.," p. 182 (1763); Müll., "Fn. Frid.," p. 37 (1764); Hfn., "Berl. Mag.," ii., p. 178 (1766); Fab., "Sys. Ent.," p. 536 (1775); "Spec. Ins.," ii., p. 139 (1781); "Mant. Ins.," ii., p. 92 (1787); "Ent. Sys.," iii., 1, p. 355 (1793); "Ill. Mag.," vi., p. 287 (1807); Schiff., "Schmett. Wien.," ed. 1, p. 41 (1775); ed. 2, p. 5 (1801); Esp., "Schmett. Eur.," ii., p. 27, pl. i (1779); Bkh., "Sys. Besch.," ii., p. 104 (1789); Schrk., "Faun. Boica," ii., 1, p. 221 (1801); Lamk., "Syst. Anim. sans Vert.," p. 282 (1801); Haw., "Lep. Brit.," 1, p. 63 (1803); Latr., "Hist. Nat.," iii., p. 401 (1802); xiv., p. 135 (1805); "Gen. Crust.," iv., p. 210 (1809); "Consid.," p. 440 (1810); Ochs., "Die Schmett.," ii., p. 249 (1808); iv., p. 45 (1816); Leach, "Edinb. Enc.," ix., p. 130 (1815); Oken, "Lehrb. Zool.," i., p. 753 (1815); Dalm., "K. Vet. Ac. Handl.," p. 212 (1816); "Sam., "Ent. Comp.," p. 243 (1819); Godt., "Hist. Nat.," iii., p. 68 (1821); Bdv., "Eur. Lep. Ind. Meth.," p. 34 (1829); "Icon. Chen.," pl. vii., figs. 2—4 (*circ.* 1840); "Gen. et Ind. Meth.," p. 49 (1840); Dup., "Icon. Chen.," pl. vii., fig. 1 (*circ.* 1840); "Cat. Méth.," p. 45 (1844); Zett., "Ins. Lapp.," p. 915 (1840); Evers., "Faun. Volg.-Ural.," p. 114 (1844); H.-Sch., "Sys. Bearb.," ii., p. 91 (1846); Chaum., "Zool.," ix., p. 3244 (1851); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Speyer, "Geog. Verb.," i., p. 325 (1858); Staud., "Cat.," 1st ed., p. 16 (1861); 2nd ed., p. 37 (1871); 3rd ed., p. 99 (1901); Wallgrn., "Skand. Het. Fjär.," i., p. 17 (1863); Ramb., "Cat. Lép. And.," ii., p. 136 (1866); Snell., "De Vlind.," p. 101 (1867); Berce, "Faun. Franç.," ii., p. 27 (1868); Nolck., "Lep. Fn. Estl.," i., p. 90 (1868); Bang-Haas, "Nat. Tids.," (3), ix., p. 403 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 41 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 120 (1875); Curò, "Bull. Soc. Ent. It.," vii., p. 113 (1875); Butl., "Tr. Zool. Soc. Lond.," ix., p. 590 (1876); Frey, "Lep. Schweiz," p. 58 (1880); Bart., "Palæark. Schmett.," p. 171 (1900). *Semiparo*, Retz., "Gen. Spec. Ins.," p. 35 (1783). *Occellata*, Brahm, "Insek.-Kal.," ii., 1, p. 430 (1791). *Salicis*, Hüb., "Eur. Schmett.," pl. xv., fig. 73 (*circ.* 1800); text p. 99 (1805); "Larv. Lep.," ii., Legit. D. *a. b* (*circ.* 1800); "Verz.," p. 142 (*circ.* 1822); Stphs., "Ill. Haust.," app.

p. 5 (1835). *Ocellatus*, Stephs., "Illus.," i., p. 112 (1828); "Cat. Br. Ins.," pt. 2, p. 30 (1829); "List Br. An. Br. Mus.," v., p. 26 (1850); Meig., "Eur. Schmett.," ii., p. 148 (1830); Wood, "Ind. Ent.," p. 11, fig. 7 (1839); Humph. and Westd., "Brit. Moths," p. 7 (1841); Sta., "Man.," i., p. 87 (1857); Hein., "Schmett. Deutsch.," p. 150 (1859); Humph., "Gen. Brit. Moths," p. 7 (1860); Newm., "Brit. Moths," p. 4 (1869); Bdv., "Spec. Gén. Het.," i., pp. 17, 31 (1875); Kirby, "Eur. Butts. and Moths," p. 74 (1879); "Cat.," p. 711 (1892); "Handbook, &c.," iv., p. 60 (1897); Poulton, "Trans. Ent. Soc. Lond.," pp. 27 *et seq.* (1884); loc. cit., pp. 283—284, pl. x., fig. 1 (1887); Hellins, "Buckl. Larvæ," &c., ii., p. 99 (1887); Auriv., "Nord. Fjär.," p. 43 (1889); Bacot, "Ent. Rec.," vi., p. 174 (1895); Meyr., "Handbook," &c., p. 299 (1895); Griffiths, "Ent. Rec.," vi, p. 256 (1895); Barr., "Lep. Brit.," ii., p. 3 (1895); Lucas, "Brit. Hawk-Moths," p. 123 (1895); Grote, "Ent. Rec.," viii., p. 18 (1896); Tutt, "Brit. Moths," p. 20 (1896); Chapman, "Ent. Rec.," xi., p. 186 (1898); Lamb., "Ent. Rec.," xi., pp. 330 *et seq.* (1899).

Original description.—*Sphinx ocellata*, alis angulatis: posticis ocellatis. Rai., *Ins.*, 148. Phalæna major, corpore crasso, alis amplis interioribus macula ophthalmoide. Mouff., *Ins.*, 91. Goed., *Ins.*, 3, p. 25, t. O. Uddm., *Diss.*, 58, f. ii. Mer., *Ins.*, 2, t. 37. Wilk., *Pap.*, 10, t. 1, B. 5. Jonst., *Ins.*, t. 8, f. 30. List., *Goed.*, 68, f. 24. Alb., *Ins.*, 8, f. 12. Roes., *Ins.*, 1, phal. 1, t. 1. Rai., *Ins.*, 148, no. 2. Habitat in *Spiraea*, *Salice*, Pomiferis, Drupiferisque arboribus (Linn., *Sys. Nat.*, xth ed., p. 489). [To this Linné adds: "Imago elinguis. Thorace macula ferruginea. Larva viridis lineis albis" (xiith ed., p. 797).]

Imago.—68mm.—93mm. Thorax and abdomen dove-grey to fawn with a broad central velvety-brown dash on thorax. Anterior wings dove-grey or fawn, shaded, mottled, and streaked transversely with olive-brown, a dark outer marginal border, a small patch on inner side of transverse streak, a suffusion of central area strongest towards base and below the pale grey lunule; the posterior wings beautifully suffused with bright rose-pink from base for two-thirds towards margin; the ocellated spot consisting of a bluish-black pupil surrounded by bright blue, in turn enclosed by a broad black margin.

Sexual dimorphism.—The ♀ is decidedly larger than the ♂—say as 85mm. to 73mm. The ♀ is much heavier and, in a set specimen, the ♂ abdomen has a concave margin, the ♀ convex; this is more marked during life, when the ♂ sits with the abdomen very markedly curved upwards. The male has larger and denser hairs on many parts, the thoracic dark crest stands up more markedly, but especially the legs are more roughly haired; this is very pronounced in the tibiæ and first tarsal joints of the front legs. The first tibiæ and spurs are more robust in the ♂. The ♂ colouring is perhaps lighter and brighter, and the markings more crisply detailed than in the ♀, but individual variation quite swamps any such distinction between any specimens taken at random. The antennæ differ as in all other Sphinges, but the hairs on the ♂ antennæ are especially well-developed, so that the sexual difference is more marked than usual. The antennal joints 54 to 56 seem the same in both sexes (Chapman).

Gynandromorphism. — Compared with the large number of recorded gynandromorphic examples of *Amorpha populi*, there are very few of this species. The following are those which appear to have been recorded:

a. Left side ♂, right ♀. Left pair of wings darker than the right; left antenna ♂, right ♀. Along the abdomen a sharply-marked dividing line, which exactly repeats the colour-differences of the wings. Shape of the abdomen on the left slender, on the right rounded and bulged with the anal end sharply bent to the left. Of the outer sexual organs only the left one somewhat projecting, anal clasp distinct, the female side crippled. Expanse—right side 35mm., left 33mm. Bred in Bremen. Coll. Wiskott (Wiskott, *Festschr. Ver. Schles. Ins.*, p. 109).

β. Similar to the above. In coll. Staudinger, *in litt.* (Schultz, *Woch. für Ent.*, ii., p. 393).

Variation.—The variation of the species is not at all striking, although a good aberration is occasionally obtained (*e.g.*, *Ent. Record*, xiii., p. 163). Second brood examples of the species are usually small and poor in colour (*Ent. Wk. Int.*, iv., p. 191). Adkin records a specimen from Lewisham with the ground colour unusually pale, giving the insect a particularly bright appearance. Butler notes a male with ocellated spots of quite a "Cambridge blue" quite different from any others examined. Barrett says (*Lep. Brit.*, ii., p. 5) that "specimens occur rarely, in which the hindwings are almost or entirely destitute of rosy colour, being of a dull yellowish instead. Webb has specimens with the forewings of a putty colour, with the usual markings; Briggs one in which the shades and marbling of the forewings are nearly absent, but the lost colour seems concentrated in the triangular spot which lies against the outer line; another curious aberration is recorded, in which the ocellus of the hindwing is replaced by a triangular dark spot." This latter form we would call ab. *caeca*, n. ab. Daws notes (*Ent. Rec.*, i., p. 98) that, on June 21st, 1890, he captured at Mansfield, Notts, a ♂ in which the right underwing is without the ocellated spot, having instead a dark triangular mark, all the other wings being normal. Hall exhibited, at the meeting of the South London Entomological Society, on May 9th, 1895, an example in which the ocellated spots are much obscured, and Oberthür notes that, in France, aberrations are found with the hindwings pale, and the ocellated spots of the hindwings obscured. We ourselves have an example in which the ground colour of both fore- and hindwings is white, the markings and ocellated spot being normal; this came from Coverdale's collection and may be called ab. *albescens*, n. ab. Bacot observes that in his experience the range of variation in *S. ocellata* is slight, confined, except in a few abnormal cases, to slight differences in depth of colour, and occasional absence or greater brightness of the pink or purple tints. Webb has a peculiar ♀ which we considered at first to be a gynandromorph, but Chapman describes it as a large ♀ 3·75 ins. in expanse, the right side affected by partial albinism, or at any rate, loss of colour with weak and distorted scales. This especially affects the whole of the right side of the abdominal segments to end, which is dorsally nearly white on the right side; on the left much darker than usual, nearly of the colour of the dark centre of the thorax; the line of demarcation of the two tints is absolutely straight and median, producing a very peculiar effect. There is a white patch at posterior corner of mesothorax, but metathorax and 1st abdominal are normal. The antennæ are ♀, the right one looks shorter, but this is the result of having been broken off and replaced. The right forewing is $\frac{1}{16}$ shorter than left. On the upperside, the specimen looks rubbed and damaged at the wingbase, along the lower margin of cell and along veins 2 and 3.

It is, however, not so, but the scaling is weak, nearly white, and the individual scales deformed and set nearly on end. The costal half of the wing is rather paler than the other, and the markings are slightly altered. The hindwing is a little paler and a little brighter in colouring than the left. The underside of the hindwing is paler and less distinctly marked than the other, and the markings are a little nearer hind margin. The forewing beneath is more largely pale and colourless than above, the weak scaling affects base of wing on its inner half, and, dividing into patchy streaks, reaches the hind margin in several places. The effect is very like that of the white patches on certain gynandromorphous (?) ♂s of *Porthetria dispar*, but is due to weakness of scales and colour (albinism ?) confined to portions of one side only. There is no trace of gynandromorphism." Bartel observes an aberration in the collection of Kricheldorff from southern France, in which the hindwings are entirely red, except a small area at the apex, the ocellated spot is unusually large, as in *S. planus*, so that the specimen looks as if it were an approach to that species. In the Pyrenees, the species is said to attain oftentimes an exceptionally large size, and the specimens remind one in other respects somewhat of *S. atlanticus*, whilst Staudinger describes a single ♀ from the Saisan district that differs greatly from the species in all other localities in the sharply defined whitish-grey (instead of reddish-grey) colouring of its forewings, the base being almost white. The large Mauretanian *atlanticus* is considered by Oberthür a geographical race only of this species, and not distinct, he finds the latter to vary slightly in the colour of the hindwings. Leech refers (*Proc. Zool. Soc. Lond.*, 1888, p. 587) to *S. planus*, Walker (*Cat.*, vii., p. 254) and *argus*, Ménétriés (*Enum. Lep. Mus. Petrop.*, p. 136), as the Japanese and Chinese representatives of this species, and states that "there is nothing whatever to separate *planus* from the European type," and that he does not attach value to the unimportant character, mentioned by Pryer, that the caudal horn of the larva is green instead of sky-blue. At a meeting of the Berlin Entom. Society, on May 4th, 1899, Schultz exhibited an insect as an example of *S.* hybr. *hybridus* that he says gave the general impression of *S. ocellata*, but was yet strikingly paler, and without red in the eyespots of the hindwings. It was reared from a larva found wild at Stettin on *Salix* (*Berl. Ent. Zeits.*, xliv., Sitz. p. 29). As nothing special was noted about the larva one suspects that it may be an aberration of *S. ocellata*. The following are the already described forms of the species known to us:

a. ab. *pallida*, n. ab. *Ocellatus* ab., Tutt, "Ent. Rec.," xiii., p. 163 (1901).—The forewings are of a delicate grey, with the normal transverse lines fairly well-marked, a brown margin to the median ring, a brown patch directly below, and another centrally on the inner margin (and continued towards the base); the outer margin is also filled up with a brown patch, roughly triangular, the base formed by the curve directly below the apex of the wing, and the apex on the submarginal line. The two forewings, however, are not quite symmetrical, either in the arrangement of the transverse lines, or in the darker patches of colour. The hindwings are also grey, slightly tinged with yellowish, the nervures alone grey, the ocellated spot is well marked, the pupil, a pale ring, and black outer rings being well-defined. The most striking features are, of course, the absence of the rosy-red tints in the hindwings, and the metallic blue ring that surrounds the pupil of the ocellated spot, but the absence of the rosy tinge of the forewing is also very noticeable. ♂. Bred L. W. Newman, June 2nd, 1900. Larva from sallow, Bexley woods.

β. ab. *rosea*, Bart., "Palæark. Gross-Schmett.," p. 176 (1900).—The somewhat lighter, more yellowish-brown ground colour of the forewings, and the rose colour of the hindwings are much more brilliant and widely extended than in the typical specimens. According to Caradja, specimens of this aberration occur in Poland among the type, but, as no material from that district lies before me for comparison, I am unable to state whether these specimens reach the splendour of colour of those which used for a long time to be brought into the market by the late Leipzig collector, A. Kröning. According to him, the larvæ which were fed on quince (*Cydonia vulgaris*) produced the ab. *rosea*. Herr Hermann Gerber, of Stötteritz, tried to produce the form, but always found that the larvæ would not accept either of the cultivated varieties of quince, but died soon after hatching. It is considered that ab. *rosea* may only arise from artificial (chemical) influence on the freshly-emerged moths (Bartel).

This was evidently used for some years as a MS. name, *e.g.*, Caradja writes (*Iris*, viii., p. 65): "The var. *rosea* occurs in Poland, &c.," at a date five years before Bartel diagnosed it.

γ. var. *cinerascens*, Staud., "Stett. Ent. Zeit.," xl., p. 316 (1879); "Cat.," 3rd ed., p. 99 (1901); Bartel, "Palæark. Gross-Schmett.," ii., p. 176 (1900).—A small ♂, much lighter than German specimens. The forewings are light ashy-grey with few prominent markings; beneath less red, almost suffused rosy, with a scarcely apparent darker border. The ocellated spots of the hindwings are largely filled up with milky-blue, otherwise agreeing with the type; the underside of the hindwings also has the marginal areas very weak. The specimen at first sight appears to be a new species. If all the *S. ocellata* occurring in the Narün district are as pale as this, they must be recognised as a local form, and could then be known as var. *cinerascens* (Staudinger).

In his *Catalogue*, 3rd ed., p. 99, Staudinger diagnoses this form as: "Al. ant. multo pallidior., cinereis, lineis transv. subnull., v. desert. arenos." It comes from the south-east sandy deserts of Russia: Narün.

δ. var. *planus*, Walk., "List," &c., viii., p. 254 (1856); Pryer, "Trans. As. Soc. Jap.," xi., pt. 2, p. 239 (1883); Kirby, "Cat.," p. 711 (1892); Bartel, "Palæark. Gross-Schmett.," ii., p. 169 (1900); Staud., "Cat.," 3rd ed., p. 100 (1901). *Argus*, Mén., "Lép. Mus. Petr.," ii., p. 136, pl. xiii., fig. 3 (1857); Bdv., "Spec. Gen. Het.," i., p. 32 (1875); Staud., "Rom. Mém.," vi., p. 236 (1892). *Ocellatus*, Leech, "Proc. Zool. Soc. Lond.," 1888, p. 587 (1888); "Trans. Ent. Soc. Lond.," 1898, p. 278 (1898).—Mas. Cervinus; alæ anticæ fascia interrupta latissima pallide fusca linea transversa obscuriore, gutta discali albida, lineis duabus exterioribus transversis undulatis obscure fuscis strigaque apud marginem exteriorem dilatata fusca; posticæ antice roseæ, ocello magno cyaneo-atro. North China. From Mr. Cuming's collection (Walker). DISTRIBUTION: Yokohama, common (Pryer), Gensan (Leech), Chang-Yang, Kiukiang (Pratt); Wei-hai-Wei, July 16th, 1898 (Fletcher).

This form, first described by Walker from North China, was afterwards redescribed as *argus* by Ménétriés. Staudinger (*Rom. Mém.*, vi., p. 236) remarks that "it was discovered by Schrenck and Maack in the southern Amur district; Christoph bred it at Wladiwostok, Dörries on the Ussuri, Suifun and Bikin, Graeser at Chabarowka, Blagoweschtschensk and Wladiwostok. It also occurs in north China, and was described from there as *planus*, Walk., which name must certainly be referred as synonymous with *argus*." Bacot says that "it is slightly larger, paler in colour, the ocellated spots rather larger than in our British form." Staudinger diagnoses (*Cat.*, p. 100) it as: "Præc. var. pallidior, al. ant. haud cervino-tinctis, al. post. ocello majore, basi non rosaceo." Leech writes (*Trans. Ent. Soc. Lond.*, 1898, p. 278): "The differences between *planus* (=*argus*) and *ocellata*, indicated by Staudinger, do not hold good in my series from Japan, Corea and northern China, when they are compared with European specimens. The Asiatic examples usually have the ocellated spot larger than those from Europe, but this is not invariably the case." Pryer says of *S. planus*: "Closely resembles *S. ocellata*. The larva feeds on willow, is green, with a green horn instead of a sky-blue one as in *S. ocellata*."

ε. var. *atlanticus*, Aust., "Le Nat.," xii., 1890, p. 190 (1890); xv., p. 72 (1893); Kirby, "Cat.," p. 711 (1892); Stdfss., "Handbuch," &c., p. 55 (1896); Bartel, "Palæark. Gross-Schmett.," ii., p. 178 (1900); Staud., "Cat.," 3rd ed., p. 99 (1901). *Ocellatus*, Luc., "Bull. Soc. Ent. Fr.," 3rd ser., iv., p. xcii (1856).—Near *S. ocellata*, but perhaps resembles especially *argus*, Mén., from eastern Siberia. Compared with *ocellata*, the following differences are observable: The size is much larger, varying according to the sex from 92mm.—103mm. like that of medium examples of *Amorpha austauti*, Staud. The dominant shade on the upper side is a dark, somewhat brownish, olive-green, the pattern and the ordinary spots clearly marked in greyish-white. The basal line is less markedly interrupted than in *S. ocellata*. The extra-basal line, which succeeds it, throws out, as in *S. ocellata*, a pale streak, which is, however, much elongated, and gives off towards the outer angle two black spots, of which one occupies the normal position, and the other is placed further behind at the extremity of the transverse wavy lines. This streak, otherwise, is twice broken, first near its point of origin, in consequence of the intersection of the two brown oblique lines, which mark the path of the extra basal line; secondly, further on by meeting another blackish-brown, quite straight, line which crosses the wing transversely from one side to the other. One observes that this last line does not touch the discoidal spot as in *ocellata*, but that it is placed equidistant from the spot and the transverse or median lines, in a manner similar to that occurring in *argus*. These median lines, being nearer the outer margin, bring about the lengthening of the white streak which has its origin in the extrabasal line, and they are also more strongly sinuate, and particularly more deeply waved than those of our European form, and one notes that the median nervure, which intersects the dark space in the middle of the wing, is marked in grey as in *kindermanni* from Asia Minor. The posterior wings of *atlanticus* present even more striking characters than the forewings. The ocellated spot, situated towards the anal angle, is more rounded, never angulated, and is very wide. The black ring which surrounds it is especially thick on the basal side. It throws out from one point a streak or "liture" towards the anal lobe, analogous to that of *ocellata*, and from another a straight ray that terminates in a point towards the centre of the wing. It results from this disappearance that the ocellated spot appears to be bounded by a circular arc of which the ends coincide with the "liture" and ray just mentioned. The basal tint of a brilliant carmine-red extends narrowly above the ocellus almost to the base, but does not descend so low as in *ocellata*, along the abdominal margin; it dies out abruptly towards the centre of the wing in the form of a prominent mark, tinged with black, and leaves the whole of the anterior margin pure white (Austaut).

Staudinger diagnoses (*Cat.*, p. 99) this form as: "Major, al. ant. minus (in ♂ fere non) cervino-tinctis."

ζ. var. gen. 2, *aestivalis*, Aust., "Le Nat.," xii., p. 191 (1890); Kirby, "Cat.," p. 711 (1892); Bartel, "Palæark. Gross-Schmett.," ii., p. 180 (1900).—Rather smaller than typical var. *atlanticus*, darker, more like a dead leaf in colour, not olive-green, and rather inclining to a yellowish tinge; markings as in *atlanticus* (Austaut).

Towards the end of July, 1880, a large green Sphingid larva with shiny blue head, and with ordinary dark ferruginous-brown subdorsal lines, was received from Morocco. This pupated and produced towards the end of August, a fine imago, very near *S. ocellata*, but with a sufficiently characteristic appearance to induce Austaut to regard it as a new species. This specimen is the type of the var. *aestivalis*. After ten years he obtained three others at the commencement of May, 1890, in the mountains of the province of Oudja at about 1200m. elevation. These were the larger individuals described as *atlanticus*. Bacot notes that the larval characters indicated, *viz.*, "the blue head and ferruginous-brown subdorsal line," appear more distinctive than are any of the imaginal characters available.

Teratological specimens.—Waller records a specimen which emerged from pupa with one antenna (*Ent.*, xxiii., p. 326).

Egglaying.—The eggs are laid singly on both sides of willow leaves or on twigs, most frequently, however, on the underside, very rarely on the upperside, of the leaves (Tutt); more usually on the underside of the leaves of the foodplant, either singly or in pairs, more rarely they are laid on the smaller twigs and leafstalks (Hellins). A ♀ enclosed in a large muslin bag in which was a large leafy sallow branch, commenced to oviposit about 8.15 p.m. of May 25th, 1898. She flew noisily, stopping frequently to deposit an egg on a leaf. In about 35 minutes she rested against a branch and became still. The following evening she repeated the business, and did so for six consecutive days. I carefully counted the eggs laid each day, with the following result: 1st day (May 25th), 96 eggs; 2nd day (May 26th), 65 eggs; May 27th, 138 eggs; May 28th, 54 eggs; May 29th, 33 eggs; May 30th, 18 eggs; the female dying the following day. I immediately convinced myself that there were no more eggs in the body, the moth having completed the egg-laying on the 6th day, and I had 404 eggs. On June 8th, 384 larvæ had hatched and 20 remained unhatched; of the moths bred from these larvæ, 6 pairs were kept under observation, and the eggs laid by the ♀ s numbered respectively—284, 220, 187, 160, 121 and 93, *i.e.*, a total of 1065 eggs, with an average of 178 for each ♀ (Lambillion). Bacot considered this decrease in the number of eggs as due to the difficulty of keeping sufficient thoroughly fresh food in a breeding-cage for such a large number of larvæ. Eggs are laid singly on leaves of various species of *Salix* and not infrequently on apple-trees, the egg stage lasting about 11 days (Newman); eggs laid singly on the undersurface of willow leaves on the banks of the canal at Hythe (Hill); ova laid singly on underside of leaf seldom more than one on each leaf; a ♀ that emerged September 2nd, 1900, was paired with a ♂ that emerged on the same date, and produced fertile ova on the 3rd, these hatched on the 19th, but the larvæ died before becoming fullgrown for want of my being able to obtain food (Ransom); eggs laid on underside of apple leaves at Lee (Bower); pearly-whitish eggs laid singly on underside of sallow leaves at Kingsmill (Watkins); ova found in nature on *Populus nigra* on July 10th, 1892, at Rainham (Burrows); June 9th, 1866, ♀ laid 351 eggs, 38 not deposited=389, at Cambridge, egg-laying lasted 5 days (Gedge); eggs on plum-trees at Kensington June 17th, 1847 (Merrifield).

Ovum*.—Of flat type, micropylar axis horizontal; 1·6mm. long, 1·4mm. wide; pale yellow-green, very shiny, oval in outline, but some variation (occasionally almost circular), the two ends almost equally rounded; the upper surface with a somewhat circular depression, variable in size, the sloping edges of the depression slightly iridescent; the surface finely striated longitudinally, very minutely pitted; the micropyle only traceable as a small depression at one end, the micropylar area apparently similar to rest of egg-shell (Described June 12th, 1899, from eggs laid June 5th, and received from Mr. Hope Alderson). Of a plump oval form, not so deep as wide, upper surface somewhat sunken in middle, the shell

* Already described (*anteà*, p. 386) in detail and compared with ova of *Mimas tiliae* and *Amorpha populi*.

shining, covered with a very slight reticulation, the colour light, tender yellow-green. Three or four days before hatching, the young larva can be seen curled up, its colour not so green as the rest of the egg outside it, and before long its red horn becomes conspicuous (Hellins). Bright emerald-green, with a pearly lustre when first laid (Bacot). Parthenogenesis has been recorded in this species (*anteà*, vol. i., pp. 27—29).

VARIATION IN EGGS.—Hellins gives the following note on the variation in the size of the eggs of this species: "The eggs of the first and second days' laying were from 1·8mm. to 1·9mm. long and about 1·4mm. wide; those of the fifth day were 1·6mm. long and 1·2mm. wide; and those of the sixth day 1·45mm. long and 1·2mm. wide, but these last shrivelled up and did not produce any larvæ." Poulton remarks that "darker ova produce larvæ of a deeper green, and *vice versâ*."

COMPARISON OF EGGS OF SMERINTHUS OCELLATA AND AMORPHA POPULI.—The eggs of *A. populi* are less full green, much paler, more whitish-green and not so yellow-green as those of *S. ocellata*; also more circular (less oblong) in outline and plumper in build. The surface is very finely netted, not at all so coarsely as the egg of *S. ocellata*, and looks almost smooth under a hand lens. [Eggs of both species laid June 5th, 1899, and compared June 12th.]

HABITS OF LARVA.—Hellins remarks that, whilst small, the larva eats away both sides of a leaf of sallow or willow, leaving the midrib untouched, and using it as a resting-place. Bacot notes the larva, when small, as "resting on the midrib or on one of the larger veins of the leaf, and having the power, like those of *Mimas tiliae* and *Sphinx ligustri* in their early stages, of dropping on a thread, if by any chance it loses its hold. It assumes the 'Sphinx' attitude in its 2nd instar, and rests attached by the 4th pair of prolegs and anal claspers only, the other three pairs of prolegs being withdrawn until flush with the ventral surface of the body; as the larva gets larger it rests, as a rule, on an upright twig, which it grasps with its anal claspers, and with the last pair (or last two pairs) of prolegs, assuming an upright attitude, with the fore-part of the body raised, and the head drawn back. In this position its resemblance to a sallow- or willow-leaf is very perfect (see, *anteà*, i., p. 80), and the reason for the withdrawal of the unused prolegs is apparent, as, if not withdrawn, they would break the regular leaf-like outline. Occasionally one finds larvæ at rest on the midribs of partially eaten leaves, and, in that position, they do not raise the fore-part of the body, and they use all the prolegs." Newman states that the larva rests on a twig of its foodplant, attached by the 2nd, 3rd and 4th pairs of prolegs and anal claspers, elevating the fore-part of the body; the head prone, the mouth touching the first pair of legs, all the legs crowded together and directed forwards; the larva never falls from its foodplant or feigns death, unless its statuesque immobility may be so interpreted. Zeller remarks (*Stett. Ent. Zeit.*, xxx., p. 386) that the larva of *S. ocellata* assumes a quite different posture when at rest from those of *M. tiliae* and *A. populi*, &c., and that Rösel has given a very natural figure of it. He has no doubt that the many near relatives of *S. ocellata* share this habit. At Carlisle, larvæ are found freely on the osiers, which fringe the small streams (Day); on dwarf sallow in a bog at Enniskillen

(Brown); on sallow on Strensall Common (Walker); on dwarf sallow on the Instow sand-hills (Hellins); common on willows growing by river at Nottingham (Whittaker); common on apple-trees at Market Drayton in 1900 (Woodforde); on dwarf sallow in a bog (Brown); larvæ occasionally found in early morning crawling down willow-trunks by the sea to pupate (James); in fair numbers on the small sallow trees, *Salix caprea*, in the railway ballast holes and edges of plantations, near the same, at Lincoln (Musham). Birks notes (*Ent. Wk. Int.*, vi., p. 187) that he observed a larva of *S. ocellata* licking itself over every accessible part of its body, leaving its skin glossy with a moisture which soon disappeared. The following dates as to the capture of the larvæ have accumulated: July to September in Upper Austria (Himsl); larvæ in June and July, and again in August and September at Comanesti (Caradja); May 18th—24th, 1893, in New Forest (Richardson); August 12th, 1891, in New Forest, on wild apple (Fitz-Gibbon); occurs sparingly on sallows at Sulby every year, September 3rd several fullfed (Clarke); larvæ July 28th—August 11th, 1847, at Brighton (Merrifield); August 11th—24th, 1856, larvæ at Cambridge (Farren); June 13th and 14th, 1858, July 10th, 1858, on sallow, August 4th, 1868, on willow, two larvæ September 13th, one of which went to earth on 17th (Hellins); larvæ exceedingly abundant on the sand-hills at Deal in 1860 (Harding alone took 26 dozen), June 12th—August 25th, 1862, August 19th—31st, 1863, August 1st, 1874, August 20th, 1875, August 3rd — September 13th, 1885, August 11th — 29th, 1886, August 11th—September 12th, 1887, August 24th—September 3rd, 1888, August 9th—22nd, 1890, August 23rd—September 15th, 1891, August 17th — September 10th, 1892, August 1st and 2nd, 1895, all at Lee, July 22nd, 1874, at Eltham, August 6th—8th, 1870 and August 26th, 1874, at Deal (Fenn); July 22nd, 1871, August 3rd, 1873, on apple, August 8th, 1874, on crab, July 22nd, 1877, August 6th, larva fullfed on willow, all at Lee, August 18th, 1890, larva on sallow at Eltham, July 27th, 1893, on apple, August 23rd, 1894, fullfed on sallow, August 18th, 1895, on apple, August 27th, 1896, larvæ small on apple, August 3rd, 1899, larvæ (seven) fullfed on sallow, August 3rd, 1900, two larvæ fullfed on apple at Lee (Bower); larvæ on September 2nd, 1871, at Wanstead, July 27th, 1887, at Brentwood, August 29th, 1892, and July 25th, 1893, at Rainham (Burrows); September 13th, 1879, fullfed at Chat Moss (Auld); July 2nd, 1883, at Barnes (Sich); August, 1884, at Romsey (Buckell); July 25th, 1885, on Tottenham marshes (Sheldon); August and September, 1885, 1886, and 1887 in North London district (James); July 20th, 1886, at Caversham, July 31st, 1888, at Hardwick, July 26th, 1889, at Burghfield, August 1st, 1889, at Bulmershe Park, August 28th, 1892, at Midgham, near Newbury, July 27th, 1891, at Pamber Forest, August 5th, 1890, at Hartley Row (Holland); abundant near Newark, on wild crab in 1886 (Hewett); larvæ August 25th, 1890, at Brentwood, August 8th, 1895, at East Barkwith, August 8th, 1896, at Panton, August 25th, 1898, at Hazeleigh (Raynor); September 15th and 16th, 1890, at Lyndhurst on sallow (G. M. A. Hewett); July 19th—31st, 1891, at Brockenhurst, July 15th — 24th, 1893, at Wicken (Mitchell); larvæ on sallow September 10th, 1891, September 12th, 1892, July 23rd, 1897, at Aylsham, August 10th, 1896, August 15th, 1898, exceedingly abundant at Prescot (Freeman); August, 1892, at Folkestone (Bryne); larvæ August 13th, 1892, August, 22nd, 1894, August 3rd, 1896, August 23rd, 1897, at Bristol, August 31st—September 3rd, 1892, August 9th—30th, 1896, at Braunton (Bartlett); larvæ on sallow, September 23rd, 1892, at Newbury (Beales); fullfed at Frimley, July 20th, 1893 (Newland); July 27th—31st, 1893, at Wicken Fen (Bouskell); August 10th, 1893, on sallow, September 5th—8th, 1894, at Enniskillen (Brown); remarkably abundant in August, 1894, on Strensall Common, where the sallow bushes are small and isolated; this autumn (1894) an excess of larvæ on one of the bushes had resulted in its being stripped before some of the larvæ were fullfed, and, having vacated it for pastures new and failed to find another bush near, some 40 or more larvæ were found crawling on the ground in its neighbourhood; also very common in the York district on young apple-trees in gardens and on crab-trees by the roadsides (S. Walker); July 14th, 1895, August 20th, 1900, at Sudbury, August 28th, 1895, at Bulmer, August 18th—21st, 1899, August 26th, 1900, at Henny (Ransom); larvæ September, 1895, August 28th, 1898, at Oxton (Studd); August 22nd, 1896, larva pupated August 29th, 1896, at Chester (Arkle); September 3rd, 1897, at Kirkbride, September 1st, 1898, in Ballaugh-Curraghs (Clarke); July 23rd, 1899, fullfed larva at Reading (Reece); larvæ August 21st, 1899, at Limbrick Lanes (Whittaker); July 28th, 1900, larvæ half-fed on sallow at Stoke Wood, Oxshott (Pickett); August 24th, 1900, at Hampstead (Hopson); eggs hatched June 9th, 1901, larvæ fullfed July 23rd, 1901, and following days at Henley-on-Thames (Stearns).

LARVA*.—*First stadium:* The larva is much shorter and stouter than that of *Mimas tiliae;* the head is generally round like that of the last-named species (although there is some variation in this respect, Poulton remarking that, in a brood of young larvæ that he reared, he was surprised to find a few of the newly-hatched larvæ with heads of the typical Amorphid shape). The caudal horn is about one-third the length of the larva, appears black to the naked eye, but under a lens is seen to be of a deep pink, the black colour being due to the hairs. When full-grown in this stadium the oblique stripes are quite distinct, and the subdorsal is also clearly developed on abdominal segments 2 to 5. (In one young larva, the subdorsal was continued throughout its whole length; it was very distinct in the 2nd instar, and could still be traced in the final stage.) *Second stadium:* The head is now roughly triangular, almost of the form of that of the mature larva; on the apex there are similar processes to those seen in the larva of *M. tiliae*, but they are red instead of yellow; the lines up the sides of the head are quite distinct in this stage. The body has a very rough appearance, due to the large size of the mammillæ of the shagreen hairs; the 7th stripe is continued some way up the horn, and the latter is now very little longer than the thickness of the body; the anal flap outlined with a yellow stripe. *Third stadium:*

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* Described in detail (*anteà*, pp. 387—388) and compared with larvæ of *Mimas tiliae* and *Amorpha populi*.

Very little change. The subdorsal stripes are yellow; the oblique stripes whiter, bordered with green of a darker shade than the ground colour; the 7th stripe is continued to the base of the horn, and this stripe is stronger than the rest; the horn is pink in front, green behind, with the tip blue. *Fourth stadium:* The red processes on the apex of the head are usually well developed, but are subject to considerable variation, in one larva they are reduced to small red knobs, in others twisted across each other, and sometimes quite flattened down; the bases of the shagreen hairs are very prominent in this stage, but are either absent or very small on the dark borders of the oblique stripes; the caudal horn is now short and thick, it it not bifid, but tapers to a point. The hairs in this stage are, as a rule, single, but some of the longer ones which spring from small tubercles are still forked. *Fifth stadium:* The processes on the apex of the head have entirely disappeared; the surface of the head very rough and granulated; the bases of the shagreen hairs are smaller in proportion than they were in the preceding stage; no trace of forked hairs observed in this instar, the stripes as in the last two stadia, the subdorsal usually distinct on the thoracic segments; the 6th oblique weak, the 7th strong; there are sometimes traces of an additional pair of oblique stripes in front of the normal first pair (Poulton mentions a larva in which there were traces of two additional pairs of stripes); the horn is blue, similar to that of the larva of *M. tiliae* but not quite so large (Bacot). The *newly-hatched larva* varies from 4mm.—5mm. in length, the caudal horn from 1·25mm.—1·4mm. The whole skin is covered with very fine two-pronged hairs, the usual dots emitting similar ones of stouter make; the horn is covered with tiny two-pronged spines, and has two sharp strong spines at the tip; the general colour is pale, somewhat yellowish-green, the back rather fuller in tint, the horn dull pink; the ventral feet increase gradually in size from segment 7 to 10. After a day's growth there can be seen faint traces of pale slanting streaks on the side. At the *first moult* the larva is about 9mm. long; the horn does not grow except at the moults; there is now a fuller green thread down the back on segments 2—4, a strong yellowish-white subdorsal line, which goes on faintly to the horn, and on segments 5—12 seven whitish streaks slanting upwards and backwards. *After the first moult* there comes a change in the form of the head; it was rounded, but now the lobes become almost triangular, and are quite pointed at the top; the skin becomes covered with little points still emitting the two-pronged hairs; the horn is now 2·5mm. long, and still bears tiny spines as before. At the *second moult* the larva is about 15mm. long; the skin shows eight wrinkles to each segment, the subdivisions bearing each a transverse row of pale yellow points. The slanting streaks are yellow; the lobes of the head outlined on their outer edges with yellow, their sharp tips rich red; the horn, 3mm. long, is pale yellow, with a pink line on its upper side. At the *third moult* the larva is about 20mm. long, has now become stout in figure; the face is still long, and the points of the lobes project so much that, in some cases, they cross one another; the horn is stout, whitish on the sides, with a purplish stripe on the upper surface; the rough points on the skin are whitish, and the lateral stripes are whitish, edged in front with deeper green than the ground. At the *fourth moult* the length is about 35mm., and the tips of the lobes of the head become shortened, and lose the red tint. The biggest larva I had this summer when fullgrown was quite three inches (75mm.) in length, the figure stout and stiff, stoutest about segment 10, and tapering forwards, and not so much backwards, the face triangular, the horn on segment 12, when perfect, curved at the tip, which is very sharp; each segment has eight subdivisions set with rough points; on the back there is an arrangement of these points marking out a dorsal space, but there is no line; the ground colour pale glaucous-green, the rough points opaque white; on segments 2—4 a white subdorsal line, on side of segments 5—12 seven oblique white stripes sloping upwards; each stripe has its lower half on one segment and its upper half on the segment behind it, reaching almost to the plain dorsal space; each white stripe is edged in front with a deeper green than the ground. The last of the seven is longer than the rest, and begins below the spiracle on segment 10, runs through 11 up to the subdorsal level, and then through 12 up into the horn; the horn is light blue, greener near the tip, and is set with white points; the spiracles yellowish-white, strongly ringed with pinkish-brown; the belly fuller green than the back, and with smaller white points; the back of the head blue, the face granulated, full green with a few white points, the lobes outlined with yellow, the mouth reddish-brown, the thoracic legs pinkish-brown, with white points on them; the ventral and anal prolegs green, with their feet slightly tinged with pink (Hellins). Newman describes the larva (*Ent.*, iii., pp. 91-92), as also does Chaumette (*Zool.*, ix., p. 3244). The moulting of the larva is noticed (*anted*, vol. ii., p. 17).

Variation of larva.—The variation of the fullgrown larva is almost parallel with that of *Amorpha populi*; the oblique stripes are, however, usually broader and whiter, though sometimes, in the yellow form of the larva, they are as yellow and nearly as narrow as in *A. populi*. Larvæ are sometimes met with which have traces of an 8th oblique stripe, and Poulton mentions one with a 9th as well. One, reared in 1896, showed a tendency to darken before pupation in the same way as do the larvæ of *Mimas tiliae* and *Sphinx ligustri* (Bacot). Buckler figures (*Larvae*, &c., ii., pl. xx., figs. 1, 1*a*, 1*b*) three very fine forms of the fullgrown larva: (1) Blue-green, with yellowish incisions and whitish oblique lateral stripes, edged anteriorly with darker green, pale blue caudal horn, the skin covered with minute white shagreen dots arranged transversely, and showing distinctly the subsegments. (1*a*) Dull grey-green, with yellow oblique lateral stripes, the subsegments distinctly marked with transverse series of yellow shagreen dots; the caudal horn yellowish with black tip; three longitudinal rows of red spots on either side of larva, *viz.*, a subdorsal row, one spot on each segment from the prothorax to 7th abdominal; a spiracular row, one spot on each segment from prothorax to 8th abdominal; a row just above base of prolegs, one spot on each segment from 1st—6th abdominal. (1*b*) Bright yellow-green, with white oblique lateral stripes, edged anteriorly with dark green; subdorsal and spiracular rows of bright crimson spots, and bright blue caudal horn. Poulton observes (*Trans. Ent. Soc. London*, 1887, p. 283) that two mature larvæ of light yellowish-green tint, captured near Oxford in August, 1886, on *Salix triandra*, had the red spots more developed than in any other individual of the species hitherto described, and he figured the most extreme form (*loc. cit.*, pl. x., fig. 1) although the other only differed in the absence of the minute dot of the upper row on the 1st thoracic segment. The small size of the upper dot on the 7th abdominal segment is noteworthy, and was the same in both individuals. Comparing these larvæ with that previously figured (*loc. cit.*, 1884, pp. 27 *et seq.*), it will be observed that, in these larvæ here described, the spots of the two upper rows are larger and extend on to more segments, while those upon the claspers are much larger and more distinct. In breeding large numbers of the species, the spots were found in various degrees of development, upon many of the whitish larvæ, although more frequently upon the yellowish varieties. This observation confirms the single instance of a whitish larva with red spots recorded in 1886. With regard to the red-spotted form of larva, Poulton further observes that larvæ of *S. ocellata*, reared from imagines that had themselves come from larvæ of the red-spotted form*, were similarly marked. Many other observers note the red-spotted form. Bartel states (*Palaeark. Gross-Schmett.*, ii., p. 172) that there are aberrations of the larva in which there are laterally two rows of red or red-brown spots, which are often tolerably large, but which vary much in number and size. This form is often confounded with the corresponding form of the larva of *Amorpha populi*, from which, however, it may be readily distinguished by the quite different resting-position of the larva and by the colour of the caudal horn. Boscher notes that larvæ feeding on sallow and apple showed a variation in colour that caused them to resemble their food; those on sallow, too, were ornamented with red-brown spots absent in those on apple. Steuart observes that larvæ found at Bedford on apple and willow contrasted strongly in colour, the former being of a rich apple-green tint, the latter of a very pale silvery-white and green. Bouskell obtained a white form of the larva at Wicken Fen from white aspen, and the difference in tint of larvæ feeding on *Salix viminalis* and *S. triandra* respectively has already been observed. Poulton treats this matter of the variation of the larvæ of this species when feeding on different foodplants at length (see *anted*, vol. i., pp. 85-86). Allchin records (*Ent. Wk. Int.*, ii., p. 164) a brood (30) of larvæ in which every individual lost the caudal horn, which gradually disappeared from apex to base, leaving only a slight smooth tubercular prominence, the peculiarity continuing through more than one change of skin.

Cocoon.—The larvæ go underground for pupation, and make a cavity for themselves two inches down in the loose soil, but with little or no silk spinning (Hellins); the larva makes a frail cell in the earth, only very few silk threads are used, although sometimes the larva burrows to the depth of several inches (Bacot); the larvæ pupate

* Peck observes (*Can. Ent.*, viii., p. 239) that the larvæ of *Smerinthus myops* has red blotches that are not uniform and are more prevalent on larvæ of the late brood (although some are entirely green), and correspond in colour to similar spots found on the leaves of the wild cherry at that season. White's notes (*Proc. Ent. Soc. Lond.*, 1887, pp. xxiv—xxvii) should be referred to, as also those of Cameron (*Trans. Ent. Soc. Lond.*, 1880, p. 69), and those of Miss Gould (*loc. cit.*, 1892, pp. 242—243).

in the ground (Clark). The pupæ are generally obtained in October and November by digging at the foot of the trees on which the larvæ have fed up. Comyn notes (*Ent. Wk. Int.*, vii., p. 44) 37 pupæ being found in a piece of ground less than 2ft. in diameter, under a sallow-bush.

PUPAL MOULT.—At the moult to pupa, the larval stripes are visible in dark green, as well as the sites of the prolegs. The lips of the 1st spiracle and the anal spine are chitinous. The tube between the 1st and 2nd thoracic segments leading to the 1st spiracle is unusually open, and allows the spiracle to be seen at bottom, light being freely afforded through the translucent green tissues. The other dark chitinous parts are the posterior border of the 7th abdominal and pale bands on the dorsum of the 3rd thoracic, and the 1st, 2nd and 3rd abdominal segments, also many of the small cutaneous pits. In another specimen the stripes and prolegs are of a vivid blue as well as the tips of the mandibles and four spots at the base of the labrum. In this species the spiracles are closed from the moult, and the movements of the valves are not visible (see *antea*, vol. ii., pp. 50-59) (Chapman).

PUPA.—♂. Length 40mm., width (at 4th and 5th abdominal segments) 13mm.—14mm.; fairly cylindrical; front straight from labrum to end of wings, and nearly to the 6th abdominal segment, thence tapers regularly to anus; dorsum curved from the 2nd abdominal to the head; the cremastral spike, being at dorsal margin of 10th abdominal, makes one take an erroneous line as the axis of the pupa and think it more truly cylindrical than it is; nevertheless, apart from the curvature of the thoracic dorsum and some "waist" at the 1st abdominal, any cross-section would be circular; from the labrum to end of maxillæ 6·5mm., to end of first legs and of antennæ 10mm., of 2nd leg 12mm., and of wings 16mm. The apparently smooth hairless surface presents microscopically a considerable number of very minute hairs scattered round the median zone of each abdominal segment; these are definite hairs with jointed bases, their length being actually ·06 of a millimétre. Specimens differ a good deal in the clearness of the mouth-parts; a favourable specimen shows a prominence at front angle of cheeks that looks like jaws, but is really process of cheek; inside this is a smoother space, with a small tubercle, the labrum, centrally forwards; two others, one on each side laterally, the mandibles; a central foveola is the opening of mouth or œsophagus, *i.e.*, the place whence œsophageal lining was withdrawn on moult to pupa. The anterior margin of maxillæ is somewhat arched forwards, being more forward centrally, but there is no forward angle here as in the pupa of *Mimas tiliae*; the lines of suture of the appendages have a polished margin as in *M. tiliae*, but the general surface being smooth and polished, the first impression is that this polished line of the suture is absent; the convexity of glazed eye is towards the venter; the 1st legs have an equal margin to face and antenna, the 2nd begins as a sharp point between antenna and 1st leg. The wings are much smoother than those of the pupæ of *Amorpha populi* and *M. tiliae*, but have an abundance of fine transverse smoothed-out wrinkles; the lines of neuration are fairly distinct. Poulton's line is obvious along the hind margin, less so along the inner margin; the strip of hindwing ending just past middle of 3rd abdominal segment shows Poulton's line well, except in some specimens, in which it is covered by forewing; the outline of forewing shows a sinuation of hind margin, somewhat nearer apex than middle, and a rounded fulness of anal angle; the wing just reaches the hind margin of the 4th abdominal segment. The head, thorax and appendages are dull but fairly smooth, their sculpturing being fine wrinkles; the abdomen is smooth and polished, its sculpturing being entirely pitting, except in the cremastral region; there is a fine suture dorsally along the thoracic and 1st abdominal segments. On dehiscence, this suture opens to a varying degree in different specimens, sometimes to middle of mesothorax only, or as far as posterior margin of mesothorax, but not into abdominal segments, where suture is only apparent, and the head- and leg-covers fall away in one piece. There is much variation in colour, some being very deep black, with strongly contrasted, brown, intersegmental membrane, others a moderately deep brown, against which the intersegmental membrane shows but a trifling difference. The thoracic spiracle is a comparatively wide opening, with sharp edges; it is not, however, wide enough to enable the true spiracle within to be seen; the abdominal spiracles have sharply raised, narrowly oval, ridges as their margins. There is considerable variation in the sculpturing of individual specimens; the legs always have some transverse wrinkles, but sometimes these are nearly invisible; similarly on the antennæ each joint has two transverse lines, sometimes these are only indicated; when this is the case, there is usually one sharp point centrally on each joint, in other cases the two lines are rough and most marked at the margin; on the prothorax the roughness is formed by small irregular compressed elevations. On the mesothorax the ridges are dorsally transverse radiating from the median suture; there is another smooth line running longitudinally backwards from the anterior margin of the segment at a point half-way from dorsum to spiracle; this is more than a mere line and expands in middle of segment to a small smooth patch; it sometimes reaches posterior margin of segment; sometimes the wrinkles on either side of it coalesce and obscure it at this margin; a little way outside its lower end and at middle of wing-base is another smooth spot with two or three isolated raised points, sometimes wanting, sometimes very marked on little raised bosses on very smooth pupæ in which the other wrinkling is very obsolescent. On the metathorax the wrinkling is fine and of no marked features, except the central suture, which is a raised ridge, with a central deep impression (the true suture). The abdomen has a very smooth polished surface with many rather deep pits and sundry other marks and irregularities sometimes a little resembling the wrinkling of the thorax, in others with nothing but smooth surface and pits. As to the subsegmentation in a well-marked specimen, one may define five subsegments; anteriorly a rather broad and well-raised portion, best marked on 3rd abdominal segment, then an extremely narrow one, usually marked on the 5th abdominal, but often not very evident, a third one of moderate width, the fourth much the same, and the fifth, reduced to obsolescence dorsally, appears to be the intersegmental subsegment, and is best seen laterally on the 4th and 5th abdominals, where its sculpturing consists of a few oblique impressed lines. Another feature of the abdomen is a dorsal suture-like groove, often very deep on the 1st subsegment of the 3rd, 4th, and 5th abdominal segments. The pitting and wrinkling, in specimens where it is to some extent wrinkling, are most marked dorsally and at the anterior borders of segments. Laterally, the subsegmentation fades out, except the intersegmental subsegment, which is there most marked, and on the 5th, 6th, and 7th abdominals the ridge of the first subsegment forms a rather sharper edge just above the spiracle, reminding one of the flange in Sphingids *(sens. rest.)*, and this feature, like all the other sculpturing, varies exceedingly in different specimens, and often cannot be found. The scar of the horn on the 8th abdominal segment may be merely a faint depression towards posterior margin of segment ; usually the depression is very decided, and is smoother than the surface around, but not polished, rarely there is a very definite prominence at the anterior margin often a hollow. The proleg scars (on the 5th and 6th abdominals) are equally variable, often mere depressions, without distinctive sculpturing, that would be passed over as accidental, they frequently are smooth hollows, transversely elongated to an oval form with definite margins and terminating externally in a curiously deep small pit, which is sometimes double on the 6th abdominal segment ; these pits as shallow depressions are common ; as deep pits (as though a pin had been thrust in) they are rare. Very similar pits, with a similar range of variation, are found just behind each spiracle. The 8th abdominal spiracle is as usual a mere scar. On the 9th and 10th abdominals the sculpturing consists of very small circular pits rather sparsely placed, *i.e.*, 3 or 4 times their own diameter apart. The 10th abdominal segment is tolerably smooth, and almost entirely without the two lateral fulnesses that are so prominent in pupæ of *Amorpha populi* and *Mimas tiliae*, and look like a persistence of the anal prolegs ; still a scar of the anal prolegs may be detected, and this appears as a rather smoother place on each side of the anal fissure. The cremastral armature is a pyramidal eminence about 1mm. in length and width, perhaps rather longer than broad, in so far that the extremity is somewhat produced whilst the base is constricted as though it had had a thread tied tightly round it ; ventrally it is smoother and flatter, dorsally it is rough with strong sharpish points, of which several occur close to the apex, seen laterally, it is curved a little dorsad, and looks as if two more threads, at equal intervals, had made slight grooves across the dorsum ; there is a rather deep hollow at the ventral base of the spine ; in front of this is the oval anal scar ; sometimes blurred, at others consisting of three fine parallel grooves with two intermediate ridges, or four if the outer margins of the outer grooves be counted. In front of the 9th abdominal segment are two small, polished, nearly hemispherical tubercles, with a minute pore between, but rather anterior to them. The ♀ pupa is more robust than that of the ♂, but not sufficiently marked in every case to enable them to be separated by this character, nor is there any other sexual difference, except in the sculpturing of the 8th and 9th abdominal segments. In the ♀ pupa, the 10th segment stretches forwards ventrally in a smooth surface, continuous with the similarly produced 9th segment and with the 8th; at the apex of this smooth surface, in the middle of the 8th segment, but having all the aspect of being on this angular projection of the 9th, are two small prominences, with a hollow between them, less prominent than those on the 9th segment of the ♂ pupa, but very similar to them. The only other difference from the ♂ pupa is that the anal groove has, in some specimens, a small pore separated from it in front, which might be part of the groove or a separate structure (Chapman). Poulton gives (*Ext. Morph. Lep. Pupa*, pp. 202—203, pl. xx., figs. 1—7) a description with illustrative figures of the terminal abdominal segments of the ♂ and ♀ pupæ of this species. He notes (♀ pupa) the last spiracle (functional in the larva) as being rudimentary in the pupa, a rough terminal spine forming the extremity of the pupa, whilst immediately in front of it (in the ventral line) is the anus, which is very distinctly indicated. The boundary between the 9th and 10th segments is prolonged forwards in the ventral line, and the apex of the narrow triangular area which is thus formed represents the opening of the oviducts, invisible in most individuals of the species, although sometimes seen. Immediately in front of the apex of the above-mentioned area is the second or anterior generative aperture, that of the bursa copulatrix. This is very distinctly marked, and is bounded laterally by prominent convex lips; it thus resembles the form of the male generative opening, but can be readily distinguished in that it is placed in the 8th abdominal segment, while the male aperture is situated in the 9th; in the side view, the dorsal projection, which corresponds with the caudal horn of the larva, is seen; this normal trace of the caudal horn consists of an anterior slight elevation formed by the soft surface of the pupa, rising in the hollow interior of the horn, and a posterior slight concavity, caused by the hinder margin of the base being depressed into the soft surface when the horn is bent backwards, becoming nearly horizontal before pupation, whilst immediately below the terminal spine is seen a curved line dividing the 10th segment into an upper and a lower (or anal) part. The terminal part of the pupa, as seen ventrally, shows distinctly the narrow pointed prolongation of the boundary between the 9th and 10th abdominal segments, although neither of the generative organs is visible without magnification; the anus is distinct, and the cushions on each side of it (representing the anal claspers of the larva) are somewhat more prominent than usual. In the ♂ pupa, ventral aspect, the opening of the male ducts is distinctly seen, placed between the prominent lips upon the 9th abdominal segment.

Variation of pupa.—The most notable fact about this pupa is the variation in the character of the surface sculpturing, not only in the degree to which it is pronounced both on the thorax and abdomen, but, especially on the abdomen, in its obsolete character, so that, in some specimens, a description of it as a perfectly smooth, polished surface with pits, on the pattern so common in Noctuid pupæ would be correct, whilst in others, the smooth surface still retains something of the labyrinthine wrinklings, such as occur in the pupa of *Mimas tiliae* (Chapman).

Variation in pupal period. — From August-September to May-June may be looked upon as the normal period of pupal life, but occasional individuals have only a pupal duration of three or four weeks. On the other hand, occasional individuals remain two years in the pupal stage before disclosing the imago, *e.g.*, Todd notes (*E.M.M.*, vii., p. 61) the emergence of an imago in 1870 that passed a second winter in the pupal stage, the only one observed out of hundreds of bred and dug pupæ; Lane records a ♀ bred June 10th, 1900, from a larva taken at Brimsdown in 1898, and Hill one bred May 29th from a larva taken at Hythe in 1898.

Foodplants. — *Salix*, apple, plum (Linné), dwarf-sallow, sallow, willow, apple (Hellins), almost all plants of the natural order *Rosaceae*, also willow, sallow (Merrin), *Populus nigra*, *Salix caprea* (Musham), *Salix viminalis*, *Populus italica*, *P. tremula*, *Prunus spinosa*, *Pyrus communis*, *P. malus*, birch, rarely (Bartel), *Salix triandra* (Poulton), *Cydonia vulgaris* (Kröning), *Prunus padus* (Speyer), wild plum (Fenn), *Persica vulgaris*, *Amygdalus communis* (Trimoulet), wild crab (Hewett), *Salix repens* (Atmore), *Populus alba* (Harris), privet (James), bramble (Montgomery), white aspen (Bouskell), Paradise stock (Pearson). The larvæ often commit considerable damage to the foliage of young apple-trees, to which they are said often to transfer themselves from *Salix caprea*; Horváth also notes them as injurious to the apple-trees in Hungary.

Parasites.—The larvæ of *S. ocellata* appear very liable to the attacks of ichneumons, some 75 per cent. of those obtained on the Norfolk Broads being usually affected (Bacot). The larvæ are greatly affected by ichneumons in the London district, often not 5 per cent. being free from their attacks; it is easy to detect those stung as the blue caudal horn becomes green and has the appearance of the extreme tip having been bitten off (Mera). *Amblyteles palliatorius*, Grav. (Marshall), *Trogus lutorius*, Fab. (Fitch), *Microplitis ocellatae*, Bouché (-*Microplitis ingrata*, Hal.) (the larvæ of this species are gregarious, leave their host in September, and form their greyish-brown rough cocoons closely agglutinated together; in these they remain until the following May or June) (Bignell), *Ichneumon pisorius*, L. (Bouché). [A very minute sand-fly, supposed to be a *Simulium*, attacks the larva of *Smerinthus planus* in Japan. Pryer records (*E.M.M.*, xxiv., pp. 156-157) observing one (under the microscope), with its proboscis buried in the back of a nearly full-fed larva. Hodges records a brood of larvæ of *Smerinthus ocellata* destroyed by wasps who cut each larva in two with the jaws, carrying off the hind-part first and returning for the caudal half.]

Habits.—The imagines emerge in the early morning, never later than 9.30 a.m. (Ransom); they then remain immovable until 8 p.m. or 9 p.m., when they suddenly vibrate their wings and then fly (Cowl). A pair of this species taken *in copulâ*, May 25th, 1892, remained paired until 7.45 p.m.; at that time the ♂ became restless, vibrated his wings rapidly for some seconds, and appeared to warn the ♀ that it was time to separate; the ♀, however, did not stir, and two or three minutes later the ♂ again vibrated his wings (more rapidly than at first), and this lasted for about half-a-minute; this aroused the ♀, who set free her companion, the latter immediately taking flight. In captivity the imagines generally emerge from 6 a.m.—8 a.m.; immediately their wings are dry, they settle down and remain quite still until about 8 p.m., when the ♂s begin to fly, seeking the ♀s, and pairing with them freely in the enclosure in which they may be confined. Whilst paired, the insects remain at rest, apparently sleeping during the period of copulation, some 22—23 hours. The couples arrange themselves vertically, the ♂ with its head pointing downwards, as other observers have noticed in other species. Several pairs were purposely disturbed, but the ♀ almost immediately returned to the previous position, and it was concluded that this was possibly necessary owing to the weight of the abdomen of the ♀. Separation took place in the same manner as described above for the first pair, the ♂ vibrating its wings, a movement repeated three times before departure, the ♀s remaining quite still more than half-an-hour after the departure of the ♂ before taking flight for the purpose of egglaying (Lambillion). Ransom observes that the ♀s sometimes pair more than once. Newman notes *(Ent. Rec.*, xii., p. 350): "The ♂s are attracted very readily by a newly-emerged ♀, rarely before 1 a.m., but between 1 a.m. and 1.45 a.m., they arrive very rapidly, and are so keen in getting to the ♀ that they may be picked up with the fingers." At rest during the day, they are not very conspicuous; on July 7th, 1884, a very fine specimen was observed at rest on the edge of a potato-leaf, and in this position it so exactly resembled a dried and withered leaf that I was almost deceived, the hindwings being hidden under the forewings, whilst the conspicuous ocellated spots were not visible (Warner). The imagines are frequently taken at light at Lincoln (Musham), and at Ahascragh, commonly (Dillon), at the electric lights at High Wycombe (Peachell), and at Chester (Arkle); they occur at electric light at Berne (Hiltbold), and three examples were taken at electric light at Borshom by H.R.H. Prince Nicolas Romanoff. Rothke records the imagines as sometimes, but very rarely, visiting flowers of an evening, like the Sphingids, resting by day on the stems or among the leaves of trees *(teste* Bartel). Cross-pairing of a ♂ *S. ocellata* with a ♀ *Mimas tiliae* has been recorded by Herfert, and hybrid *tiliae* ♂ × *ocellata* ♀ have been bred (see *anteà*, p. 391). Crosses of ♂ *astylus* × ♀ *ocellata* are fruitful *(loc. cit.*, p. 392), whilst those of *ocellata* ♂ × *populi* ♀ are common *(loc. cit.)*, on one occasion a ♂ was found paired with a ♀ *A. populi* in Princes Park, Liverpool, May 28th, 1860. The reciprocal cross is very rare *(loc. cit.*, p. 395).

Habitat.—The species appears not to be particular as to its habitat; in gardens in the London suburbs, where a newly-emerged ♀ placed on a shrub in the early evening is almost sure to be found with a partner in the morning; in gardens and orchards on fruit-trees in Kent, Hereford, the Burton-on-Trent district, &c.; by the sides of ditches on the marshes along the banks of the Thames, on marshy land at Enniskillen, Sandwich, on Wicken and the other Cambridgeshire fens, on the coast sandhills at Instow, Deal, &c.; on Strensall Common abundant, and on the open common at Fleet; hedgerows, by roadsides and the outskirts of woods, are some of the many different habitats affected by this species throughout the greater part of England and Ireland. Its range, however, is remarkable, for common as is the species locally as far north as Grange-over-Sands in Lancashire, in parts of Cumberland and Yorkshire, it becomes exceedingly rare in Durham and Northumberland, and the whole of the records from Scotland number fewer than half-a-dozen single individuals, although Stainton notices the species from as far north as Sutherland, a record, however, that has never since been confirmed.

Time of appearance.—May and June are the usual months in which the imagines appear, although in early years emergences may take place in April and in late ones in July, usually, however, this species appears a little later than either *Mimas tiliae* or *Amorpha populi*. Occasional second brood examples are recorded in August and September. Fritsch gives dates for Austro-Hungary from April 30th to July 12th, and notes 3 second-brood specimens from Biala, September 20th—30th and another from Innsbruck, September 30th, whilst Galvagni caught a ♂ August 11th, 1899, in the Brenner district. The following data are interesting: April at Novorossiisk on the Black Sea, April and May in the Loire-Inférieure, May 31st, 1900, at Pont de l'Arche (Dupont), May in Brussa, Fiume, Hermannstadt and Augsburg, May and June in most German and Austrian localities, Belgium, &c., May 25th, 1898, at Namur (Lambillion), May to July in Brunswick, Leipzig, and the Baltic provinces, June 1st, 1897, at Lyngör (Strand), June in Borshom, Lombardy, Mulhausen, Crefeld, Upper Austria, &c., June 3rd, 1896, at Postlingberg (Himsl), June and July at Schwerin, &c. The following suggest more or less partial double-broodedness. April to August at Budapest, May to August at Grumazesti (Caradja), May and August generally in France (Berce), May and August in Alsace (Peyerimhoff), April, June, and August-September, in Tuscany (Curò), May and September in Seine-Inférieure (Viret); May-June and August in the Haute-Garonne (Caradja), June and August at Bremen (Rehberg), July, August at Aix-les-Bains (Agassiz), July to September at Eutin (Dahl). The occasional British second-brooded examples that have been recorded in our magazines, &c., will be found among the following dates of capture, &c.: Imagines May 28th, 1847, at Brighton, and June 12th, 1849, at Holm Bush, eggs at Cuckfield, July 31st, 1857, very probably those of 2nd brood, these hatched August 4th, on August 6th nearly full-grown larvæ also taken on sallow, these went down on August 12th, on which date other large larvæ were found (Merrifield); imagines June 19th, 1855, at Chelsea, and July 1st—10th, 1855, at Chertsey (Clarke); six pairs bred August 12th, 1857, and following days from eggs hatched 1st week in June, 1857, larvæ from the August imagines were fullfed by the end of September, 1857 (Allchin); June 1st, 1858, at Barnstaple (Mathew); June 1st—11th, 1858, at Machynlleth (Alington); June 1st, 1859, at Stoke Newington, July 2nd, 1859, at Thames Ditton, larvæ obtained September, 1860, at Deal, produced imagines which emerged May 24th—June 27th, 1861, imagines captured or bred May 23rd, 1863, May 23rd, 1865, May 1st, 1876, June 7th and 8th, 1886, May 18th—July 4th, 1888, May 14th—June 12th, 1889, June 8th, 1892, May 29th, 1893, June 6th and 7th, 1896, all at Lee (Fenn); a partial second brood, diminutive and poor in colour emerged on August 25th, 1859, and following days at Wakefield (Talbot); June 15th, 1860, at Mansfield (Brameld); April 9th—15th bred at Worcester (Edmunds); May 10th, 1861, from pupæ found at Tottenham (Huckett); June 18th, 1867, a ♀ on wing at Eltham, May 20th, 1868, a ♀ at rest on grass at Tilgate, July 12th, 1873, a ♀ on wing in Dartford Marshes, June 11th, 1877, 3 ♂s at light in Wicken Fen (A. H. Jones); May 20th, 1870, June 10th, 1876, at rest on apple-tree, June 22nd, 1878, at roadside lamp, June 15th, 1887, at rest on fence (obtained ova which hatched June 24th), June 25th, 1894, two imagines on apple at Lee (Bower); June 4th, 1870, one netted in a garden at Odiham, May 30th, 1873, at Reading (Holland); June 4th, 1870, from a larva that pupated August 26th, 1869, another June 12th, 1888, from a larva that pupated August 15th, 1887, at Kingsmill (Watkins); June 11th, 1871, at Wanstead, May 18th, 1885, at Rainham (Burrows); ♂ September 1st, 1874, from larva that pupated July 31st, 1874, at Walton-at-Stone (Hodges); June 15th, 1877, at Instow (Buckler); June 17th, 1879, at Rugby (Solly); May 31st, 1884, at Chichester (Anderson); June 18th, 1888, at Bristol (Bartlett); July 24th-30th, 1888, at Bristol (Griffiths); September 17th, 1889, larvæ fullfed at Ballaugh-Curraghs, imagines appeared the following May (Clarke); June 20th, 1890, July 10th, 1896, May 28th, 1900, at Mansfield, May 29th to end of June 1899, at Penzance (Daws); from larvæ reared in confinement imagines emerged May 23rd-31st, 1891, and May 6th-10th, 1893, at Ealing, May 18th, 1897, at Polegate (Montgomery); June 19th, 1891, at Lincoln (Mackonochie); larvæ August, 1891, on sallow, emerged May 27th-June 11th, 1892 (Prout); May 25th-29th, 1892, at Wisbech (Glenny); May 19th, 1892, at Clapton (Bacot); May 26th, 1892, at Llandogo (Nesbitt); May 29th, 1892, May 19th, 1893, May 18th, 1898, at Reading (Butler); June 27th-29th, 1892, at Abbott's Wood (Porritt); May 5th, 1893, at Chiswick (Sich); May 9th, 1893, on the sandhills at Port Talbot, Swansea (Robertson); one netted May 20th, 1893, June 5th-14th, 1894, May 28th-June 6th, 1895, at Enniskillen (Brown); May 24th, 1893, at Tottenham (Clark); September 1893, one imago from an egg laid in the spring of 1893, at St. Leonards (Esam); May 25th, 1894, May 17th, 23rd, June 2nd, 13th, 19th and 26th, 1896, May 24th-June 12th, 1897, May 25th, 1897, at Carlisle (Day); June 1st, 1894, at Hayton Moss (Bowman); June 14th, 1894, at East Torrington, June 12th, 1896, at Legsby (Raynor); July 28th, 1894, at Worcester Park (Kaye); May 15th, 1895, at West Dulwich (Fletcher); May 23rd, 1895, at light at Rugeley (Freer); May 1895, at light at Ipswich (Pyett); June 11th, 1895, June 3rd—14th, 1896, at Worcester (Rea); April 16th, 1896, at Stratford-on-Avon (Frohawk); April 24th-May 9th, 1896, from larvæ at Herne Bay, September 5th, 1895, June 22nd, 1896, at light at High Wycombe (Peachell); June 16th, 1898, June 9th, 1899, at Chelmsford (Miller); pair *in copulâ* at Enniskillen, May 23rd, 1896 (Allen); May 26th-31st, 1896, May 28th, June 3rd-4th, 1900, at Oxton, one forced March 31st, 1897

(Studd); June 4th and 15th, 1896, at light at Bath (Greer); June 20th-July 10th, 1896, at Mansfield, May 29th-June 28th, 1897, at Paul (Daws); larvæ September 8th, 1896, imagines emerged May 23rd, 1897, at Llanstephan (Newland); imago emerged from pupa May 19th, 1897, June 5th, 1897, at rest, June 14th, 1898, June 21st, 1898, at light at Newtown (Tetley); June 6th, 1897, June 7th, 1898, also bred May 6th-26th, 1898, at Carlisle (Wilkinson); June 17th, 1897, a ♂ at light at Sydenham (Swain); June, 1897, at Aldershot (Bland); July 6th, 1897, in Norfolk Broads (Freeman); August 25th, 1897, at Eccleston Mere, June 9th, 1900, at Winster (Cotton); May 28th-June 10th, 1898, from larvæ obtained August, 1897, at Fleet, June 6th-10th, 1898, from larvæ obtained September 2nd-4th, 1897, June 3rd, 1899, from larvæ obtained September 4th, 1898, at Southend near Catford, June 8th and 17th, 1899, from pupæ obtained October 4th, 1898, at Fleet (Russell); June 2nd, 1898, at rest on a rhododendron leaf, others bred May 30th to June 5th, 1898, at Enfield (Edelsten); June 4th-11th, 1898, at Bremhill (Eddrup); June 7th, 1898, at Leicester (Dixon); June 26th-30th, 1898, on sandhills between Waxham and Horsey (Cox); June 8th, 9th and 13th, 1899, at Dawlish (Rogers); June 9th, 1899, July 2nd, 1900, from Sudbury pupæ, July 1st, 7th, 8th, 1900, from York pupæ (Hewett); June 21st, 1899, at Bournemouth (Cowl); larvæ at Norwich pupated July, 1899, an imago emerging August 19th, 1899 (Laddiman); larvæ August, 1899, imagines June 8th, 1900, in New Forest (Moberly); June 10th, 1900, from larva at Brimsdown in 1898 (Lane); May 29th, 1900, from larva at Hythe in 1898 (Hill); June 8th, 17th and 21st, 1900, at Chilwell (Pearson); May 22nd, 1901, at Cranbrook (Marshall); June 3rd, 1901, at High Cummersdale (Thwaytes); ova June 5th, 1901, produced larvæ that pupated July 12th, 1901, imagines (6 ♀s) from August 9th-20th, 1901, in the Dorking district (Oldaker); June 20th, 1901, at light at Haverstock Hill (Hopson); September 2nd, 1900, a ♂ and ♀ at Sudbury from ova laid in spring, this ♀ laid ova that hatched September 19th, but larvæ died for want of food (Ransom); September 2nd, 1901, from larva that pupated July 23rd, 1901, at Henley-on-Thames (Stearns). Of 200 (out of 384) larvæ hatched on June 8th, 1898, the first went down on July 8th, 30 days after hatching, and 8 days later pupation was completed; the pupæ, kept in an unheated room, were placed on a bed of "heather" mould and covered with moss; the first imago emerged on May 27th, 1899, and the emergences were continuous for 15 days—177 perfect imagines and a score of cripples (Lambillion).

LOCALITIES.—Widely distributed in Ireland, but usually scarce (Kane), exceedingly rare in Scotland, and only occurring occasionally in odd specimens. [ABERDEEN: Fyvie (Sim), rare at Aberdeen (Traill).] ARMAGH: Armagh (Johnson). BEDFORD: Bedford (Steuart). BERKS: Reading (Butler), Burghfield, Bulmershe Park, Midgham, nr. Newbury (Holland), Hurst (Groome), Newbury (Beales). BRECON (Tutt coll.). BUCKS: High Wycombe (Peachell), Burnham Beeches (Williamson), Halton, common, Wavendon, nr. Newport Pagnel (Stainton). CAMBRIDGE: common throughout Fen dist. (Balding), Fulborne (Henderson), Wicken (Mitchell), Cambridge (Waters), Wisbech (Glenny). CARMARTHEN: Llanstephan (Newland), Langharne (Kaye). CARNARVON: near Deganwy (Gardner), Abersoch, common (Day). CHESHIRE: common throughout (Ellis), Hoylake (G. O. Day), Chester, very common, Delamere (Arkle), Wirrall, frequent (Gardner), Wallasey sandhills (Galliers), Birkenhead (Stainton). CLARE: Ennis (Brakey). CORK: Mallow (Newland), Timoleague, not common, Glandore, Courtmacsherry, common (Donovan). CORNWALL: Land's End (Mera), Penzance dist., common, Paul (Daws). CUMBERLAND: tolerably abundant (Day), Carlisle district, common (Wilkinson), rather rare at Keswick (Beadle), Cockermouth (Robinson), Orton, Cummersdale, Durdar (F. H. Day), Hayton Moss (Bowman), Lake district (Stainton). DENBIGH: Colwyn Bay (Newstead). DERBY: fairly common in southern part of county (Payne), Staveley district (Hooke), common Burton-on-Trent district (Brown), Bretby Lane (Harris). DEVON: Honiton district (Riding), Topsham, occasional (Kane), Oxton, not common (Studd), Instow (Buckler), Exeter (Morgan), Sidmouth (Majendie), Dawlish (Rogers), Plymouth (Basden-Smith), Barnstaple (Mathew), Ilfracombe (Gardner), Dartmoor (Gummer), Teignmouth (Stainton). DORSET: common throughout (Dale). West Bournemouth (Robertson), Blandford (Stainton). DUMFRIES: Dumfries (Lennon). DUBLIN: Phœnix Park (Rathbone). DURHAM: singly only (Robson), Darlington (Sang), Swalwell (Nowell), Crimdon Cut nr. Hartlepool (Gardner), Hartlepool (Fleetham), Darn's Head, Axwell (Hedworth). ESSEX: generally common (Harwood), Shoeburyness (Mera), Chingford (Henderson), Harwich (Mathew), Woodford (Bishop), Chelmsford (Miller), Bulmer, Henny, Sudbury district, common (Ransom), Wanstead, Brentwood, Rainham, Southend (Burrows), East Barkwith, Hazeleigh (Raynor), Eastwood (Whittle), Isle of Dogs (Woolley), Colchester (Harwood), Theydon, Loughton (Lane), Ilford (Adams), Epping (Quail), Hackney Marshes (Clark), Feering Bury, not common (Reid). FERMANAGH: Enniskillen (Allen). FLINT: Overton, occasional (Perkins). GALWAY: Clonbrock, Ahascragh, very abundant locally (Dillon), Galway (Kane). GLAMORGAN: Port Talbot, Swansea (Robertson). GLOUCESTER: Kingsmill, Painswick (Watkins), Bristol dist.—generally distributed but not common (Hudd), Cheltenham, Charlton Kings, Prestbury (Robertson), Tewkesbury, sparingly (Fox). HANTS: Niton (Sich), Gosport, Portsea, common (Pearce), New Forest, Brockenhurst (Mitchell), Southampton (Burchell), Christchurch (Adye), Ringwood (Fowler), Scrogg's Bottom, Aldershot (Bland), Fleet (Russell), Odiham, Pamber Forest, Hartley Row (Holland), Winchester, Basingstoke (Holdaway), Winchfield (Robertson), Burghclere (Alderson), Bournemouth (Cowl), Lyndhurst (Hewett), Romsey (Buckell), Horndean (Hawker), Sandown (Prout) HEREFORD: Leominster (Hutchinson), Tarrington (Wood). HERTS: Hertford (Stephens), Walton-at-Stone (Hodges), Hitchin, Knebworth (Griffith), Bushey Heath (Burraud), Enfield Lock, rare (Bowles). HUNTS: St. Ives (Norris). ISLE OF MAN: Sulby, Ballaugh Curraghs, Cranstal, Lochbride, Kirkbride, Ramsay (Clarke). KENT: Rochester and Chatham dist., not common (Chaney), Strood (Latchmore), Ramsgate (Willson), Dover (Walker), Folkestone, common (Bryne), Wye, Ashford (Theobald), Sydenham (Swain), Crocken Hill, Lee, Eltham (Bower), Abbey Wood, Dartford (Jones), Sheerness (Fletcher), Herne Bay (Peachell), Bexley (Newman), Deal (Fenn), Brockley (Turner), Gravesend, abundant (Jennings), Hythe (Hill), Cranbrook (Marshall), Southend near Catford (Russell), Tenterden, very common (Stainton), Higham, Greenwich marshes (Tutt), Lewisham (West). LANCS: common throughout (Ellis), freely in north Lancashire (Murray), St. Anne's-on-Sea, common (Baxter), Southport (Porritt), Hulme (Adamson), Prescot (Freeman), Dutton (Shuttleworth), Chat Moss (Auld), Winster, Eccleston Mere (Cotton), Limbrick, near Chorley (Whittaker), Liverpool (Harker), Grange-over-Sands (Booth), Warrington (Collins), Manchester, Preston (Stainton). LEICESTER: Loughborough (Moss), Leicester, Bradgate, Croft, common (Headly), Gumley, Queniborough, Aylestone (Bouskell). LIMERICK: Limerick (Bristow). LINCOLN: Hartsholme, common (Carr), Lincoln (Musham), Panton, Legsby, East Torrington (Raynor), Great Grimsby (Dawson). MERIONETH: Harlech dist. (Graves). MIDDLESEX: Clapton very abundant (Ogden), Bloomsbury (Brit. Mus. Coll.), Tottenham (Coste), Chiswick Park (Cockerell), Enfield (Skyes), Hampstead Heath (Henderson), Hammersmith (Allchin), Kingsbury (Godwin), Mill Hill (South), Bedford Park (Gray), Isleworth (Meyers), Crouch End, Highgate (James), Perivale, Ealing (Montgomery), Ponders End, Chelsea (Clarke), Neasden (Phillips), Twickenham (Burrows), Tottenham marshes (Sheldon), Harrow dist., common (Rhoades-Smith), Camden Town (Newbery), Gunnersbury (Mitchell), Wandsworth (Galloway), Kilburn, Willesden (Wormald), Hendon (South), Lea Valley, Southall (Battley), Walham Green (Dawe), Ealing (Fenton), Hornsey Rise (Riches), Brimsdown (Lane). MONMOUTH: Llandogo (Nesbitt). MONTGOMERY: Newtown (Tetley), Machynlleth (Alington). NORFOLK: Aylsham, the Broads (Freeman), Ipswich (Pyett), King's Lynn (Atmore), Horning Ferry (James), Barton (Sheldon), Fakenham (Woolhouse), Norwich (Harris), Waxham, Horsey (Cox). NORTHAMPTON: Northampton (Imms), Kettering (Sturgess), Peterborough (Morley). NORTHUMBERLAND: singly only (Robson), Wylam-on-the-Tyne

(Rhagg). NOTTINGHAM : Newark (Hewett), Mansfield (Daws), Chilwell, Lowdham (Pearson), Nottingham (Whittaker). OXFORD : Chinnor (Spiller), Oxford (James), Hardwick, Caversham (Holland), Cuddenden (Eddrup), Henley-on-Thames (Stearns), Standlake (Warner). PEMBROKE : Pembroke, common (Barrett). ROXBURGH : Hawick dist. Howgate, one (Guthrie). RUTLAND : Uppingham (Bell). SHROPSHIRE : Market Drayton dist., common (Woodforde), Shrewsbury (Stainton). SOMERSET : Taunton (Farrant), Wellington (Milton), Bath (Greer), Bristol coalfield dist., generally distributed but not common (Hudd), Castle Cary, frequent (Macmillan). STAFFORD : common in north Stafford (Daltry), scarce at Rugeley (Freer), Stone (Masefield), Market Drayton dist., common (Woodforde). SUFFOLK : somewhat common (Bloomfield), Waldringfield, Lowestoft (James), Sudbury district (Ransom), Bungay (Groome), Stowmarket (Crewe). SURREY : Wimbledon (Whittle), Frimley (Newland), Worcester Park (Kaye), Richmond (Clark), Chertsey (Clarke), King's Wood, nr. Reigate (Phillips), Dulwich (Helps), West Dulwich (Fletcher), Leatherhead (Briggs), Barnes (Sich), Croydon (Sheldon), Stoke Wood, Oxshott (Pickett), Wisley (Carr), Dorking district (Oldaker), Kingston-on-Thames (Cooper), Gipsy Hill (Wells), Streatham (Henderson), Thames Ditton (Fenn). SUSSEX ; Chichester (Anderson), Hailsham (James), Polegate, Eastbourne (Montgomery), Tilgate (A. H. Jones), rather common, Brighton, Hayward's Heath, Lewes, Battle, &c. (James), Worth (Silvester), Holm Bush, Cuckfield (Merrifield), Groombridge (Blaber), Bognor (Lloyd), Bersted, Worthing (Fletcher), St. Leonard's (Esam), Hastings district, somewhat common (Bloomfield). [SUTHERLAND (Stainton).] WARWICK : Stratford-on-Avon (Frohawk), Rugby (Solly), Birmingham (Imms), Harborne (Harrison). WESTMEATH : Cromlyn (Battersby), L. Iron, common (Kane), Mullingar, common (Middleton). WESTMORLAND : occurs freely in the districts bordering north Lancashire (Murray), Kendal district (Moss). WICKLOW : Tinahely (Bristow), Wicklow (Kane). WILTS : Calne, Bremhill (Eddrup). WORCESTER : very common, Worcester, etc. (Rea), Malvern Wells dist. (Mason). YORK : very abundant near York, especially so on Strensall Common in 1894 (Walker), Sheffield (Doncaster), Wakefield (Talbot), Wilford (Whittaker), Hull district, Wold Carr (Boult), Askern (S.D.B.), Askham Bog (Prest), Barnsley (Harrison), Bishop's Wood (Tyers), Bramham, common (Smith), Horsforth (Pickles), Huddersfield, rare (Porritt), Pannal (Roebuck), Pontefract (Hartley), Richmond (Lang), Scarborough, very common (Stainton), Skipwith, common (Ash), Doncaster (Corbett), Everingham, abundant (Sumner), Cudworth (Whitaker), Market Weighton (Hewett).

DISTRIBUTION.—Distributed over Europe, occurs rarely in Asia Minor and south-west Siberia. In eastern Asia replaced by *S. planus*, which may be only a local variety taking the place of *S. ocellata* ; similarly *S. atlanticus* may be considered as only a local Mauretanian form of *S. ocellata*. ASIA : Siberia (Pallas), north-west Asia Minor — Brussa, Olympus (Mann), north-east Asia Minor—Amasia ; Govts. Tobolsk, Tomsk, Uralsk, Turgai, Turkestan, Akmolinsk, Semipalatinsk, Saisan district (Staudinger). AUSTRO-HUNGARY : Tyrol, not common (Hinterwaldner), Brenner district (Galvagni), Lavantthal (Höfner), Taufers, Innsbruck (Weiler), Upper Carinthia and Salzburg (Nickerl), Upper Styria—St. Lambrecht (Kodermann), Carniola — Nanos-Berg, nr. Wippach, Carinthia — Friesach (*teste* Bartel) ; Bukovina, everywhere (Hormuzaki), Pressburg (Rozsay), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Brünn (Müller), Hermannstadt (Czekelius), Epiries, common (Husz), Kocsocz (Vángel), Gölnitz (Hudák), Galicia — Syklo (Garbowski), Tarnów, Lemberg, Brody (Nowicki), Lower Austria — Vienna, Bohemia — Carlsbad, Moravia — Mährisch-Trübau, Ungarisch-Brod, Hungary, everywhere common — Transylvania, Nagy-'Ag or Noság, Kaschau, Rosenau, Neusohl, Raab, Budapest, Fünfkirchen, Josefsthal, Croatia (*teste* Bartel), Fiume (Mann), Upper Austria—Inn Valleys, somewhat rare, Linz, Postlingberg, Buchenau, Hagen, Plesching (Himsl). BELGIUM : very common throughout (Lambillion), Rochefort (Carlier), Namur, abundant (Colignon). CHANNEL ISLES : rare (Luft), Jersey (Breton). DENMARK : rather common (Bang-Haas). FINLAND : distributed (Lampa). FRANCE : common (Berce), Haute-Garonne, common, but not above the hill-region (Caradja), Puy-de-Dôme (Guillemot), Doubs (Bruand), Loire-Inférieure, common—La Chapelle-súr-Erdre, Nantes, Savenay, Ancenis (Bonjour), near Paris (Walker), Pont de l'Arche (Dupont), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne (Sand), Var (Cantener), Morbihan (Griffith), Gironde (Trimoulet), Aude (Mabille), Saone-et-Loire (Constant), Seine-Inférieure, common (Viret), St. Quentin (Dubus), Sarthe (Desportes), Meurthe, Meuse (Speyer), Savoy—Aix-les-Bains (Agassiz), Corsica (*teste* Bartel). GERMANY : not rare (Heinemann), general in north-west (Jordan), Silesia, common (Assmann), Ratisbon (Schmid), Pomerania, everywhere common (Hering), Dessau (Richter), Hanover, not rare (Glitz), Thuringia, everywhere—Erfurt, Gotha (Knapp), Eutin (Dahl), Frankfort-on-Oder (Kretschmer), Brunswick (Heinemann), Wernigorode (Fischer), Rhine Palatinate (Bertram), Bremen dist., distributed but not common (Rehberg), Würtemberg—Stuttgart (Seyffler), Chemnitz (Pabst), Nassau (Rössler), Baden—Constance, Carlsruhe (Reutti), Giessen (Dickore), Lower Elbe dist. (Zimmermann), Waldeck (Speyer), Zeitz-on-the-Elster (Wilde), Halle-a.-S., singly (Stange), Munich, common—Isarauen, Schleissheim (Kranz), Rudolstadt (Meurer), Saxon Upper Lusatia (Schütze), Upper Lusatia (Moeschler), Dresden, common (Steinert), Prussia (Schmidt), Schwerin - Mecklenburg, common, Sylt Island, Crefeld dist., not rare—Wollicher, Oppumer, Bahndamm, Hülersbruch, etc.; Barmen, Elberfeld, Ahrthal, Cassel, Leipzig, common, Augsburg, common, Kempten, Frankfort-on-Main, Wiesbaden, Wetterau, Trier, Bavarian Palatinate (*teste* Bartel), Alsace—Mulhausen, &c. (Peyerimhoff), Colberg on Baltic coast (Sich), Heligoland (Gätke), Berlin dist., common (Pfützner), Hildesheim, not rare (Grote). ITALY: throughout (Curò), Modena (Fiori), throughout Tuscany, not common, Roman Campagna (Calberla), Lombardy, Piedmont, Liguria, Montagna de Matese, Sardinia, Corsica (*teste* Bartel). NETHERLANDS: common throughout (Snellen), Breda, somewhat common (Heylaerts). PORTUGAL (*teste* Bartel). ROUMANIA: somewhat common, Grumazesti, &c. (Caradja), Comanesti (Leon). RUSSIA: Baltic provinces, throughout, but not common, Dorpat, Neu-Kasseritz, nr. Werro (Nolcken), Lapland, rare, govts. Archangel, Oblonez (*teste* Bartel), Moscow provinces (Albrecht), St. Petersburg (Erschoff and Feild), Volga dist., not rare (Eversmann), Cracow (Zebrawski), Kurland, govts. Pskow, Mogilew—Gorki, Wolynien, govts. Kijew, Poland — Kamenez - Podolskii, Bessarabia, govts. Cherson, Jekaterinoslaw, Poltawa—Lubny, Charkow, Orel, Kaluga, Tambow, Lower Volga dist., Kasan dist., not rare, Simbirsk, Ufa, Orenburg dist., Samara, Saratov, Astrachan — Sarepta, Noworossiisk on the Black Sea (*teste* Bartel), Transcaucasia—Borjöm (Romanoff), Manglis (Sievers). SCANDINAVIA: fairly common to 61° N. lat., very rare farther north (Aurivillius), Sweden — Skania, Upland, Torneå, southern Norway (Lampa), Lapponia Tornensis (Zetterstedt), Norway—Christiania, Drammen, Odalen, rare, Naes Vaerk (Siebke), Lyngör (Strand), Saeterstoen (Chapman). SPAIN: Bilbáo (Seebold), Malaga (Rambur), Santiago (Velado), Barcelona — Lobregat and Besós dist. (Cuní y Martorell), Catalonia (Martorell y Peña). SWITZERLAND: widely distributed, but at no great height in the mountains (Frey), Gadmenthal 2000ft.—2500ft. (Rätzer), Glarus, nr. Biel (Heer), Grisons (Killias), Bern (Hiltbold), Bechburg (Riggenbach-Stehlin), Zürich dist., somewhat common—Mettmenstätten, Nürensdorf, Weisslingen (Dietrich).

SMERINTHUS HYBR. HYBRIDUS, Stephens.

SYNONYMY.—Hybrid: *Hybridus*, Stphs., "List. Br. An. Br. Mus.," p. 26 (1850); Staud., "Cat.," 1st ed., p. 16 (1861); 2nd ed., p. 37 (1871); 3rd ed., p. 99 (1901); "Berl. Ent. Zeits.," xviii., p. 149 (1874); Höge, "Verh. Ver. Nat. Hamb.," i., p. 141 (1871); Strecker, "Lep. Rhop. and Het.," p. 60, pl. vii., fig. 15 (1873); Ziegler, "Berl. Ent. Zeits.," xxxvi., Sitz. p. xxiii (1892); Stdfss., "Handbuch," &c., p. 54 (1896); "Bull. Soc. Ent. Fr.," 1901, pp. 87—89 (1901); Wisk., "Fests. Ver. Schles. Ins. Bres.," p. 109 (1897); Spuler, "Lep. Bad.," 2nd ed., p. 40 (1898); Frings, "Soc. Ent.," xv., p. 164 (1901); Bartel, "Die Palæark. Gross-Schmett.," ii., p. 176 (1900); Prout, "Ent. Rec.," xiii., p. 323 (1901); Schultz, "Berl. Ent. Zeits.," xlv., Sitz. p. 29 (1900). *Ocellata* (*us*) × *populi*, House, "Trans. Ent. Soc. Lond.," 1842, pp. 193—194 (1842); "Ent. Wk. Int.," iv., pp. 77—78 (1858); Westd., "Trans. Ent. Soc. Lond.," pp. 195 *et seq*, pl. xi., fig. 1 (1842); Humph. and Westd., "Brit. Moths," p. 7, pl. i., fig. 10 (1842); Hague, "Ent. Wk. Int.," ii., pp. 188, 197 (1857); Hagen, *loc. cit.*, iv., p. 77 (1858); Adamson, *loc. cit.*, iv., pp. 117, 127 (1858); Galliers, *loc. cit.*, viii., p. 75 (1860); x., p. 100 (1861); Birch., "Rept. Brit. Assn.," 1870, pp. 111-112 (1871); Talbot, "Ent.," v., p. 450 (1871); Chawner, *loc. cit.*, vi., p. 147 (1872); Porritt, "Ent Mo. Mag.," xi., pp. 116, 157 (1874); Briggs, "Ent.," xiv., p. 217, fig. (1881); Kirby, *loc. cit.*, pp. 253—254 (1881); Eckstein, "Ber. Oberhess. Gesell. Natur.," xxvi., p. 54, pl. ii., fig. 4 (1888); "Illus. Zeits. f. Ent.," iv., p. 332 (1899); Kirk, "Ent. Rec.," i., pp. 202—203 (1890); Tutt, *loc. cit.*, p. 203 (1890); Dönitz, "Berl. Ent. Zeits.," xxxvi., Sitz. p. xxii (1892); Barr., "Lep. Brit.," ii., p. 10, pl. xli., fig. 2 (1893); Dale, "Hist. Brit. Hawk-Moths," p. 25 (1893); Bacot, "Ent. Rec.," vi., pp. 179—181 (1895); viii., p. 318 (1896); ix., p. 299 (1897); x., pp. 7, 188 (1898) Prout, "Ent. Rec.," xiii., p. 266 (1901).

Natural pairings.—Very few records of the two species pairing in nature are extant. Koch observes (*Indo-Aust. Lep.*, p. 32) a ♂ *S. ocellata* found *in cop.* with a ♀ *A. populi* on the park palings at Frankfort-on-Main by C. Schneider. Foucart notes (*Cat. Lép. Douai*) that Deligny exposed a ♀ of *A. populi* with the intention of attracting a ♂, and found it paired with a ♂ *S. ocellata*. On May 28th, 1860, a ♂ *S. ocellata* was found paired with a ♀ *A. populi* in Princes Park, Liverpool.

Original description.—Stephens named this cross *hybridus* without describing the form. His name was given to one of the individuals described by House (*Trans. Ent. Soc. London*, 1842, pp. 194-195), and figured by Westwood. House writes: "I always keep my subterranean chrysalides in large garden pots, filled within about two inches of the brim with light sandy loam, hooped over the top with wire and covered with gauze, leaving a space of 8 or 10 inches from the mould to the top of the wires. When *S. ocellata* began coming out (having them in one of these pots, and *S. populi* in another), I, every evening, before dark or twilight, took out the ♀s of *S. ocellata*, one or two, not more, and put them in the pot with ♂ *populi*, and *vice versa*, and then placed the two pots closely side by side in the garden or window for the night, so that the ♀ of each species formed an attraction to its own ♂, while the ♂ could only gain access to the ♀ of the other species. By this means I obtained five broods of eggs of *S. populi* impregnated with *ocellata* and one of *S. ocellata* impregnated with *populi;* only about 30 eggs of one of the former broods hatched, about the middle of June last; of these, I reared nineteen caterpillars to perfection, which went underground in about a month or five weeks, and, in August last (1837), twelve of the moths came out perfect, the other seven being still in the pupal stage, and will, in all probability, come out in May next. The insects thus obtained are as near alike to each other as any species with which I am acquainted, and are as nearly intermediate as one can conceive. The power of reproduction is completely lost, as they appear to be as nearly intermediate between the sexes as between the species, and evidently partake of the nature of both sexes, for, as proof, every freshly-bred insect of the genus *Smerinthus* on being touched discharges copiously a fluid which, in the ♂, is pure white, and in the ♀ of a yellow or ochre colour. These specimens discharged, at the same motion, first the white and then the ochre fluid, quite distinct, and this compound discharge was quite uniform in every specimen, which is never the case in any true species or sex. I had often indulged in fanciful ideas respecting this production, but I never conceived such an unfinished painting as it is; this is not nature improved by art, but nature sadly defaced by art, as the beauty of both species is, in great measure, lost. I took care to provide myself with eggs of both species, which should hatch at the same time as the hybrids, for the sake of comparison; in their infant state, no difference was observable between them and *populi*, very little in their second stage, more, however, in the third, and finally they were more like *ocellata* than *populi*. The pupa differed as much from either, yet as much resembled both, as the moth. Whether such a production has ever been obtained before or not, I am totally ignorant as I have never had the advantage of studying any work on entomology."

Imago.—The insects are as near alike to each other as any species with which I am acquainted, and are as nearly intermediate (between *ocellata* and *populi*) as one can conceive (House). In the outline of the wings the character is intermediate between the two species, the external margin being nearly similar in its general figure to that of *ocellata*, but notched, although far less strongly than in *populi*. The markings of the forewings are almost identical with those of *populi*, the outer margin of the dark discoidal central broad bar is more irregular, and is succeeded by two waved fasciæ, the first of which is less conspicuous than the other. The markings of the hindwings, on the contrary, more nearly resemble those of *ocellata*, the pink colour of the base is, however, exchanged for the dark ferruginous colour as in *populi*, extending more generally over the wing than in the latter species. In the place, however, of the beautiful and clearly marked grey, silvery, blue and black eye of *ocellata*, there is a large indistinctly suffused black patch, in which is an obscurely defined dark leaden-coloured eyelet. On this pair of wings are no traces of the transverse lines of *populi*. On the underside, the markings of all the wings resemble those of *ocellata* more nearly than those of *populi*, there being four waved fasciæ across the disc of the posterior pair. The thorax has a large, oblong, dark mark, but not so dark-coloured or large as in *ocellata* ; in *populi* there is no trace of this mark. From the form of the body, and the pectination of the antennæ it must be regarded as a ♂. Pl. xi., fig. 1 is an illustration of this insect (Westwood). The imagines are beautiful and curious, having all the markings and all the colours of both species in one ; some have the markings of *ocellata* on one wing and those of *populi* on the other ; some have *populi* bodies and others *ocellata* bodies, and the wings *vice versa* (Hague). The forewings with a slight mixture of *ocellata*, hindwings with the brick-coloured blotch and eyespot as well marked as can be expected (Adamson). The forewings resemble those of *populi*, only they are much darker, and the hindwings those of *ocellata*, the moon, or large, round, bluish-like spot fully developed (Galliers). The markings and colours of both species come out very distinctly (Porritt). The forewings of a pair of hybrid *ocellata* × *populi* in my possession, are of a rich brown colour with the markings of *A. populi*, the hindwings being marked like those of *S. ocellata*, with the patch of a reddish colour, and the eye very distinctly marked, but without the pupil (Chawner). Dönitz exhibited (*Berl. Ent. Zeits.*, xxxvi., Sitz. p. xxii) a hybrid of *S. ocellata* × *populi*, which had in general the form of *populi* and the colour of *ocellata*. Particularly striking are the dentated margins of the wings, as *populi* also has them. The colour is very much duller than in *ocellata*, and the dark central stripe on the thorax (which *ocellata* possesses) is wanting. The specimen was obtained from Schaufuss, of Meissen. Herr Gleissner remarked that he had made an attempt to pair *ocellata* ♀ with *populi* ♂, the ♀ had laid eggs but only one larva hatched, and that also perished after a few hours. Herr Ziegler also showed (*loc. cit.*, p. xxiii) a hybrid of

S. ocellata and *populi* (= *S. hybridus*, Westw.), which in colour and markings more approached *A. populi*, and had the eyespots only weakly indicated. He suspected this hybrid had arisen from a pairing of ♂ *populi* with ♀ *ocellata*. Schultz exhibited *(Berl. Ent. Zeits.*, xlv., Sitz. p. 29) two examples of *S. hybridus*, which resembled *A. populi* in the forewings, but had indistinct ocellated spots on the hindwings. Standfuss writes *(in litt.)*: "*S.* hybr. *hybridus* is known in nature, but as quite a decided rarity; a ♂ is in my collection from Saarau, near Konigsselt in Silesia. I have bred over 500 specimens in the course of the year (1901) and it has also been bred by many other entomologists." Bacot writes *(in litt.)*: "Two ♂ s are 3·25ins. and 2·875ins. in expanse. Both examples have a rather *ocellata* outline to the outer margin of the forewings, the hindwings being very much narrower than in *A. populi* and the notch near the anal angle being in evidence, in one specimen poorly, and in the other strongly, marked. The ocellated spot of one specimen shows a very faint tendency to a central spot, in the other the left ocellated spot is rather lunular in shape, while the right shows a very faint division by an oblique dusky bar, really a prolongation of the encroachment of the dark outer area; that on the other wing makes a lunule instead of a circular spot. On the underside of the wings the coloration is, on the whole, *A. populi*-like in dulness, but as regards the number of lines forming the band that is continued across both wings, and also in respect of its general contour, it follows *S. ocellata*, although it loses the small crenulations in the lines which occur about the middle of this band on the hindwings of *ocellata*. I suspect, now that I am better acquainted with the North American allies of these species, that many of the characters usually attributed to the *A. populi* parentage are in reality ancestral (reversionary), and that there is no such predominance of the ♀ parental influence as is often supposed, the *A. populi* facies, both as regards colour and markings, being already fully developed in some North American species, *Triptogon modestus* and *occidentalis*, while the forewings of *vancouverensis* and *geminatus* also show a strong tendency in this direction." Bartel writes: "The markings of the forewings of examples arising from the cross *ocellata* × *populi* are similar to those of *A. populi*. The dark colour on the disc is irregularly divided, and is intersected by two darker waved lines, of which the first is the less distinct. The contour of the wings is similar to that of both species; the outer margin is formed nearly as in *S. ocellata*, and dentated, yet not so strongly as in *A. populi*. The markings of the hindwings resemble more those of *S. ocellata*; the brown basal patch of *A. populi* is, indeed, present here, but much lighter, yellowish. In place of the anal eye-spot of *S. ocellata*, *S. hybridus* has a large black spot, which is distinctly granulated with dark blue, and shades off into the ground-colour. The costa of the hindwings is dark. The markings of the darker under-surface agree almost entirely with *S. ocellata*, yet the colouring of the basal and median areas of the forewings is not so extended and not so roseated, but yellow-brown, coloured like the basal patch on the upper surface of the hindwings. The middle of the thorax is occupied on the upperside by a dull olive-brown spot, which is not such a full, velvet colour as in *S. ocellata*, but [which] is always wanting in *A. populi*. The colouring of head, thorax, abdomen and legs approaches more to that of *S. ocellata*."

Sexual dimorphism.—The hybrid *S. hybridus* has, in the ♂s, antennæ extremely like those of ♂ *S. ocellata*. Those of a quasi-♀ specimen (*posteà*, p. 453, gynandromorph θ) are ♀, but with a considerable display of the ♂ hairs. These are most fully developed close to the scaling, and are, in places, almost typical ♂; over the more ventral portions of the antenna they are largely wanting, and are, when present, sparse and shorter than in the ♂ (Chapman).

Gynandromorphism.—House notes (*Trans. Ent. Soc. Lond.*, iii., 1st ser., p. 194) of certain *S.* hybr. *ocellata* × *populi* that he reared, that "nineteen larvæ became adult, and in August twelve of the imagines came out perfect . . . . The power of reproduction is completely lost, as they appear to be as nearly intermediate between the sexes as between the species; they evidently partake of the nature of both sexes"; as proof he states that "every newly-emerged insect of the genus *Smerinthus* on being touched discharges copiously a fluid, which, in the male, is pure white, and in the female of a yellow or ochre colour, whilst these hybrids discharged, at the same motion, first the white and then the other fluid quite distinct, and this compound discharge was quite uniform in every specimen, which is never the case in any true species or sex." Westwood states (*loc. cit.*, p. 195) that two of these specimens submitted to him were males so far as related to their external organs, and adds (p. 202) that in all gynandromorphous *A. populi* recorded up to that time the right side was ♂ and the left ♀. Adamson writes (*Ent. Weekly Intell.*, iv., p. 127) of a brood of hybrid *S. ocellata* × *populi* that, in general, the sexes were more or less mixed, but he had one "such a decided male * that he was inclined to see if it would breed," and further noted that he had observed many of the peculiarities referred to by House with regard to their sterility. Kirby observes (*Ent.*, xiv., p. 253) that he was under the impression that gynandromorphism was the usual character of hybrid *ocellata* × *populi*. We are disinclined to this view, as Mr. Kirk, who reared ten imagines in August 1890, sent us 5 which we still possess, and which, though intermediate between the species, are apparently distinct enough as to sex, consisting of 4 males and 1 female (*Ent. Rec.*, i., p. 203). On the other hand, Bacot reared three imagines in 1896, and their genitalia were examined by Pierce, who reported (*Ent. Rec.*, x., p. 188) that those of the ♂s were pretty normal, but those of the ♀ showed many marked ♂ characters. He notes (*Ent.*, xxix., p. 374) that of the 3 specimens the 2 males, although perfectly distinct from the male parent, had perfectly formed genitalia,

* Standfuss' opinion as to the general failure of the female hybrids of the Attacids (*anteà*, p. 300) to produce ova, and the large percentage of gynandromorphous examples among the apparently female examples, whilst the males were capable of pairing with females of either of the parent sex, is supported by Pierce with regard to *S.* hybr. *ocellata* × *populi*, for he notes (*Ent. Rec.*, x., p. 189) that whilst the only apparently female example was gynandromorphous, and evidently incapable of reproduction, the hybrid males might cross again with a ♀ of either of the parent species. Chapman notes that in the ♀ pupæ of Bacot's brood of *S. hybridus* the sexual organs showed considerable tendency towards a confusion of the sexes, those of the ♂s not differing greatly from those of *A. populi* (see *posteà*, p. 458).

and were apparently capable of copulation, but an apparent ♀ was gynandromorphous, the genitalia containing the organs of both sexes. Birchall notes (*Rept. Brit. Assn.*, 1870, p. 111) the rearing of 6 specimens—3 ♂ s, 2 ♀ s, and 1 gynandromorph. In spite of the reputed general tendency to gynandromorphism in *S.* hybr. *hybridus*, we find only the following described examples:

α. Right side, ♂, *ocellata*; left ♀, *populi*. The right antenna ♂, right side presents the characters of *S. ocellata* the ♂ parent, whilst the left side is ♀ and differs from an ordinary ♀ *A. populi* only by a little more brilliancy of colour. The generative organs were much distorted, and there were no ova in the abdomen (Birchall, *Rept. Brit. Assn.*, 1870, p. 111). The specimen passed into Briggs' hands, who figured it (*Ent.*, xiv., p. 217).

β. Right side ♂, left side ♀. The right side inclining, both above and below, more to *S. ocellata* in coloration and markings, the left side more to *A. populi*. The ocellated spot on the right side larger with a broad black border, the left one smaller, and more obsolete. Right antenna ♂, left ♀. Abdomen without ova, left side distinctly stouter, and with the anal point rounded towards the right, with a very distinct right anal clasp. Difference in wing expanse, right side 36mm., left side 34mm. Bred in Wiesbaden. Wiskott coll. Breslau. (Wiskott, *Festschrift. Schles. Ver. Ins.*, pp. 109—110, pl. iii., fig. 8).

γ. Right side ♂, left ♀. Wings and antennæ on the right side ♂, on the left side ♀; wings of the right side larger than those of the left. Abdomen from its shape ♀; of the sexual organs only a ♂ anal clasp observable. The outer ♀ genital organs are not discernible. Daub coll. Carlsruhe (Gauckler) (Schultz, *Ill. Woch. für Ent.*, ii., p. 395).

δ—*η*. Four gynandromorphs in the Staudinger coll. Not described (*loc. cit.*).

θ. Apparently ♀. The genitalia have the lobes similar to those of the ♀ s of *A. populi* and *S. ocellata*, but, mixed up with them in the last segment, are the rudimentary and partially developed organs of the ♂, the whole apparatus being much smaller than is that of the ♀ parent species. Immediately behind are some curious structures which are apparently the rudimentary inferior harpes, then there is one superior harpe, well-defined, but very small; neither the uncus nor the anal flap is separable, but no doubt both are present in some rudimentary form; the penis is very distinct; it is rounded at the base, and consists of a short tube, surmounted by a large number of very small spines. Farther back, near the junction of the penultimate segment, is the ovipositor (?), scarcely smaller than that of the parents (*vide*, *Ent. Rec.*, x., pl. iii., fig. 7). Ova were also discovered in the body. I should certainly say that this specimen was incapable of reproduction. Bacot coll. (Pierce, *Entom. Record*, &c., x., p. 189).

Comparison with parent species and allies.—Bacot notes of his ♂ *S. hybridus* that it is superficially more like the ♀ than ♂ parent, though a close examination reveals the fact that in many faint but important markings it follows *Smerinthus ocellata*. The wings are narrower than those of *Amorpha populi*, especially the secondaries, the notch at the anal angle being very distinct. There are three dark patches on the forewings, two situated near each other towards the anal angle, whilst the third is placed at about the middle of the outer transverse band. These patches are of very general occurrence among the Amorphids, being especially distinct, and evidently forming protective markings in *Sichia quercûs*, and some of the American and exotic species. They are present in both *S. ocellata* and *A. populi*, strong and dark in the former, faint only in the latter. In the hybrid, though they are scarcely so strong as in *S. ocellata*, they appear to me to partake more of the ancestral character. The hind tibiæ of the hybrid moths possess two spines only. The ocellated spot on the hindwing is rather lunular than ocellated (Bacot).

Egglaying.—The egglaying habit must of necessity agree with that of *Amorpha populi*, the ♀ parent. Bacot notes a pairing on June 13th, 1896, between which date and the 19th, 163 eggs were laid by the ♀.

They commenced to hatch on the 24th, 59 larvæ resulting. Of the other 104 eggs, 55 appeared to have fully developed, but from some unexplained cause had not emerged; 27 were still green (these afterwards dried up), and of the remainder some were very discoloured (probably died during the development of the embryo), and others had shrivelled up without change (probably unfertilised).

OVUM.—Exactly the same as that of *Amorpha populi*.

LARVA.—*First stadium* (June 29th): Length between one-eighth and three-sixteenths of an inch when newly hatched, growing to between three-eighths and seven-sixteenths before the first moult. Head: green, large, rounded, but with a tendency to triangular shape; a few scattered hairs and a yellow inverted V on face. Body: pale green; scutellum fairly distinct; a faint, dark, mediodorsal line; two tubercles on the dorsal area of the thoracic segments can be distinguished as rather larger, and bearing longer hairs than the usual shagreen mammillary points. The trapezoidals on abdominal segments can also be observed standing out among the mammillary points, though not quite so clearly as the two mentioned above as being on the thoracic segments. (This last feature is not distinctive of the hybrid larvæ; it can also be seen in the larva of *Smerinthus ocellata*, and is probably present in those of *Amorpha populi* and *Mimas tiliae*. I merely call attention to it as an important point that I had not previously noted.) Seven oblique stripes are present, the seventh being rather stronger than the rest; the subdorsal lines distinct. All the stripes are more conspicuous after the larva has been feeding for a few days. Caudal horn: long, pale pink; some of the larvæ have only short horns, which appear withered (in one instance almost to the stump, in another it is almost entirely absent, while a third has the horn constricted just above the base, as though a piece of thread had been tied round it). I have noticed a similar deformity to this last in a larva of *M. tiliae*. [Unfortunately, I had no larvæ of either *S. ocellata* or *A. populi* in the first stage with which to compare, but, judging from memory and written descriptions, I noted as follows: The larva closely resembles that of *S. ocellata* in shape and attitude, as well as in markings.] *Second stadium* (July 3rd): Most of the larvæ are now in the 2nd stadium, and are growing rapidly. [By this time I had larvæ of both *S. ocellata* and *A. populi* in the same stage as the hybrid larvæ, so that the comparisons in this and subsequent stages are more exact.] Length, three-eighths to five-eighths of an inch. Head: triangular, broader, less tall and pointed than in larva of *S. ocellata*, but not so bulged at cheeks nor squat as in that of *A. populi*; yellow mammillæ at apex of head taller than in the latter species. Body: scutellum indistinct; the subdorsal stripes are continued faintly across the oblique lines to the 5th (in one larva to the 7th); the mediodorsal line is produced by the absence of shagreen mammillæ; dark borders to oblique lines are present. The stripes are stronger than in *A. populi*, but not so marked as in *S. ocellata*. In addition to the other stripes, there is a faint lateral line below the subdorsal, on the thoracic segments. Caudal horn: the base is pink for about one-third its height; shorter and lighter in colour than that of *S. ocellata*, though more marked in both respects than in larva of *A. populi*. [Habits: The larva retracts the first two pairs of forelegs (in one larva the third pair also); I did not note any marked preference for either the upright or hanging position in this stage, but one larva assumed a rather marked "Sphinx" posture, very like that of *Sphinx ligustri*.] A careful examination of the larva proves it to be curiously midway between the parent species as regards most of the important differentiating characters. In coloration and shape it is neither so white a green nor so graceful in form as the larva of *S. ocellata*, nor is it so yellow-green and heavy-looking as the larva of *A. populi*. Looked at in a less critical manner, and without the aid of a glass, it reminds one most of the yellow form of *S. ocellata*. Its habits and position also show rather more trace of the ♂ than ♀ parent. The fact of the 1st pair of oblique stripes being no stronger than the 2nd to 6th pairs, and weaker than the 7th, still further adds to its resemblance to *S. ocellata*. *Third stadium* (July 8th): Head: as before, nearly midway between the parent forms in shape, &c., but it now resembles *A. populi* more nearly than *S. ocellata* in size, colour and roughness, being covered with yellowish mammillæ, which are only very small in the larva of *S. ocellata*; the large apical points are only slightly larger than in the larva of *A. populi*, with which they agree as regards colour (yellow); they are, however, situated, as in *S. ocellata*, close together, and *not* a short distance apart with two smaller ones between, as is the case in the larva of *A. populi*. Body: becomes paler towards close of this stage, though not so white as in *S. ocellata*. Stripes: oblique stripes, as in *M. tiliae* and *S. ocellata*, 1 to 5 equal, 6 narrow and weak, 7 strong and broad. The subdorsal line is faint and narrow, is continued backwards to the 7th oblique, but barely noticeable on thoracic segments; a double mediodorsal stripe is faintly marked; the anus outlined with same colour as other stripes. Caudal horn: long and very thick at base. Hairs: still bifid, but this character is not quite so marked in the hybrid larva as in the larva of *S. ocellata*. [Habits: the larvæ rest either with the head downwards (*A. populi* habit) or with it upright (*S. ocellata* position), with the first two pairs of forelegs withdrawn, though not so completely as is the case in *S. ocellata*.] One larva is growing to a large size in this stage; it is already over one inch long, and shows no sign of an approaching moult. The larva of *S. ocellata*, when about to moult in this stage, is of about the same length as this larva now is, but it is not nearly so bulky. By July 12th there were only 19 living larvæ, three well grown in the 4th skin, the remainder mostly in 3rd. They varied in colour from a yellow-green to a pale, whitish sage-green, and were tolerably constant in shape, but very variable in size. *Fourth stadium* (July 12th): Head: as previously described. Body: the 7th oblique stripe is faintly continued forwards to the 3rd pair of prolegs; the 1st oblique runs forward to the prothorax. The small oblique stripes that are present in *A. populi*, just above base of prolegs 1, 2 and 3, can be faintly traced in the hybrid larva. The larvæ now mostly rest in the position taken by that of *A. populi*. Both yellowish and whitish forms are present in this stage. Just after the 3rd moult the yellow forms are superficially very like *A. populi* in its 3rd skin, the only striking difference being the absence of any strengthening of the 1st oblique stripes. July 17th. One is now nearly full-grown, in 4th skin, while the majority of the remainder are about to undergo a 4th moult. *Fullfed larva in 4th skin* (July 17th): Head: not so large or tall as that of *S. ocellata* in 5th skin, and the yellow bands down the sides of the face are stronger and broader. The resemblance of the apical points and their position on the crown of the head are remarkably close to *S. ocellata* in everything except colour. This is, however, partly due to the fact that, with *S. ocellata* in the adult stage (5th skin), the tubercles or processes have greatly dwindled in size. Body: in colour it now almost exactly resembles a typical larva of *S. ocellata;* the oblique stripes are much stronger than when the larva first changed into this skin; the subdorsal is very weak and faint; the spiracles bright red, whilst in *S. ocellata* they are deep crimson, and much larger; anal flap outlined with yellow, in *S. ocellata* with white. [In general shape and habits the larva is still very similar to that of *A. populi*, and is restless under examination, as is the larva of the latter species. The larva of *S. ocellata*, on the other hand, will usually retain its stiff and rigid resting-position during the process unless greatly provoked.] The first larva went down on July 21st, having only undergone three moults. *Fifth stadium:* The same as in the fourth. By the 24th the majority were fullfed, or nearly so, and the remainder, with one or two exceptions, were in the final stage. So far as I was able to follow them, the majority had four moults, a few only attaining their full growth in the 4th skin (Bacot). House notes that in the first stage there was no difference observable between the larva of the hybrid and that of *A. populi*, very little in the second stage, more difference in that of the third, whilst finally they were more like larvæ of *S. ocellata* than those of *A. populi.* Birchall observes that the larvæ he had were barely distinguishable from those of *A. populi*, and appeared healthy, but there must have been constitutional weakness, for of 16 which assumed the pupal stage, only six produced moths.

VARIATION OF LARVA. — Bacot observes (*Ent. Record*, x., p. 190) that the hybrid larvæ of *S.* hybr. *hybridus*, bred by House and Birchall, differed in some particulars from those he reared. These latter resembled more closely those of *S. ocellata* than those of *A. populi*, whilst theirs resembled the larvæ of *A. populi* more nearly than those of *S. ocellata*, although House records that after the 3rd moult his larvæ began to lose their *A. populi* traits, and finally were more like *S. ocellata.* Different broods may, of course, vary considerably in their tendency to follow either parent species. Frings observes (*Soc. Ent.*, xv., p. 164) that, when young, the larvæ had the characteristic form, narrowed anteriorly, as well as the colour and markings, of *A. populi* of like age, so that had he not known their history he would unhesitatingly have called them that species. But after the third moult, the greater part of them already approached the larva of *A. ocellata;* the ground-colour assumed a bluish-white colour in place of yellow-green as heretofore. Nevertheless, nearly all retained the form of *populi* larvæ. Not till after the 4th moult did his specimens assume the form, colour and markings of the *ocellata* type, but then so completely that they were scarcely distinguishable from true *ocellata* larvæ. Only a few specimens had retained the short, pointed horn of *populi* larvæ, but this was always bluish in colour, never yellow or reddish as in *populi*. All the larvæ possessed the horizontal prolongation of the first oblique stripe on the neck, a characteristic which also only belongs to *populi* larvæ.

DIFFERENCES BETWEEN ADULT LARVÆ OF S. HYBR. HYBRIDUS, S. OCELLATA, AND A. POPULI.—(1) *S.* hybr. *hybridus* and *S. ocellata.*—Head of *S.* hybr. *hybridus* smoother, and not so pointed; yellow lines down face much broader. Body not so long and graceful; the subdorsal stripes much weaker, the oblique stripes not so strong; slight traces of small oblique stripes just above the bases of prolegs 1, 2 and 3 (these are altogether absent in *S. ocellata).* Caudal horn: yellowish at upper end. Spiracles: not so large or dark; 1st and 2nd pairs of prolegs are retractile, but to a less extent than in *S. ocellata.* Resting habits differ as a rule. (2) *S.* hybr. *hybridus* and *A. populi.*—Head of *S.* hybr. *hybridus* taller and more pointed. Body: longer and not so dumpy. Oblique stripes: rather broader as in the larva of *S. ocellata*, the stripes are due rather to colour than structure, the 1st no stronger than the following — 2nd to 5th; the 7th runs forward to front of 4th pair of prolegs (as in *S. ocellata).* Small oblique lines above base of prolegs present, but much fainter than in *A. populi.* Caudal horn: sky-blue in colour at base. (3) *General notes:* In its general appearance the larva, in the 1st and 2nd stages, approaches *S. ocellata* rather than *A. populi;* in 3rd and early part of 4th stages it has a greater resemblance to *A. populi;* when fullfed it veers back again towards *S. ocellata.* A very similar change takes place in the larval life of *A. populi*, though, perhaps, this is not quite so marked as in the hybrid. It is in the middle stages (2nd and 3rd) that this larva attains its greatest distinctiveness; in the first and last stages the difference between it and the larva of *S. ocellata* not being nearly so sharply contrasted, and this departure and return is in no way due to the development of *S. ocellata*, which does not greatly differ in appearance throughout its ontogeny. In the shape and structure of the head, and the markings on its body, the hybrid larvæ were remarkably constant. I looked with especial care for any individual variation or difference in the oblique stripes, which it seemed not unlikely might vary in the direction of *A. populi*, by a strengthening of the 1st, but in no case was there the slightest tendency in this direction. Throughout my notes I have made comparisons between the hybrid larvæ and those of the parent species, but in some characters the agreement with *M. tiliae* is as close as, or closer than, that with *S. ocellata* and *A. populi*, and where this agreement is present, as, for instance, in the colour of the processes at the apex of head, we have, I think, conclusive evidence that this was their original appearance. The larvæ were very delicate, more especially during the early stages, the moulting periods being the most critical of all. The less robust appeared to have great difficulty in getting rid of their old skin; I assisted them off with their old clothes in several instances, but, alas, in no case did my help prove of any avail, for they died in spite of my philanthropic efforts. I suspect the difficulty really consists in drawing out the old linings of the tracheæ, the rough assistance one is able to render, probably results in breaking them away from their attachment to the old skin, and leaving them to clog the breathing apparatus (Bacot).

COCOON.—Two of the larvæ formed rather large and firm oval cells in which to pupate, but no silk appeared to have been used in their construction; they were from two-and-a-half to three-and-a-half inches below the surface. Of the remainder I cannot speak with certainty, their cells, if any, must have been extremely fragile (Bacot).

PUPA.—Very close indeed to the pupa of *Amorpha populi;* they are a little smaller, and are more delicate in texture. They tend to great exaggeration of the scars of the prolegs and of the caudal horn. As weak specimens of other Amorphids tend to do this, this is rather an evidence of weak constitution than of definite variation. The subsegmentation, as described in the pupa of *A. populi*, is very distinct; on abdominal segment 3 five subsegments are marked out; the neuration and Poulton's line are better marked than in the pupa of *A. populi*, again apparently owing to the thinness of the chitin not allowing wrinkling, etc., to obscure the more essential markings; the pattern of wrinkling or surface sculpturing is quite the same as in *A. populi;* the anal spike is not quite as smooth as in the pupa of *A. populi*, but very nearly so. The thinness of the chitin is again evidenced by the shrivelling of one or two dead specimens, as never occurs in either *A. populi* or *S. ocellata*. In one ♀ pupa, abdominal segments 8, 9 and 10 are almost as distinct and separate as in the ♂ pupa, but the anterior pore is at posterior margin of 8, and has, on right side, a rounded boss as in ♂, which is wanting on left side; a median suture proceeds from this to front margin of segments. Another ♀ pupa is nearly like the pupa of a normal *A. populi* as to markings, but the three segments are continued across nearly as in ♂, the invasion of 8 by angle of abdominal segment 9 not occurring; in another the pore is almost in abdominal segment 9. The pupæ of the ♂s might be those of normal *A. populi* (Chapman. Pupæ received from Mr. A. Bacot). The pupæ vary to a slight extent both in colour and shape. They are, as a rule, nearer in shape to the pupa of *S. ocellata*, being longer and not so dumpy as that of *A. populi*, with a tendency to narrow towards the head. On the ventral area the scars of the prolegs and the anal claspers do not show up so plainly as is usually the case with *A. populi;* the final segments are, however, not nearly so rounded off as they are in *S. ocellata;* the dorsal aspect of the anal segments and cremaster are much more distinctly like those of the pupæ of *A. populi*. The surface is much smoother than that of *A. populi*, but without the polished finish of *S. ocellata*. As regards colour, four were dead black, two of these having a slightly greyish tinge on the wing-cases, the remaining two being of a deep reddish-brown with a slightly smoother surface. The sexual organs are quite as plainly marked in pupæ of the hybrid as in those of the parent species; the reddish pupæ were female, and the four black ones male (Bacot). The hybrid pupæ had in part the deep black colour of *populi*, in part a lighter tone of colour, reminding one of *ocellata*. The pupæ were never found so smooth as those of *ocellata*, yet also not so rough as those of *populi*. The wing-cases remind one much of *ocellata* in their narrow and waved form (Frings).

Habits.—The resting-position of the ♂ that emerged September 2nd was similar to that usually adopted by *A. populi*, with the forewings hanging back and the hindwings protruding far beyond the costa of the anterior pair (Bacot).

Time of appearance.—Hybridisation appears to hurry on the emergence of the imagines, for, instead of the pupæ going normally over the winter, as do the pupæ of the parent species, a very large percentage emerges in the autumn. House, who first reared this hybrid, notes (*Trans. Ent. Soc. Lond.*, 1842, pp. 193—194) that eggs hatched in mid-June, 1837, 19 of the larvæ therefrom pupated during July, 12 of the imagines from these came out in August, the remaining pupæ going over the winter 1837—8. Hague observes (*Ent. Wk. Int.*, ii., p. 188) that eggs laid in June produced larvæ that pupated in July, 1857, ten imagines emerging between September 1st, 1857, and the Thursday preceding that date. Adamson, on the other hand, records (*loc. cit.*, iv., p. 117) hybrids from eggs laid June, 1857, not appearing as imagines until June, 1858; the pupæ were kept out of doors, but this he considers would matter little enough in July and first week of August, when the hybrids usually mature. Galliers notes (*loc. cit.*, viii., p. 75 and x., p. 100) eggs laid May 29th, 1860, one imago from the brood emerging June 23rd, 1861, all the rest of the batch having emerged in the autumn of 1860. Talbot observes (*Ent.*, v., p. 450) that he bred imagines in 1868, some of which were only 22 days in the pupal state. It is quite clear from the record that those bred by Stephenson (*E. M. M.*, xi., p. 116) emerged in August, 1874, from eggs laid that year, whilst Kirk's batch (*Ent. Rec.*, i., pp. 202—203) pupated at Dundee from July 20th—27th, 1890, and emerged between August 10th—17th of that year; similarly, those reared by Bacot in 1896, pupated July 21st and following days, three emergences taking place between September 2nd—15th, 1896, at Clapton.

Tribe: Amorphidi.

This is probably the most specialised tribe in the family. There appear to be but two Palæarctic genera in the tribe, *viz.*, *Triptogon* and *Amorpha*. As seen in *Amorpha populi*, the egg approaches spherical in outline, the surface reticulation very fine, the cells slightly depressed with a minute central elevation. The young larva of the outline of the adult, but rather longer and more slender proportionally; the larval head without the apical extension seen in *Smerinthus (ocellata)*, more triangular in outline in first stadium; the bifurcating hairs somewhat fish-tail-shaped at apex. The puparium without silk, the pupa often exposed, the surface rough, the bosses on either side of anus distinct; anal spike very short, slender and sharp. The imaginal frenulum, almost obsolete and functionless. The heavy mode of flight, the non-feeding habit of the imagines, and many other details of habit suggest a greater modification from the original Sphingid phylum than do these characters in the Sichiid and Smerinthid groups.

Genus: Amorpha, Hübner.

Synonymy.—Genus: *Amorpha*, Hb., "Tent.," p. 1 (1806); Kirby, "Cat.," p. 710 (1892); "Handbook," &c., iv., p. 58 (1897); Prout, "Ent.," xxxii., p. 60 (1899). *Sphinx*, Linn., "Sys. Nat.," 10th ed., p. 489 (1758); 12th ed., p. 797

(1767); "Faun. Suec.," 2nd ed., p. 286 (1761); Scop., "Ent. Carn.," p. 183 (1763); Müll., "Fn. Frid.," p. 37 (1764); Hfn., "Berl. Mag.," ii., p. 178 (1766); Fab., "Sys. Ent.," p. 537 (1775); "Spec. Ins.," ii., p. 141 (1781); "Mant. Ins.," ii., p. 93 (1787); "Ent. Sys.," iii., 1, p. 357 (1793); Schiff., "Schmett. Wien.," 1st ed., p. 41 (1775); 2nd ed., p. 7 (1801); Esper, "Schmett. Eur.," ii., p. 34, pl. ii (1779); Berg., "Sphing. Eur. Larvæ," p. 5 (1782); Bkh., "Sys. Besch.," ii., p. 106 (1789); Brahm, "Insek.-Kal.," ii., 1, p. 312 (1791); Hb., "Eur. Schmett.," fig. 74 (*circ.* 1800), text p. 99 (*circ.* 1805); "Larvæ," &c., ii., Legit. D. *a*, *b* (*circ.* 1800); Schrk., "Fauna Boica," ii., 1, p. 222 (1801); Haw., "Lep. Brit.," 1, p. 64 (1803); Ochs., "Die Schmett.," ii., p. 252 (1808). *Smerinthus*, Latr., "Hist. Nat.," xiv., p. 135 (1805); "Gen. Crust.," iv., p. 210 (1809); Ochs., "Die Schmett.," iv., p. 45 (1816); Sam., "Ent. Comp.," p. 243 (1819); Hb., "Franck Cat.," p. 88 (1825); Godt., "Hist. Nat.," iii., p. 71, pl. xx., fig. 3 (1821); Stephs., "Illus.," i., p. 112 (1828); "Cat. Br. Ins.," ii., p. 30 (1829); "List Br. An. Br. Mus.," v., p. 26 (1850); Bdv., "Eur. Lep. Ind. Meth.," p. 34 (1829); "Icon. Chen.," pl. vi., figs. 1—3, pl. vii., fig. 1 (*circ.* 1840); "Gen. et Ind. Meth.," p. 49 (1840); "Sp. Gén. Lép. Het.," i., p. 23 (1875); Dup., "Hist. Nat.," supp. ii., pp. 161 - 162 (1835); "Icon. Chen.," pl. 72 (*circ.* 1840); "Cat. Méth.," p. 45 (1844); Wood, "Ind. Ent.," p. 12, fig. 9 (1839); Humph. & Westd., "Brit. Moths," p. 7 (1841); Evers., "Faun. Volg.-Ural.," p. 115 (1844); H.-Sch., "Sys. Bearb.," ii., p. 91 (1846); Chaumette, "Zool.," ix., p. 3244 (1851); Heydenr., "Lep. Eur. Cat. Meth.," p. 19 (1851); Sta., "Man.," i., p. 87 (1857); Speyer, "Geog. Verb.," i., p. 325 (1858); ii., p. 280 (1862); Hein., "Schmett. Deutsch.," p. 149 (1859); Humph., "Gen. Brit. Moths," p. 7 (1860); Staud., "Cat.," 1st ed., p. 16 (1861); 2nd ed., p. 37 (1871); 3rd ed., p. 99 (1901); Snell., "De Vlind.," p. 102 (1867); Berce, "Faun. Franç.," ii., p. 28 (1868); Nolck., "Lep. Fn. Estl.," i., p. 90 (1868); Newm., "Brit. Moths," p. 4 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 403 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 41 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 120 (1875); Curò, "Bull. Soc. Ent. Ital.," vii., p. 113 (1875); Kirby, "Eur. Butts. and Moths," p. 73 (1879); Frey, "Lep. Schweiz," p. 58 (1880); Poult., "Trans. Ent. Soc. Lond.," p. 297 (1885); *loc. cit.*, pp. 281 *et seq.* (1887); Buckl., "Larvæ," &c., ii., pp. 20, 103, pl. xx., fig. 2 (1887); Auriv., "Nord. Fjär.," p. 44 (1889); Gould, "Trans. Ent. Soc. Lond.," pp. 241 *et seq.*, pl. xi., figs. 11—13 (1892); Meyr., "Handbk.," p. 299 (1895); Barr., "Lep. Brit.," ii., p. 7 (1895); Lucas, "Brit. Hawk-Moths," p. 127 (1895); Bacot, "Ent. Rec.," vi., p. 175 (1895); Griffiths, *loc. cit.*, p. 256 (1895); Tutt, "Brit. Moths," p. 23 (1896); Bartel, "Palæark. Gross-Schmett.," p. 183 (1900). *Laothoë*, Fab., "Ill. Mag.," vi., pp. 287, 288 (1807). *Laothöe*, Leach, "Edinb. Ency.," ix., p. 130 (1815); Oken, "Lehrb. Zool.," i., p. 753 (1815). *Dilina*, Dalm., "K. Vet. Ac. Handl.," p. 212 (1816); Zett., "Ins. Lapp.," p. 916 (1840). *Polyptychus*, Hb., "Verz.," p. 141 (*circ.* 1822); Stphs., "Illus.," iv., app. p. 5 (1835). *Merinthus*, Meig., "Eur. Schmett.," ii., p. 150 (1830). *Polyptichus*, Stphs., "List Br. An. Br. Mus.," v., p. 26 (1850).

Amorpha was the generic name given by Hübner, in 1806, in his *Tentamen*, p. 1, to *populi*, which he had already figured as *Sphinx populi* in his *Europ. Schmett.*, fig. 74. *Amorpha* is probably in many respects the most specialised genus belonging to the family *Amorphidae*. There appear to be only two species in the genus, *populi*, with a range throughout Europe and Central Asia to the Altai mts., and *tremulae* confined to central and northern Russia, Finland and Siberia as far as the Ussuri district. The Persian *populeti* and the North African *austauti* are sometimes treated as distinct species.

Amorpha populi, Linné.

Synonymy.—Species: *Populi*, Linn., "Sys. Nat.," 10th ed., p. 489 (1758); 12th ed., p. 797 (1767); "Faun. Suec.," 2nd ed., p. 286 (1761); Scop., "Ent. Carn.," p. 183 (1763); Müll., "Fn. Frid.," p. 37 (1764); Hfn., "Berl. Mag.," ii., p. 178 (1766); Fab., "Sys. Ent.," p. 537 (1775); "Spec. Ins.," ii., p. 141 (1781); "Mant. Ins.," ii., p. 93 (1787); "Ent. Sys.," iii., 1, p. 357 (1793); "Ill. Mag.," vi., pp. 287—288 (1807); Schiff., "Schmett. Wien.," 1st ed., p. 41 (1775); 2nd ed., p. 7 (1801); Esp., "Schmett. Eur.," ii., p. 34, pl. ii (1779); Berg., "Sphing.

Eur. Larv.," p. 5 (1782); Stoll, "Pap. Ex.," iv., pl. 398 A (1782); Bkh., "Sys. Besch.," ii., p. 106 (1789): Brahm, "Insek.-Kal.," ii., 1, p. 312 (1791); Hb., "Eur. Schmett.," fig. 74 (*circ.* 1800); text p. 99 (*circ.* 1805); "Larvæ Lep.," ii., Legit. D. *a*, *b* (*circ.* 1800); "Tent.," p. 1 (1806); "Verz.," p. 141 (*circ.* 1822); "Franck Cat.," p. 88 (1825); Schrk., "Faun. Boica," ii., 1, p. 222 (1801); Haw., "Lep. Brit.," 1, p. 64 (1803); Latr., "Hist. Nat.," xiv., p. 135 (1805); "Gen. Crust.," iv., p. 210 (1809); Ochs., "Die Schmett.," ii., p. 252 (1808); iv., p. 45 (1816); Leach, "Edinb. Ency.," ix., p. 130 (1815); Oken, "Lehrb. Zool.," i., p. 753 (1815); Dalm., "K. Vet. Ac. Handl.," p. 212 (1816); Sam., "Ent. Comp.," p. 243 (1819); Godt., "Hist. Nat.," iii., p. 71, pl. xx., fig. 3 (1821); Stephs., "Illus.," i., p. 112 (1828); iv., app. p. 5 (1835); "Cat. Br. Ins.," ii., p. 30 (1829); "List Br. An. Br. Mus.," v., p. 26 (1850); Meig., "Eur. Schmett.," ii., p. 150 (1830); Bdv., "Eur. Lep. Ind. Meth.," p. 34 (1829); "Icon. Chen.," pl. vi., figs. 1—3, vii., fig. 1 (*circ.* 1840); "Gen. et Ind. Meth.," p. 49 (1840); "Sp. Gén. Lép. Het.," i., p. 23 (1875); Dup., "Hist. Nat.," supp. ii., pp. 161, 162 (1835); "Icon. Chen.," pl. 72 (*circ.* 1840); "Cat. Méth.," p. 45 (1844); Wood, "Ind. Ent.," p. 12, fig. 9 (1839); Zett., "Ins. Lapp.," p. 916 (1840); Humph. & Westd., "Brit. Moths," p. 7 (1841); Evers., "Faun. Volg.-Ural.," p. 115 (1844); H.-Sch., "Sys. Bearb.," ii., p. 91 (1846); Chaumette, "Zool.," ix., p. 3244 (1851): Heydenr., "Lep. Eur. Cat. Meth.," p. 19 (1851); Sta., "Man.," i., p. 87 (1857); Speyer, "Geog. Verb.," i., p. 325 (1858); ii., p. 280 (1862); Hein., "Schmett. Deutsch.," p. 149 (1859); Humph., "Gen. Brit. Moths," p. 7 (1860); Staud., "Cat.," 1st ed., p. 16 (1861); 2nd ed., p. 37 (1871); 3rd ed., p. 99 (1901); Snell., "De Vlind.," p. 102 (1867); Berce, "Faun. Franç.," ii., p. 28 (1868); Nolck., "Lep. Fn. Estl.," i., p. 90 (1868); Newm., "Brit. Moths," p. 4 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 403 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 41 (1874); Praun, "Erg.," pl. i., fig. 11*a* (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 120 (1875); Curò, "Bull. Soc. Ent. It.," vii., p. 113 (1875); Kirby, "Eur. Butts. and Moths," p. 73 (1879); "Cat.," p. 710 (1892); Handbk.," iv., p. 58 (1897); Frey, "Lep. Schweiz," p. 58 (1880); Poult., "Trans. Ent. Soc. Lond.," p. 297 (1885); *loc. cit.*, pp. 281 *et seq.* (1887); Buckl., "Larvæ," &c., ii., pp. 20, 103, pl. xx., fig. 2 (1887); Auriv., "Nord. Fjär.," p. 44 (1889); Gould, "Trans. Ent. Soc. Lond.," pp. 241 *et seq.*, pl. xi., figs. 11—13 (1892); Meyr., "Handbk.," p. 299 (1895); Barr., "Lep. Brit.," ii, p. 7 (1895); Lucas, "British Hawk-Moths," p. 127 (1895); Bacot, "Ent. Rec.," vi., p. 175 (1895); Griffiths, *loc. cit.*, p. 256 (1895); Tutt, "Brit. Moths," p. 23 (1896); Prout, "Ent.," xxxii., p. 60 (1899); Bartel, "Palæark. Gross-Schmett.," ii., p. 183 (1900).

Original description.—*Sphinx populi*, alis angulatis reversis; posticis basi ferrugineis; anticis puncto albo. *Fn. Suec.*, 810. Phalæna prismicornis spirilinguis, alis planiusculis erosis griseis, antennis albis. Roes., *Ins.*, 3, supp. t. 30. De Geer, *Ins.*, 1, t. 8, f. 5. Alb., *Ins.*, t. 57. Habitat in *Populo*, *Salice rubra* (Linné, *Sys. Nat.*, xth ed., p. 489). [Later Linné changes "angulatis" to "dentatis" (xiith ed., p. 797).]

Imago.—65mm.—102mm. Anterior wings with dentate outer margin; ashy-grey or greyish-brown in colour, with a basal transverse line, median band, elbowed line and antemarginal line brown, a dark brown patch also on outer margin from apex nearly to anal angle; nervures pale ochreous; discoidal lunule well-marked and white. Posterior wings with dentate margin; of the same tint as forewings; three wavy transverse lines and outer margin brown; a large brick-red basal blotch.

Sexual dimorphism.—The ♀ is usually larger, paler, and much less distinctly marked than the ♂. The ♂s average from 70mm.—83mm. in expanse; the ♀s from 72mm.—90mm. The ♂ antenna consists of about 40 visible joints, dorsal scaling nearly white, faintly straw-tinted, hairs and ventral surface yellowish-brown, where the arch of hairs touches the scaling the latter is raised a little as being on a slight projection; keel strong, long hairs arising from its sides diverge at an angle of 180°; terminal joint nearly equal to $1\frac{1}{2} \times$ the preceding one; scales irregularly placed. In the ♀ antenna the scaling as in ♂, except that it is undisturbed by the (since non-existing) arch of hairs, the whole antenna is rather more slender, and the terminal joint is rather longer, than in ♂ and carries a brush of a few hairs. On the ventral surface, each segment carries on each side a basal and a nearly median bristle. On the centre of the distal margin of the ventral surface is a very short bristle, a short, thick baton, that is more pronounced towards the antennal apex. These batons are more obvious in the ♀ antenna, but they exist also in the ♂, where they are accompanied by a few short hairs (Chapman).

GYNANDROMORPHISM.—The large number of gynandromorphous examples of this species makes it impossible to hope to deal with all those recorded. The following are those with which we have met:

α. The right antenna is ciliated and perceptibly larger than the other, on which one can discover no sign of hairs. Along the middle of the head, thorax and abdomen runs a straight line, by which the different parts of the sexes seem to be divided, but on the underside of the body this stripe is not visible. The wings on the right side are also more highly coloured, and agree with the colour which is usual in the ♂, while the left wings have the coloration distinctive of the ♀. On the underside one observes the same difference. As regards the sexual parts, I have only been able to discover those of the ♂, which, however, are placed more to the right side than in the middle. The left side of my specimen was very much shrunken, which hindered further investigation (Cramer, *Pap. Exot.*, iv., p. 230, pl. cccxcviii., fig. A).

β. Right side ♂, left side ♀. Right side entirely ♂, with a strongly pectinated antenna, left side ♀. The wings of the right side shorter than those of the left side; the border of the outer margin is more whitish-coloured in the indentations between the nervures. The markings of the wings somewhat different. The abdomen on the right with longer, male down. The dividing line between the ♂ and ♀ sides is median up to the last segments, where it is bent over strongly towards the left side. On the underside the ♂ scaling does not reach so far beyond the middle line as above. In the Berlin Museum. Bred by Herr Ude, one of the assistants; dissected, and described at length by Tetens (Tetens, *Berl. Ent. Zeits.*, xxxvi., pp. 457—464, pl. xiii., fig. 2).

γ. Right side ♂, left ♀. Perfect gynandromorph. Coloration on the right reddish-grey, with rather dark browner band, on the left light grey. Only along the costa of the left forewing, exactly over the subcostal nervure, runs a stripe of dark reddish-grey. The band on this half only expressed by the rather sharp outline. Dividing line very sharp. Antenna on the right ♂, on the left ♀. Body rather large. Left forewing 35mm., right 32mm. Bred by Jirak in Prague. In Nickerl coll. (Nickerl, *Verh. zool.-bot. Ges. Wien*, 1872, pp. 728—729).

δ. Right side ♂, left ♀. Length of the somewhat shrunken body 12‴, expanse of the wings 2″ $9\frac{3}{4}$‴. Dividing line distinct above and below; right side of the body ash-grey; left side reddish-grey; right antenna strongly pectinated and longer; right forewing $14\frac{1}{2}$‴, left $16\frac{1}{2}$‴. The dark bands and the waved lines on the ♂ side strongly expressed, on the ♀ side very much less strongly pronounced. Berl. Mus. (Klug, *Jahrb.*, i., p. 257; Tetens, *Berl. Ent. Zeits.*, xxxvi., pp. 464—466, pl. xiii., fig. 1).

ε. A second example in the Berlin Museum, mentioned but not described by Tetens (*Berl. Ent. Zeit.*, xxxvi., pp. 464—466).

ζ. Right side ♂, left ♀. Size of thorax and abdomen as in ♀. Right antenna and wings in shape and colour ♂, left antenna ♀. Basal third of left forewing with ♀ coloration, contour and the rest of the wing ♂; right anterior tibia hairy as in the ♂; underside of the wings ♂ (Thrupp, *Trans. Ent. Soc. Lond.*, 1845, p. 68).

η. Left side ♂, right ♀. Left antenna, wings and body decidedly ♂, the right ♀. The dividing line distinct. Captured near Witham, in Essex (Wing, *Trans. Ent. Soc. Lond.*, 1849, v., p. 119, pl. xiv).

θ. Left side ♂, right ♀. Size as in the ♂. Left antenna and wings of

♂ shape and coloration (Bellier de la Chavignerie, *Bull. Soc. Ent. Fr.*, vi., 1858, p. 18).

ι. Left side ♂, right ♀. Brightly coloured example. Median line indistinct. All the wings of the same size. Left antenna ♂, right ♀. Body large, ♀, with ♂ down. Gleissner coll. (Schultz, *Ill. Woch. für Ent.*, i., p. 368).

κ. Right side ♂, left ♀ (Fischer-v.-Waldheim, *Oryctogr. de Moscou*, pl. xii; Lefebvre, *Ann. Soc. Ent. Fr.*, iv., p. 148).

λ. Right side ♂, left ♀. 1887. Cologne. Westkamp coll. (*Ent. Zeits. Guben*, i., p. 50).

μ. Left side ♂, right ♀. On May 24th, 1893, rom a pupa which had been kept all the winter, an imago emerged which, on its left side had a ♂ antenna and a small ♂ forewing, whilst on the right side it had a ♀ antenna and a large ♀ forewing. The hindwings were crippled (Brown, *Ent. Mo. Mag.*, xxix., p. 165).

ν—ξ. Amongst a number of *S. populi* I am now (April 16th, 1880) rearing from pupæ, I find two hermaphrodite specimens, each having a ♂ and a ♀ antenna. One of these is depositing eggs (Shuttleworth, *Ent.*, xiii., p. 116; *E. M. M.*, xviii., p. 167; *Proc. Ent. Soc. Lond.*, 1880, p. xxx).

ο. Left antenna ♂, right antenna ♀. Left forewing and right hindwing light in colour, the two other wings marked with darker (Seydel, *Ent. Zeitsch. Breslau*, 1886, p. xxvii).

π. Left side ♂, right side ♀. Division sharp on head, left antenna ♂, right ♀, eye and palpus on left side larger, with longer hairs. On the right the epaulette is darker, both wings on this (the ♀) side much more intense in colour, sharper marked, less emarginate, and larger. In the outer area of cells i—iii of the right (♀) forewing, irregular dark-brown male stripes run through the violet-grey ground-colour. The left (♂) front leg is far shorter and more strongly clothed with hair than the right. The abdomen is very interesting in form; dorsally and laterally it is purely ♂ in clothing and colour; ventrally, however, it has many irregular patches of ♀ coloration and with short hairs; it is also strikingly long and thick, of the size of that of a large ♀, right side much more strongly ventricose than left, with purely normal ♂ external genitalia, which were examined in the fresh moth. The specimen is very large, of a fine violet-grey colour on both pairs of wings, in spite of the unlikeness in other respects of the left and right sides. The pupa-case distinctly shows the difference of the antennal sheaths. The pupa came from the neighbourhood of Leipzig. Imago bred April 30th, 1900 (Frings, *Soc. Ent.*, xv., pp. 52—53).

ρ—σ. We have twice, in the neighbourhood of Paris, met with a poplar *Sphinx* which had, at least externally, the characters of a gynandromorph (Godart, *Encycl. Méth.*, ix., p. 66). [No further details are given. Godart had been describing a gynandromorphous *Papilio ulysses*, and just mentions these incidentally to show that the occurrence was not unique.]

τ. Halved. Right pair of wings and antennæ ♂, left ♀. Body and genitalia ♀. Bred, 1896. Hartmann coll. (Schultz, *Ill. Woch. für Ent.*, ii., p. 393).

υ. Halved. Right pair of wings and antenna ♂, left ♀. Body in shape ♀. Genitalia indistinct. Hartmann coll. (Schultz, *Ill. Woch. für Ent.*, ii., p. 394).

φ. Right pair of wings and antenna ♀, left ♂. Body in shape ♀. Genitalia indistinct. Hartmann coll. (Schultz, *loc. cit.*).

χ. Right side ♂, left side ♀. Perfectly divided gynandromorph. Bred by Eiffinger in 1893 at Frankfort-on-Main. In Roeder coll. (Schultz, *Ill. Woch. für Ent.*, i., p. 368).

ψ. Right side ♂, left side ♀. Left antenna ♀, right antenna ♂. Both pairs of wings of grey coloration. Bred by Schumann, Berlin, from a dug pupa (Schultz, *Ill. Woch. für Ent.*, ii., p. 393).

ω. Right side ♂, left side ♀. Left antenna ♀, right antenna ♂. Right ♂ pair of wings grey, left ♀ pair rusty-brown coloured. Captured by Hanschmann, 1895, near Schmargendorf (near Berlin). Thiele coll. (Schultz, *Ill. Woch. für Ent.*, ii., p. 393).

α′. Right side ♂, left side ♀. Halved. Right antenna, legs and wings and right side of head and thorax entirely of ♂ form, left side of ♀ form. Right pair of wings ash-grey, left pair more fawn-colour. (Gerstäcker, *Sitzungsber. d. Ges. naturf. Freunde*, Berlin, 1867, p. 25; Bronn, *Klassen und Ordnungen*, v., 1, pp. 213—215).

β′. Left side ♂, right side ♀. Coll. Dönitz. Obtained from Schaufuss ot Meissen (Dönitz, *Berl. Ent. Zeits.*, xxxvi., Sitz. p. xxii).

γ′. Left side ♂, right side ♀. In coloration, both pairs of wings alike, though the median band of the left forewing is darker. Left antenna ♂, right ♀. Abdomen stout and long, with a dividing-line up to the terminal point, more slender on the ♂ side and bent towards the left. Right wing 40mm., left 37mm. in expanse. Bred at Berlin. Wiskott coll. (Wiskott, *Festschrift. Ver. Schles. Ins.*, 1897, p. 110).

δ′. Halved. Left side ♂, right side ♀. Right ♀ side somewhat redder in colour than the left. Left antenna ♂, right ♀. Abdomen according to shape and size ♀. The grey and reddish coloration of the abdomen is separated by a very sharp dividing-line. Wing on the right side 38mm., on the left 35mm. in expanse. Bred at Berlin. Wiskott coll. (Wiskott, *loc. cit.*).

ε′. Halved. Left side ♂, right side ♀. Asymmetrically coloured and marked on the left forewing. From nervure 2 to the outer margin, and the costa of a dull brownish-grey with very obliterated median band, on the contrary from nervure 2 to the inner margin, deep black-brown. The other three wings dark grey-brown, with rosy incarnadine and sharply pronounced markings. Left antenna ♂, right ♀. Body according to the shape ♂, without really recognisable sexual differences. Bred at Breslau. Wiskott coll. (Wiskott, *loc. cit.*).

ζ′. Halved. Left side ♂, right side ♀. Neither in size nor coloration of the wings any essential differences. On the contrary, the left antenna decidedly ♂, right ♀. Abdomen from the shape ♂. Dividing line faintly discernible. Bred at Hamburg. Wiskott coll. (Wiskott, *loc. cit.*).

η′. Halved. Left side ♀, right side ♂. Coloration and markings of the right pair of wings and patagia darker and sharper than on the left. Right antenna ♂, left ♀. Abdomen on the left stouter and fuller than on the right. Difference of expanse right side 36mm., left side 39mm. Bred at Hanover. Wiskott coll. (Wiskott, *loc. cit.*).

θ′. Imperfect. In coloration, markings, and shape of wings, the left side is distinctly ♀, the right ♂. The left antenna, however, does not correspond to this division, in so far that it is almost as stout as the right, typically formed ♂ antenna, and beset with weak, certainly shorter, but distinctly recognisable, teeth. Body ♀, with a line dividing it into a reddish left and a grey right half. Genitalia ♀. Left pair of wings larger (38mm.) than right (36mm.). Bred in Hamburg. Wiskott coll. (Wiskott, *loc. cit.*).

ι′. Halved. Right side ♂, left side ♀. Right wings and antenna ♂, left ♀. Form of the body that of the ♀ but with ♂ anal clasp. Daub coll. (Gauckler, *in litt.*) (Schultz, *Illus. Woch. für Ent.*, ii., p. 394).

κ′. Halved. Right side ♀, left side ♂. Wings and antenna on right side ♀, on the left ♂. Body purely ♀. Daub coll. (*loc. cit.*).

λ′. Halved Right side ♀, left side ♂. Wings and antenna on the right side ♀, on the left ♂. A divisional line runs down the centre of the body. ♂ and ♀ genital organs present. Daub coll. (*loc. cit.*).

μ′. Right side ♀, left side ♂. Right wings ♀, left ♂. Both antennæ with somewhat shorter pectinations than in the normal ♂. Body preponderantly ♀, with imperfect genital organs. Daub coll. (*loc. cit.*).

ν′. Halved. Right side ♀, left side ♂. Right wings and antenna ♀, left ♂. A divisional line runs down the centre of the body. The ♂ anal clasp is plainly visible, also the ♀ genital organs of the other half, although somewhat imperfect. Daub coll. (*loc. cit.*).

ξ′. Halved. Right side ♀, left side ♂. Right wings and antenna ♀, left ♂. Abdomen according to form ♂. Anal clasp not well expressed. Daub coll. (*loc. cit.*).

ο′. Halved. Right side ♂, left side ♀. Right wing and antenna ♂, left ♀. Form of the body more that of the ♀, although with crippled ♂ genital organs. Daub coll. (*loc. cit.*).

π′. Halved. Left side ♂, right side ♀. Both pairs of wings brown, the left ♂ pair darker and more sharply marked, also rather larger than the right ♀ pair. A divisional line runs nearly exactly down the centre of the body. The portion to the left of the line is darker than that lying to the right. Form of the body ♀, with indistinct genital organs. Koser collection (Schultz, *Illus. Woch. für Ent.*, ii., p. 395).

ρ′—ω′. Eight gynandromorphs of this species are in Staudinger's coll. (Schultz, *loc. cit.*).

α.″ Halved. Right side ♂, left side ♀. Right side of head and thorax ♂, dark slaty-grey, with thick erect hair; left side ♀, light reddish-grey, hair appressed. Right side of head and also right eye distinctly larger than the left. Right antenna ♂, left ♀. On the underside of the right first femur, and on the upperside of the second and third femora, there is a thick broad brush of hair; all the legs on the left side without such brush. ♂ palpus broader and longer than in the ♀. The ♂ pair of wings much darker, grey, with sharper central band and outer-marginal marking, also of a darker brownish-red at the anal angle of the hindwings. ♀ pair of wings reddish-brown, longer than the right pair. Right half of thorax more swollen, more massive. Divisional line recognisable neither on thorax nor abdomen; the latter in form, down and coloration normally ♀. Genitalia feebly developed although entirely of ♀ structure. Captured July 3rd, 1892 (Schultz, *Illus. Zeits. für Ent.*, iii., p. 135).

β″. Halved. Left side ♂, right ♀. Left pair of wings ♂, with richly-contrasting darker markings; left forewing $2\frac{1}{4}$cm. long. Right pair of wings ♀, with paler, slighter markings; right forewing 3cm. long. Left antenna ♂, right ♀. Thorax on the left more strongly hairy than on the right. The genitalia were, in the living insect, clearly developed in exact halves, and became indistinct owing to the subsequent desiccation. The darker coloration of the left side shows itself on the upperside of the body as well as on the down of the limbs. Bred by Koch (*in litt.*) (*Ent. Zeitschrift Guben*, xi., p. 56).

γ″. Right side ♂, left ♀. Perfectly divided. Divisional line very clearly perceptible on the upper- and undersides. ♂ pair of wings slaty-grey, the distinctly larger ♀ pair reddish-brown in colour. Form of the wings of each half different. Right side: eye and palpus larger, thorax more voluminous, legs with brushes of hair, and antenna purely ♂. Left side: legs longer, without brushes; antenna shorter, quite ♀. The last abdominal segment, except a spot situated on the left side, of ♂ coloration. Genitalia entirely ♂, on the left somewhat smaller and crippled. Captured in 1887 in Silesia. Frings coll. (*in litt.*) (Schultz, *Illus. Zeits. für Ent.*, iii., p. 135).

δ″. Halved. Left side ♂, right side ♀. Wing-markings of the left ♂ side sharper, the coloration also brighter, more violet. Right pair of wings less conspicuous, more brownish. Margin of the right forewing more sharply indented and considerably more oblique. Basal spot on the right ♀ hindwing smaller, and almost imperceptibly paler. Left antenna ♂ in form, right antenna ♀. Left palpus large, clothed with long dark hairs, the right smaller, with shorter paler hairs. On the abdomen a narrow longitudinal ridge, which divides the sexes according to the coloration (left brownish, right more grey-brown). Towards the end of the abdomen this ridge verges round to the right. On the abdomen the anal tuft of the ♂, even if somewhat curtailed, is distinctly perceptible; on the right side it disappears entirely. Bred by Herr Lehrer Denke in Crefeld in the spring of 1895 (Rothke, *Jahresbericht des Vereins für naturw. Sammelwesen zu Crefeld*, 1895 to 1896, p. 14).

ε″. Halved. Left side ♀, right ♂. Right pair of wings very sharply marked, with dark prominent central band and waved line, bluish-grey (as also is the right patagia). All the rest coloured reddish-brown, and more weakly marked. Underside in agreement with the upperside. Left antenna ♀, right ♂. Abdomen stout and long, towards the anal end of ♂ form. Coloration of the body up to the last segment red-brown; terminal segment, together with the down of the anus and the longer right side of the anal tuft, on the contrary, coloured bluish-grey. Great difference in wing expanse; left side 38mm., right 35mm. Bred in Saxony. Wiskott coll. (Wiskott, *Iris*, 1897, p. 381).

ζ″. Halved. Left side ♂, right ♀. The left ♂ side bluish-grey, with sharply-marked band, the right ♀ side red-brown. Similar distinction in colour from the head to the end of the body marked out by a woolly ridge along the centre of the body. On the underside the left hindwing also from the base to the costa within veins 2—6 of ♀ red-brown coloration. Abdomen in structure ♀, though on the left more slender, less rounded, with the extremity bent round to the left. On the underside the division between the two colours on the abdomen much more striking than on the upperside, the whitish-grey and dark reddish-brown sharply bounded. This boundary-line keeps the centre till shortly before the anal point; there the brown ♀ coloration verges over towards the right, while the point is covered with ♂ whitish-grey hair. Left legs grey, right brown. Left antenna ♂, right ♀. Expanse of wing: left 37mm., right 39mm. Bred in 1897 at Berlin. Wiskott coll. (*loc. cit.*).

η″. Strictly halved. Left side ♀, right ♂. Right pair of wings smaller than the left. Right forewing with strongly expressed markings, of reddish-brown coloration, the latter especially prominent on the disc of the wing and on the outer margin. Left forewing with washed-out markings of a grey-brown colour; the disc of the wing, owing to want of colour and demarcation, scarcely at all in contrast with the ground colour; the whole wing more expanded than the right. The red-brown basal spot on the left ♀ side is only about $\frac{3}{4}$ the size of that on the right. On the underside the left pair of wings distinctly differs in coloration from the right; the ♂ wing is here distinctly marked, the ♀ almost without markings. Right antenna ♂, left ♀. Palpus of the ♂ side dark brown, longer-haired; palpus of the ♀ side paler-coloured, less long-haired. Abdomen with distinct longitudinal ridge, which divides the body into two halves, of which the right is considerably more voluminous and more darkly coloured than the left. The anal tuft of the ♂ as well as the genital aperture of the ♀ is distinctly discernible. This gynandromorph was bred in 1896 by Krieghoff at Langewiesen in Thüringia (Schultz, *Soc. Ent.*, xiii., p. 1; *Ill. Zeits. für Ent.*, iii., p. 136).

θ″. Left side ♂, right ♀. Left antenna ♂, right ♀. Palpi without distinct difference as regards coloration. The same may be said of the legs. Right pair of wings larger, ♀, left smaller, ♂. Left forewing dark brown, with sharp markings and strongly contrasting central area, less scalloped than the right, which passes more into the grey coloration and allows of less marked contrast in the central area; however, the character of the markings is more distinctly pronounced here than on the ♀ forewing of the example above described. Right hindwing with smaller red-brown basal spot; left hindwing normal ♂. Body without any sort of dividing ridge of hair above or below. ♀ genital aperture visible, and on the right side of it a ♂ tuft of hair. This example was bred from the same brood as the above, together with about 60 normal specimens, by Krieghoff (*loc. cit.*).

ι″. Halved. Left side ♂, right side ♀ (*Ent. Zeitschrift Guben*, ix., p. 115).

κ″. Left side ♀, right ♂. Left pair of wings and antenna ♀, right pair of wings and antenna ♂. Body in outward form ♂. Philipps coll., Cologne (*in litt.*) (Schultz, *Illus. Zeits. für Ent.*, iii., p. 137).

λ″. Halved. Left side ♂, right ♀. Antennæ in exact accordance with the two sexes. Body with ♂ anal tuft on the left side, on the right side materially stronger and fuller, running to a point at the anus (as in the ♀). The left ♂ forewing, measured from the base to the apex, 33mm. long, the right ♀ wing 36mm. The hindwings, in agreement with these dimensions, likewise of unequal length, that is to say, in exact proportion to the length of the corresponding forewing. The ground-colour of the left ♂ wings whitish-grey; the transverse bands, especially the central fascia, sharply laid on with brown, the latter with distinct whitish median spot. The ground-colour of the right ♀ wings more reddish-grey, the transverse band more washed out, and the median spot indistinct. On the underside of the left ♂ pair of wings the transverse bands distinctly visible, while on the right ♀ side they are scarcely to be recognised. This gynandromorph emerged from the pupa on August 27th, while all the remaining examples of this brood came out between May 10th and June 21st. A. Hoffmann coll. Cologne (*in litt.*) (*loc. cit.*).

μ″—ν″. Two further examples were bred in 1897. Descriptions of these are wanting (*cfr. Entom. Jahrbuch*, 1898, Report of the "Orion," p. 241).

ξ″. Right side ♂, left side ♀. Emerged from pupa in 1844 (Eyndhoven, *Alg. Konst en Letterbode*, 1847, pt. ii., p. 149).

ο″. Right side ♂, left side ♀. This example is smaller than the succeeding one, its abdomen is that of a ♀, the right ♂ antenna is thickened and characteristic, the left ♀ antenna fine. From Osnabrück. Oberthür coll. (Oberthür, *in litt.*).

π″. Right side ♂, left side ♀. The example has the abdomen placed slightly crosswise, is slightly deformed, on the right, enlarged and flattened. The four wings are similar; the insect is very large, well-developed as to its wings, with all the markings clearly shown. From Châlons-sur-Saone. In Boisduval coll. This is the specimen noticed by Boisduval (*Spécies Gén.*, i., p. 24) as being a magnificent gynandromorphous specimen which was given to him by M. Martin, of Châlons-sur-Saone (Oberthür, *in litt.*).

ρ″. A specimen bred from a Brighton larva, which has the left antenna ♂, the right ♀; the wings are hopelessly crippled; the body is ♀ and full of eggs (Fletcher, *in litt.*).

σ″. Right side, wings small, ♂, greenish-grey in colour; left side, wings considerably larger, ♀, reddish-grey in colour. Right antenna ♂, left ♀. Bred by Dahlstrom in Epiries from a dug pupa (Bartel, *Palaeark. Gross-Schmett.*, ii., p. 191).

τ″. Halved. Right side ♂, left side ♀. Wings on the right side smaller than on the left, paler coloured and weaker marked. The abdomen distinctly divided medially by a longitudinal ridge, with longer hairs on right side. Kricheldorff coll. (Bartel, *Palaeark. Gross-Schmett.*, ii., p. 191).

υ″. Halved. Left side ♂, right side ♀. Right wings larger than left; central lunule of the right forewing more indistinct than that of the left, which is darker coloured. The partition-line along the middle of the body is sharply marked. Bred in 1898 at Berlin from a dug pupa (Bartel, *Palaeark. Gross-Schmett.*, ii., p. 191).

ϕ''. A faultless gynandromorph, bred by Jahn, from a pupa found at large (Schütze, *Iris*, ix., p. 323).

χ''. Head and thorax divided longitudinally, so that the right side is ♂, the left ♀. The last-named side shows the rare light red-grey colour, and the hairs appressed, the ♂ side is dark, more black-grey in colour, and has dense raised hairs. Right antenna and right legs ♂, left ♀. Left (♀) wings of a reddish tint, right (♂) much darker, almost entirely dark grey. Abdomen of the size of that of a small ♀, but no trace shown of a partition-line. It has completely the form, the hairs and the light colour of a normal ♀. The last segment is very small, as are also the genitalia, which are somewhat aborted, yet completely of ♀ form (Frings, *Soc. Ent.*, vii., p. 179).

ψ''—α'''. Mr. Weaver reared three gynandromorphous *A. populi*, one of which is now in the possession of Mr. Stevens. Right side ♂, left side ♀ (Westwood, *Trans. Ent. Soc. Lond.*, 1842, p. 202; Lefebvre, *Ann. Soc. Ent. Fr.*, iv., p. 149 (1835)).

β'''. A gynandromorph found by Westwood in Bentley's collection [Lefebvre, *Ann. Soc. Ent. Fr.*, iv., p. 149 (1835)].

γ'''. Halved gynandromorph. Bred by Auer of Berlin from a pupa found in the neighbourhood (Bartel, *Palaeark. Gross-Schmett.*, ii., p. 189).

δ'''. Left ♂, right ♀. Bred at Weissensee, near Berlin (*loc. cit.*).

ε'''. A gynandromorph noted by Kalender (Russ's *Isis*, iv., no. 20, 1879; Bartel, *Palaeark. Gross-Schmett.*, ii., p. 186).

ζ'''. Of medium size; the right side smaller, ♂, the left larger, redder, ♀. The palpi, eyes and genitalia are abnormal, and bear characters of both sexes. Bred from larva at Moscow by Zetter. The difference in the antennæ was noticed in the pupa before emergence (Zetter, *in litt.*) (Treitschke, *Die Schmett.*, x., 1, p. 141). [Possibly that figured by Fischer von Waldheim, *anteà*, p. 463, gynand. κ].

η'''. A very fine hermaphrodite, presented to me by Sheridan; the wings, antenna and legs on right side ♂, those on the left ♀; the division as perfect as if a ♂ and ♀ had been divided lengthwise vertically, and the halves of the sexes united (Curtis, *Brit. Ent.*, expl. pl. 482 (1834)).

Variation.—Bacot observes that this species is more variable than *S. ocellata*, but the variation is chiefly confined to a greater or less intensity of the various tints, and not to an actual alteration in the markings. In Britain, the ground-colour extends from whitish-grey and pale reddish-grey to very dark grey, the latter sometimes suffused with rose, giving it a distinct purple gloss. Caradja notes the Roumanian form at Grumazesti as always grey, which is, however, strikingly dark and sharply marked, whilst at Comanesti, Leon obtains a brown form. Steinert in his fauna of the Dresden district tells of an unusually large example of *A. populi*. The specimen, a ♀, has a wing-expanse of 102mm.; it was bred by A. Kotzsch, of Loschwitz, near Dresden. The specimens which exceptionally emerge in late summer or autumn, without hibernation of pupa, are said to be distinguished by their less strongly emarginate wings and the almost rounded tips of the projections. A specimen of this species was found by Kollar, which had also on the forewings a rust-red basal spot similar to that of the hindwings (*cfr*, Treitschke, *Die Schmett.*, x., 1, p. 141). A large number of the specimens from Transcaucasia are distinguished by very light reddish-brown colour, and approach more nearly to the var. *populetorum* of *A. populeti* (Bartel). Newman observes that he bred, at Bexley, a ♀, on July 5th, 1897, after the pupa had been subjected to heat from March, which had a very pink tinge; pink and dark forms, however, normally occur in all batches reared from Bexley larvæ. West has more than once noted that the ♂s of the Lewisham and

Greenwich districts are frequently very rosy in tint. A large number of aberrations have been described in the British magazines, *e.g.*, a ♂ with three large pink blotches on the forewings, another of an extremely pale buff, and a third wholly chocolate in colour; one of a reddish-brown colour striped with amber, the spots in centre of forewing pale amber instead of white, the under part of body green, resembling a poplar leaf, the underside of wings tinged with a dull golden hue (Ranson, *Ent.*, iv., p. 148); bred imagines of a light unicolorous fawn-colour, only 2″ 2‴ in expanse, yet from these specimens, almost without markings, some of the finest and most distinctly marked specimens were reared (Gregson); a ♀ specimen having "the whole of the insect—wings, legs, thorax, and abdomen—of a colour between brick-red and chocolate suffused with a whitish bloom as on ripe fruit; there is the usual whitish spot on the forewings, and also the crimson flush on the hindwings, but no other markings whatever; the nervures of the wings are bold and distinct and the antennæ white"; pupa from Scarborough (Finch, *Ent.*, xxvi., p. 279). Of some Irish ones, Thornhill says (*Ent.*, xxvii., p. 294) "of 36 bred, none of the males are of the red form, and only one tending to a reddish-purple, of the females 5 are of a very light red form, some of the ordinary red form, and the others (11) the same colour as the males." Some handsome aberrations are often bred in Ireland, suffused with lavender at the bases and over the oblique marginal band—Mayo and Howth; also specimens with rich olive-green central band and hind margin and similar lavender suffusions, but also with the discoidal mark very white and prolonged to the costal nervure; in another, russet takes the place of the green, and the lavender is of a warmer tone, all these possess the usual fuscous patch on the hindwing—Howth, mid-Galway (Kane). Bred a nice rosy form from dug pupæ at Worcester (Rea), a light form sparsely scaled from New Forest, a ♀ in spring of 1890 from larva taken September 9th, 1889, feeding on sallow at Forest Gate, with the usual red markings at the base of the underwings replaced with straw-coloured patches (Mera), whilst Hill notes (*E. M. M.*, xxiii., p. 5) a specimen from Derby with the russet spot on the hindwings wanting. He also records another Derby specimen of the brown form, with a lovely lilac bloom. Some of the Yorkshire specimens bred are suffused with a purplish-red over both fore- and hindwings (Lofthouse), two bred at Gosport 1882, with a mauve pink tinge on the wings (Pierce), bred 1893 from larvæ taken in Sutherlandshire in 1892, the majority of the usual Scotch form, but in one the prevailing colour was a pinkish-grey and closely resembled two others from the New Forest and Lewisham that we bred (Adkin); pale form bred from larva with rows of red spots on both sides at Baldock (Wood); a very pale male the same tint as the palest ♀ and with the usual markings rather indistinct from Guildford larva (Grover); a ♂ with ♀ coloration also an imago emerged August 6th, 1893, from pupa of same year, in which the discoidal spot on forewings was much smaller and less white than in the rest of the brood which emerged in the spring of 1894 (Filer); Corbin, Winkley and others observe that the autumnal-bred specimens are inferior in size to their spring relatives. Briggs notes that two imagines that emerged in August, 1887, were lighter than those of the same batch that went over the winter as pupæ and emerged the next year; whilst we have already noted that Bartel says they are to be distinguished by their less strongly emarginate wings, and the almost rounded tips to the projections. Frey and other continental authors remark on the usually paler colour of the autumnal-bred specimens. Poulton exhibited at the meeting of the Entomological Society of London, on May 7th, 1902, four very small, almost unicolorous, light brown specimens, bred as a second brood during the extremely hot weather of the middle of July, 1900. Oberthür observes that Scotch specimens (received from Pitcaple) are smaller than the normal size of French examples. The Aberdeen examples that we have observed have been strongly marked, and the ♀s almost as dark as the ♂s, but of fair size; males from Rannoch are very dark and rather small; the Sutherland ♂s are also small in size, dark grey in tint, brightly and decidedly marked, the central and submarginal areas especially dark, the females dimorphic—both grey and red forms occurring. Except for the fact that they are rather smaller, there is no real difference between these and south of England examples. The following appear to be the usual British forms:

1. Dark grey; sharply defined markings; median and submarginal areas especially clearly defined; suffused with rose, giving the wings a purplish tinge; not uncommon in the ♂s=ab. *roseotincta*, Reuter.

2. Dark grey; sharply defined markings; median and submarginal areas especially dark; hindwings usually with very bright russet basal patch; frequent form of ♂s=ab. *suffusa*, n. ab.

3. Paler grey, with less sharply defined markings; rarer in ♂, not uncommon in ♀=? *populi*, Linn.

4. Whitish-grey, often with a faint yellowish tinge; usually with ill-defined markings; rare in both sexes=ab. *pallida*, n. ab.

5. Pale reddish-grey, the markings ill-developed; very rare in the ♂, common in the ♀=ab. *rufescens*, Selys.

6. Reddish-grey, leading up to foxy-red; markings well-developed, rare in both sexes=ab. *fuchsi*, Bartel.

The following are the already-named aberrations and varieties of this species:

a. ab. *roseotincta*, Reuter, "Fört. Macrolep. Faun. Finl.," p. 20 (1893); Buckell, "Ent. Rec.," v., p. 276 (1894). — Corpore alisque superne saturate, roseotinctis, maculis umbrosis intra marginem exteriorem alarum omnium fasciaque anticarum media ferrugineis, ♀. Finland (Univ. coll.), Aland (Björn Lendberg), Kristinestad (Sjöberg) [Reuter].

β. ab. *tremulae**, Bkh., "Rhein. Mag.," p. 649 (1793); Meig., "Eur. Schmett.," ii., p. 150, pl. lxviii., fig. 4 (1829); Koch, "Schmett. S.-W. Deutsch.," p. 51 (1856); Glaser, "Der Neue Borkh.," p. 83 (1863); Carad., "Iris," ix., p. 3 (1896). *Populi* var., Esp., "Schmett. Eur.," pl. xxii., fig. 2 (1780); Bkh., "Sys. Besch.," ii., pp. 181—182 (1789); Ochs., "Die Schmett.," ii., p. 251 (1808). *Borkhauseni*, Bart., "Palæark. Gross-Schmett.," ii., p. 194 (1900).—In 1789 Borkhausen writes (*Sys. Besch.*, ii., p. 181): "Herr Esper gives us, on pl. xxii of his *Abendschmetterlinge*, fig. 2, a variety of the poplar-hawk, which has the same contour as the ordinary form, but is only half as large. The wings have no markings at all except the burnt-coloured spot at the base of the hindwings, but are of an unicolorous light grey. The example from which Esper's figure is taken is in the cabinet of Herr Jung of Uffenheim, and was bred by him from a larva which only differed from the normal in its smaller size. Pastor Scriba

* *Tremulae*, F. von Wald., "Oryctogr. Mosc.," pl. x., figs. 1—2 (1830); Tr., "Die Schmett.," x., 1, p. 140 (1834): Dup., "Hist. Nat.," supp. ii., p. 29, pl. ii., figs. 2 *a*, *b* (1835); H.-Sch., "Sys. Bearb.," ii., p. 91, pl. iv., fig. 12 (1846); vi., p. 50 (1852); Bdv., "Spec. Gén.," i., p. 24 (1875); Staud., "Cat.," 3rd ed., p. 99 (1901).—This is a distinct species, with a var. *amurensis*, Staud., "Rom. Mém.," vi., p. 292. Bartel has renamed Borkhausen's *tremulae* and allowed Fischer's to stand. But, according to the law of priority, it is Fischer's species that must be renamed, and Staudinger's *amurensis* will have to be adopted for it.

of Arheilgen tells me that he once found several larvæ on black poplar early in June, which were in all respects like the ordinary larva of the poplar-hawk, but which pupated when they were scarcely half the usual size, and produced imagines the same summer which completely agreed with Esper's figure. Late in the autumn of 1783 I likewise found on aspen such a larva, which had scarcely reached half the normal size when it pupated; I kept the pupa successfully through the whole winter, but it unfortunately perished through an accident towards the spring. Might not one conclude, from these corroborative observations, that this so-called variety is a distinct species? I will not decide at present, but await more precise observations. This autumn I have again obtained several poplar-hawk larvæ, which for the most part have pupated at half size. Perhaps they will produce similarly varying moths. I will make known my experience in the supplements to the following parts of this work." In 1793 (*Rhein. Mag.*, p. 649) he adds: "The so-called small obsoletely marked aberration of *Sph. populi*, which I have made known in the *N. G. d. eur. Schm.*, ii., p. 181, has now been repeatedly bred in both sexes by an accurate and observant young entomologist, Herr von Schenk, who is at present studying at Giessen. Every time he has found the larva only on aspen. It was only half as large as the ordinary larva of *Sph. populi*, proportionally somewhat thinner, and the moth agreed entirely with Esper's figure. If it is really a separate species, one might name it *Sph. tremulae*."

Koch worked out somewhat unsatisfactorily the history of this aberration (*Schmett. S.-W. Deutsch.*, p. 51) and gives the following summary: This aberration was first figured by Esper (*Die Schmett.*, ii., pl. xxii., fig. 2), who gives a very reddish figure of it, whilst he describes it (p. 52) as 'unicolorous light grey.' Borkhausen (*Sys. Besch.*, ii., p. 181) cites Esper and adds that Scriba also has bred this aberration from the larva. In his *Rhein. Mag.*, p. 649, he repeats this and says further that Herr von Schenk has also repeatedly found the larva on aspen and bred both sexes. On account of the foodplant he gives it the name *tremulae*. Meigen gives the following very correct description: 'The moth is quite uniform light-grey, only the hindwings have at the base a scarcely noticeable rust-coloured spot.' Ochsenheimer only knew *tremulae* from Esper's defective figure. Treitschke mentions (*Die Schmett.*, vol. x., part 1, p. 140), that Herr Zetter has discovered this great rarity in the neighbourhood of Moscow. Zetter sent 3 specimens to Vienna, one of which remains in the Royal Nat. Hist. Cabinet. [Koch then goes on to say: "Zetterstedt, evidently thus erroneously named above, takes a newly discovered (near Moscow) species for the true *tremulae*. This can only be the one which Mann has diligently copied from the specimen in the Royal Museum at Vienna. Zetterstedt wrote his *Faun. Ins. Lapponica* in 1840; thus the priority-right of the name *tremulae* belongs to Borkhausen, not to him; moreover, Borkhausen described a moth which occurred at Giessen, not at Moscow. In any case he [Borkhausen] did not at all know Zetterstedt's insect, for his *tremulae* is 'quite unicolorous light-grey,' while Zetterstedt's—at least according to Herrich-Schaeffer's figure (Bd. ii., Taf. iv., fig. 12)—is certainly far from light-grey, and shows altogether quite a different species. If only some degree of attention had been given to Borkhausen's description, his *tremulae* would certainly not have been united or confused with Zetterstedt's." This confusion of names tends to obscure the facts somewhat, Koch having mistaken Zetter's name for a contraction of that of Zetterstedt.] Koch then says that in order to become acquainted with the puzzling *tremulae*, he asked several friends in Giessen, who collected lepidoptera, to look out for it, and

Herr Binzer succeeded in finding a larva on aspen from which a variety appeared, agreeing most exactly with Borkhausen's description. In order that others may be able to convince themselves of the correctness of these statements, Koch adds to his work, on pl. 1, fig. 1 an accurate figure, copied from nature, and concludes: "It only remains to be remarked that this variety does not result from all larvæ of *populi* which live on aspen; for those which I have not rarely found thereon have all produced typical *populi*." Glaser describes it (*Der Neue Borkhausen*, p. 83) as: "The small light aberration of the poplar-hawk, of greenish-whitish ground-colour and with weaker markings, usually also with the rust-coloured spot almost obsolete, which is found in certain districts, *e.g.*, about Biedenkopf (on the Upper Lahn), on aspen in woods, and having a very pale-green, sometimes blood-red spotted, larva. This aberration was known already to Esper and Borkhausen as the aspen-hawk, which they treated as a separate species." He also repeats Koch's statement that "Zetterstedt's *Smer. tremulae* is, however, a quite different species from this aberration. One also very often finds larvæ of the ordinary poplar-hawk on aspen, and a noteworthy variety is only produced by a long succession of generations on aspen. In Heydenreich's *Catalogue*, var. *tremulae* is omitted, but Meigen has described it correctly, others only from hearsay." Bartel observes: "♀. A small and light form *A. populi*, with greenish-grey ground-colour, weaker markings and almost obsolete rust-red basal spot of hindwings. This aberration, in which Caradja (*Iris*, ix., p. 3) suspects a transition to the true *A. tremulae*, has no connection with this eastern species, and is only a casual aberration of the very variable *A. populi*. Hesse—about Biedenkopf on the Upper Lahn, Giessen; Belgium; Roumania—in the forest of Grumazesti, &c. Middle to end of June."

γ. ab. *rufescens*, Selys, "Ann. Soc. Ent. Belge," i., p. 42 (1857); Bartel, "Palæark. Gross-Schmett.," ii., p. 193 (1900).—Rufescens à fond roussâtre pâle, ressemblant un peu au *S. quercûs* du midi. Belgium (Selys); Douai, rare (Foucart).

δ. ab. *fuchsi*, Bartel, "Palæark. "Gross-Schmett.," ii., p. 193 (1900). *Rufescens*, Fuchs, "Jahrb. Nass. *Ver.* Nat.," xlii., p. 204 (1889); Kirby, "Cat.," p. 710 (1892).—In this aberration the grey of the ordinary form is replaced by a delicate fox-red, which results in making the specimen widely different in appearance from other *A. populi*. The parts of the wings which have the fox-red colour are the central and marginal areas of the forewings and the margin near the apex of the hindwings. The base of the hindwing is dull rust-brownish, not dark red-brown as in other *A. populi*. The rest of the wings is almost rose-coloured in aspect, much more delicately coloured than ordinary specimens, *viz.*, the basal area of the forewings, the space between the central and marginal areas of the forewings where the fox-red colour shades off on each side into the rose-colour without distinct demarcation; lastly, a marginal spot above the hind angle of the forewing; on the hindwing the area between the dull rust-brownish base and the fox-reddish apex. This central area is traversed on the hindwings by an indistinct double stripe of fox-reddish colour. All markings fainter, much less distinct than in the ordinary form. On the underside also all the wings show more faintly a reddish tone. Through this mixture of fox-red and rose-colour this specimen presents a characteristic appearance. Bred from larva found on *Populus tremula* in the autumn of 1886; the imago emerged June 4th, 1887. I have received another ♀ from northern Germany, which entirely agrees with this in colour and only differs in its better expressed markings (Fuchs).

Bartel renamed Fuchs' ab. *rufescens* as not agreeing with Selys aberration of the same name, and writes as follows: "♀s. All the markings weakened, and much more indistinct than in the typical form. The grey of the type is replaced in ab. *fuchsi* by a delicate fox-red. This colouring is especially conspicuous in the marginal and central areas of the forewing and on the margin about the apex of the hindwing, while the other parts of the wing are almost rose-colour, and much softer-toned than in ordinary *S. populi*. These are the basal-area, the space between the central and marginal areas of the forewing (where, on both surfaces, the fox-red colour is lost in the rose without any distinct demarcation), on marginal spot above the inner angle of the same wing, and the space between the base and the fox-red apex of the hindwing. This central space is traversed on the hindwing by an indistinct double stripe of fox-red colour. The large basal patch of the upperside of hindwing is not dark red-brown as in the type, but weakly rust-brownish. This aberration was erected upon two otherwise entirely agreeing ♀ examples of which the one only differed from the other in having the markings better expressed; also a specimen of ab. *fuchsi* lying before me is a ♀. One of Fuchs' examples came from a larva found on *Populus tremula*, but it would be an error to ascribe the origin of this aberration to the influence of the leaves of the plant mentioned, for it is generally known that the larvæ living on aspen yield just as variable moths as those which feed on black poplar or willow. Central Europe (North Germany and Rheingau); probably also in the rest of Europe everywhere among the type" (*Palaeark. Gross-Schmett.*, ii., p. 193).

ε. var. *populeti*, Bien., "Lep. Ergeb. Persien," p. 33 (1870); Kirby, "Cat.," p. 710 (1892); Bartel, "Palæark. Gross-Schmett.," p. 194 (1900); Staud., "Cat.," 3rd ed., p. 99 (1901).—*Smerinthus populeti*, n. sp. *Smerinthus* alis supra pallide ferrugineis (♀ albido ochraceis) obsolete dentatis, fasciis ferrugineis; anticis puncto medio nullo, posticis basi ferrugineis. 100mm.—110mm., 2 ♂ and 1 ♀, the former much worn, in a poplar plantation at Meschhet. Larger than *S. populi*, paler and more indistinctly marked. The transverse bands are scarcely indicated in the ♂, in the ♀ the outer is bright rust-colour; the inner, bounding the basal area, is lighter rust-colour. The sharply defined basal area of the ♀ is lighter with two darker marks in the middle. Colour of body agrees with wings. Antennæ of ♂ strongly dentated, of the ♀ with only a slight suggestion of teeth. Beginning of July, 1858. Mesched and Charlog (Bienert). Pallide ferruginea vel albido-ochracea, al. ant. minus signat. [in ♂ fere unicolor.], non albido lunulatis (Staudinger). Kouldja (Alpheraky).

By some lepidopterists this eastern form is considered to be a distinct species, and var. *populetorum* has been suggested to be a variety thereof.

ζ. var. *populetorum*, Staud., "Stett. Ent. Zeit.," xlviii., p. 65 (1887); "Cat.," 3rd ed., p. 99 (1901); Kirby, "Cat.," p. 710 (1892); Bart., "Palæark. Gross-Schmett.," ii., p. 195 (1900). *Populi* var., Alph., "Hor. Soc. Ent. Ross.," xvii., p. 16 (1882).—From Usgent I received over 100 bred specimens of this form, also single individuals from Osch, sent by Haberhauer. I at first took them for *populeti*, Bienert, but this north Persian form is smaller and far more uniformly marked. The few specimens I have (2) or have seen of var. *populeti* are strongly reddish-grey in tint, and the wings especially exhibit only a darker transverse band on the outer margin. Although this, especially in the forewings, gives a tolerably different aspect, yet I suspect that *populeti* is only one of the many local forms of *A. populi*. The central Asiatic var. *populetorum* approaches far more nearly the Algerian var. *austauti*, Staud., for this also is only a local form of *A. populi*, the different colour aberrations of which have been recently provided by Austaut with names. The dull yellow-green specimens he has called *staudingeri*, the reddish form *incarnata*, and the dark grey mixed with brown *mirabilis*. In size, my central Asian *populetorum* vary from 85mm.—112mm., and are, therefore, as large, on the average, as the north African *austauti*, of which, indeed, my largest specimen measures 118mm. The colour is mostly of a light reddish-grey, as in the ab. *incarnata*, Aust., and single specimens are hardly to be distinguished from this. The colour is seldom so grey as it is normally in *populi;* it is never yellow-grey, nor quite dark grey in the specimens before me. Most of the examples are rather strongly marked, and have, on the outer area of the forewing, 2—4 dark, wavy, transverse lines, which are occasionally so faint as to be scarcely distinguishable; on the hindwings also the corresponding 2 or 3 darker, posteriorly lighter-margined, wavy, transverse lines usually stand out distinctly, whilst the large, red-brown, basal scale-patch is almost always strongly marked as in *populi* and *austauti*. The form of the wings varies considerably in *populetorum*, but not so much as it does in *populi*. In *populetorum* the outer margins of the wings are far less crenate than in *populi*, of which, however, I possess also some almost smooth-margined examples. The hindwings of *austauti* are almost entirely smooth-margined. At any rate, *populetorum* is a fine, large, interesting local-form of our *populi*, or, perhaps, really the type-form, if, indeed, Europe obtained its lepidopterous fauna from Asia (Staudinger). Usgent, Osch (Haberhauer), Pamir (Grum-Grshimailo).

η. var. *austauti*, Staud., "Pet. Nouv.," ii., p. 190 (1877); "Cat.," 3rd ed., p. 99 (1901); Aust., "Le Natural.," i., pp. 11, 68, 85 (1879); Obth., "Etudes," etc., vi., p. 65, pl. v., fig. 1 (1881); Kirby, "Cat.," p. 710 (1892); Standfuss, "Handbuch," &c., pp. 55, 62, 150 (1896); Bartel, "Palæark. Gross-Schmett.," ii., p. 196 (1900). *Poupillieri*, Bell., "Pet. Nouv.," ii., p. 193 (1878).—A *Smerinthus populi* (?), taken in May, deserves special mention, although unfortunately it is not very fresh. It is very large, measuring 100mm. in expanse; its colour is greyish with a reflection of violet; its markings do not differ from those of *S. populi*. The indentation of the margin of the wings is much less pronounced, almost none, especially on the inferiors; this character, combined with its large size, gives this specimen a characteristic aspect; however, as *S. populi* varies much even in the indentation of the wings, I should not venture to establish on this single individual the characters of a species. Perhaps it is identical with *S. populeti* from Persia; but this latter is too insufficiently described for one to be able to identify it; if this supposition be not found correct, and a certain number of individuals are found in Algeria belonging to the same type, I shall propose to name this form in honour of its discoverer: *Smerinthus austauti* (Staudinger). PUPA: The immense pupa, 53mm. long, or even more, of the var. *austauti*, is very nearly identical with that of *A. populi*, except in size. The sculpturing is bolder, or perhaps only appears so, the anal spike is smaller, shorter, blunter and rougher, being sculptured and even spiculated to the end. The tibio-tarsal joint of the first leg forms a marked prominence; this is so also in *A. populi*, but usually to so small a degree as to escape notice. The lateral prominences of the 10th segment are very definitely shorter and smaller, so that the anterior horn almost falls into the general pupal surface (Chapman).

Oberthür writes *(in litt.)* that he does not believe *A. austauti* to be a distinct species, but considers it to be simply a very large form of *A. populi*, some of the 60 examples in his collection being very large; it is also very variable. The examples he has have come from Morocco, Sebdon, Géryville, &c.

θ. ab. *austauti-incarnata*, Aust., "Le Nat.," i., p. 237 (June 15th, 1880); Kirby, "Cat.," p. 710 (1892); Bartel, "Palæark. Gross-Schmett.," ii., p. 199 (1900).—Two specimens only, ♂ and ♀, received from Algiers. Does not differ from the type in markings, nor in the outline of the wings, but in the general colour, which is a fine rose carmine-grey instead of being of a more or less pale ashy-grey. The undersurface is still brighter than the upper, and the abdomen is particularly accentuated. The brown spot on the secondaries is redder, and also occupies an extended area. These examples came from larvæ obtained at the same time as those of the type, but it is worthy of mention that the larvæ, which produced these remarkable specimens, were not green like those which I have previously described, but of a fine bluish-grey, tinged with violet (Austaut).

ι. ab. *austauti-mirabilis*, Aust., "Le Nat.," ii., p. 359 (Nov. 1st, 1883); Kirby, "Cat.," p. 710 (1892); Bartel, "Palæark. Gross-Schmett.," p. 199 (1900).—Size and pattern normal; but that which distinguishes it from the forms already known is the fine delicate rose tint which forms the ground-colour, both above and below, and which also covers the entire body, except the antennæ which are whitish. In addition, the centre of the forewings is shaded with a slight reflection of greenish, which enhances still further the richness of colouring of the moth. This superb aberration was obtained from larvæ found at Morocco. It belongs to the æstival form *staudingeri*, just as *incarnata* comes from the vernal form *austauti*. I have before me 3 examples agreeing among themselves; these are the only ones which I have thus far seen (Austaut).

κ. ab. *austauti-staudingeri*, Aust., "Le Nat.," i., p. 85 (September 1st, 1879); Kirby, "Cat.," p. 710 (1892); Bartel, "Palæark. Gross-Schmett.," ii., p. 198 (1900).—Two examples of *Smer. austauti*, Stgr., bred at Bel-Abbas from the larvæ which formed the subject of my article in *Le Naturaliste* of August 1st" [*i.e.*, "Discovery of the larva of *Smer. austauti*"], the larvæ being raised from eggs obtained from a ♀ caught by my brother north of Maroc, but the imagines present such a different appearance that, at first sight, it is difficult to recognize them. In general they are of a *very pale* colour, and I do not know how to characterise them better than by saying that all the pale grey shades of the type have become whitish, and that those of a darker grey have passed into a greenish-grey so pale that this colour hardly stands out from the ground colour; all the wings, in addition, have a yellowish gloss which gives the moth a very delicate aspect. Body entirely whitish, the transverse lines vaguely defined, with a tendency to obsolescence. This splendid variety appears to me to differ so much from the type that I do not hesitate to give it a separate name. All second-brood examples appear to agree with this, and it seems to be a regular second-brood form (Austaut).

Egglaying.—Sladen reports (*Ent.*, xxi., p. 14) that he has seen this species laying its eggs whilst on the wing. Attached singly or in pairs (laid side by side) on leaves of foodplant (Tutt); deposited in pairs on poplar leaves, on the upper- or underside indifferently, generally from 5 to 7 feet from ground (indicates possibly not the height at which the moth prefers to oviposit so much as the height at which it was convenient to gather the leaves) (Hellins). Sich notes (*Ent.*, xxv., p. 217) finding, on June 7th, 1892, at Barnes, 16 eggs, laid possibly by a crippled ♀, not singly but in two groups on a brown dead twig of balsam poplar, and they were, like the twig, brown in colour. Bonhote records (*loc. cit.*) taking 18 ova of the same species on one small leaf at Harrow. Eggs laid singly on underside of poplar leaves (Gordon); laid singly on underside of poplar leaf occasionally two or three in a cluster on the same leaf but never more, the egg-stage lasts 13 days (Ransom); found on July 9th, 1895, in twos and threes on poplar, the colour then yellow, but it disappeared gradually by the 14th, and the larvæ appeared on the 16th; when first laid the eggs are of a clear light green (Bartlett); pairing obtained July 31st, 1860, the ♀ began to lay next night, and continued to do so until August 8th, having then laid nearly 150 eggs, these began to hatch on August 12th (Merrifield), ♀ seen ovipositing on *Salix alba* in garden at 9 p.m. on July 8th, 1897, at Ealing (Montgomery); eggs hatched on July 16th, 1895, and fullfed larvæ found next day at Bristol (Bartlett); eggs found as late as August 13th, 1885, at Barnstaple (Mathew); ova hatched as early as March 22nd, 1894 (Prideaux).

Ovum*.—Oval, inclining to circular in outline, varying from 1·7mm. long and 1·5mm. wide to 1·5mm. long and 1·5mm. wide; the height rather less than the width, the ends very rounded, when first laid, plump without any depression; of a pale pearly-green colour; the shell shiny, very finely pitted, with some trace of a polygonal reticulation; a faint, very finely reticulated depression at one end of the egg forms the micropyle; this latter is very difficult

* Already described in detail (*anteà*, pp. 386-387) and compared with ova of *Mimas tiliae* and *Smerinthus ocellata*.

to detect, but appears a little paler than the surrounding surface of the egg [Received July 21st, 1897, from Mrs. McMillan, described same day under a $\frac{2}{3}$ lens]. The eggs are very large, nearly globular, some are rather more oval; smooth-shelled, of a very delicate greenish tint, and glistening like so many pearls. A few days before they hatched there could be seen through the shell what looked like two air-bubbles, and a few hours before hatching the form of the embryo larva could just be discerned of the same colour as the shell, though the latter when the larva has left it is quite clear like glass (Buckler). Of broad oval outline, nearly as deep as wide, the shell glossy, but when magnified is seen to be covered with a very fine reticulation, irregularly varying from hexagonal to almost square meshes, in colour pale yellowish-green. Some eggs I have measured were over 2mm. long and 1·75mm. wide, but the largest of both layings (1882 and 1886), those in each case that were laid on the first day, were 1·95mm. long and 1·6mm. wide; those of the second, third, fourth, and fifth days 1·8mm. long and 1·6mm. wide; those of the sixth and eighth days slightly smaller; those of the ninth and tenth days 1·65mm. long and 1·45mm. wide, and the last egg I found in the 1882 laying was only 1·6mm. by 1·4mm. (Hellins). Kowalewsky has used (*Mém. Ac. Sci. St. Petersb.*, (7), xvi., pl. xii) the eggs of this species for some of his embryological investigations (see also *antea*, vol. i., p. 22). Parthenogenesis has been reported in the species by Meisner (p. 45 (1818)).

Habits of larva.—The newly-hatched larva sometimes eats the greater part of the eggshell as soon as it is hatched, others, however, eat only enough to enable them to escape from the shell. Even before the first moult they eat pieces of the entire substance of the willow or poplar leaves on which they are feeding (Buckler). The larva of this species has only three moults, whilst those of the other two British Amorphid species have four. Whether this is always the case I cannot say. Chapman states that some larvæ of *Moma alpium (orion)* have four moults, others five, and that this is not a sexual difference, as is the extra moult in the female larva of *Notolophus antiqua*. The young larvæ have very similar habits to those of *S. ocellata*, but, as they get older, the position in which they rest is very different; this is nearly always with the head downwards, and although the forepart of the body is raised, as in *S. ocellata*, the head is curved inwards towards the leaf or twig; they will grasp the stalk of a leaf with their anal claspers only and hang down behind it, and it is quite remarkable how small a sallow leaf suffices to hide a fullfed larva. On poplars I have frequently noticed them, when they have eaten half the leaf, so resting as to represent the eaten portion themselves, and they are then so well protected that, with any wind, it would, I think, be impossible to detect them. I have noticed that the larvæ are much easier to find on misty mornings and before the sun is up. Probably the explanation of this is that, in bright sunshine, the light and shadow are much stronger, and consequently the slight difference in tint between the larva and the leaf is not so noticeable. The same fact holds good with *S. ocellata*, and I think that, as a rule, the protective coloration of larvæ is most perfect in sunlight or in full daylight (Bacot). Borkhausen notes (*Sys. Besch.*, ii., p.

182) that his observations lead him to suppose that the imagines from the early summer larvæ are disclosed the same year, at Darmstadt, after a pupal period of 3 or 4 weeks. He states that the larvæ which one finds late in autumn, often even after the frost has injured the leaves, are from the second generation, that he has noticed that these larvæ, delicate as they appear, have yet a very strong constitution. He says: "They freeze to a piece of ice, and when by day they are thawed by the sun, they eat quite cheerfully the fallen poplar leaves, finally pupate, and produce in the following May perfect moths." Ransom says *(in litt.)*: "The larvæ are found later in the autumn than those of *S. ocellata*. I have frequently found them when the leaves are falling, and a very small one on October 4th, 1900. These larvæ also rest and feed upon the underside of the leaves, appearing to eat both by day and night. Fullgrown larvæ can often be found at the same time as unhatched ova." For notes on the moulting habits, see *antea*, ii., p. 17. Notes on a peculiar licking habit of the fullfed larva are also given *(antea*, vol. i., p. 99). The following notes on the larvæ may be useful: July to October, in Linz district (Himsl), October 12th, 1878, at Gallipoli (Mathew), August 21st-28th, 1886, at Jersey (Jordan); June 30th-August 14th, 1845, very young larvæ August 17th, older larvæ September 4th, 1856, at Brighton, young larvæ at Cuckfield, August 2nd-4th, 1857, possibly those of a second brood (Merrifield); larvæ July 5th-August 14th, 1865, August 8th, 1875, common July and August, 1885, ova hatched on August 25th, 1887, larvæ fullfed September 23rd, also July 13th, and August 5th to September 26th, 1896, all at Lee (Fenn); very abundant, August, 1870, on poplar at Douglas (Robinson); larvæ plentiful on willow at Greswell on August 5th, 1870, at Butterwood on August 9th, 1871, at Bulmershe Park on August 6th, 1880, at Burghfield on August 3rd, 1884, at Tilehurst, August 10th, 1889, at Goring, August 14th, 1887, at Warren on August 1st, 1890 (Holland); larvæ, July 22nd-August 14th, 1871, June 21st, 1872, small on June 26th, 1878, September 16th, 1879, July 26th, 1893, all on poplar, September 6th, 1896, on sallow, all at Lee, July 25th, 1889, on aspen, August 31st, 1895, on willow at Bexley, September 19th, 1891, on aspen at Teesdale, September 3rd, 1895, on poplar at Grove Park, September 12th, 1895, on willow at Darenth, August 18th, 1897, on osier at Bromley, October 4th, 1897, on sallow at Stone (Bower); fullfed larvæ at Chat Moss, September 13th, 1879 (Auld); larvæ, September 1st, 1880, at Palmerston Park (Flemyng); July, 1881, in north Devon (Mathew); August 24th, 1881, at Jedburgh (Elliot); August 10th, 1886, July 19th, 1887, at Brentwood, September 21st, 1891, at Bentley, September 2nd, 1892, at Mucking (Burrows); larvæ, September 10th-14th, 1888, September 25th, 1889, September 5th-6th, 1890, August 31st, 1892, July 17th-21st, 1895, fullfed July 23rd, 1897, $\frac{3}{4}''$ long, at Bristol, August 9th-September 22nd, 1892, September 5th, 1893, at Braunton (Bartlett); larvæ, July 18th, 1889, September 24th, 1892, August 25th, 1898, July 10th, also October 25th, 1900, at Chiswick, July 18th, 1889, June 7th, 1892, at Barnes (Sich); August 17th, larvæ in last instar on willow, August 30th, 1889, very small, on weeping willow at Lowestoft, August 8th-10th, larvæ fullfed, 17th, 19th, 22nd, 29th, these had

buried, but were unchanged on August 30th, September 1st, 6th, 1887, at Clapton on willow (James); August 4th, 1891, at Bedford, larva pupated August 9th (Steuart); late wet season of 1891 affected larvæ to such an extent that some were quite young in September, these fed up till leaves began to fall, when larvæ were about half-size, lingered on into November, and died of starvation, the trees having lost their leaves (Adkin); August 26th, 1894, on poplar at Worcester Park, the number of Sphingids noticed in 1894 was remarkable (Kaye); larvæ fullfed, September 17th, 1894, September 24th, 1895, August 5th-27th, 1900, at Sudbury (Ransom); larvæ taken at Great Yarmouth on September 29th, 1895 (Miller); July 20th, 1896, on osier at Whitwell, July 22nd-August 8th, 1897, on poplar at Prescot (Freeman); ova, July 3rd, 1897, hatched July 16th, fed up on poplar, commenced to pupate September 7th, all but one in pupal stage on September 21st, at Middlesborough (Lofthouse); July 30th, 1898, at Knowsley Park (Cotton); larvæ August 14th, fullfed September 3rd, 1898, also fullfed on poplar on September 12th, 1899, in Sulby Glen, fullfed from Cranstal Loch on September 3rd, 1900, on sallow (Clarke); crawling on ground fullfed on October 3rd, 1895, still feeding but fullgrown at Reigate, September 13th, 1900 (Prideaux); eggs deposited July 2nd, 1899, hatched July 13th, larvæ all fullfed by August 30th at Weymouth, larvæ July 16th, 1899, at Weymouth, August 6th, 1898, at High Wycombe (Peachell); 3 larvæ taken at Halliwell on August 22nd, 1899, the first one buried on August 25th (Whittaker); September 9th, 1899, at Forest Gate, quite a small larva taken in autumn of 1900, when nearly all the leaves had fallen, and it would have been quite impossible for it to have fed up (Mera); in 1900 ova did not hatch till June 25th, and the first larva pupated July 30th, in the Dorking district, but 125 eggs were laid by a second-brood ♀ between July 26th-30th, and larvæ emerged August 5th, &c., in 1901 (Oldaker).

Larva *.—*First stadium:* Much larger than the larva of either *Mimas tiliae* or *S. ocellata*; short and thick by comparison with *S. ocellata;* the head large; roughly triangular in outline, but rounded at top; the segmental incisions well-marked, but not so conspicuously as in *M. tiliae*; the scutellum distinct (a noticeable character in all the later stadia); the caudal horn green, of the same tint as the rest of the body, about one-third the length of the larva, and it appears to be slightly movable at will; the oblique and subdorsal stripes present though not very distinct; the prolegs markedly well-developed. When fullfed in this stadium, the lines down the sides of the head are distinct, the oblique lateral body stripes markedly so, the subdorsal also clearly defined and continued as far back as the base of the caudal horn; there are also two spots on the dorsal area of the 2nd, 3rd, 4th and 5th abdominal segments, which are elongated into short stripes on the 5th. *Second stadium:* The head distinctly triangular in outline, but neither so long nor so pointed as in *S. ocellata*; the scutellum has along the front a border of yellow mammillæ, forming a ridge just behind the head; the 1st and 7th pairs of oblique stripes are

* Described in detail (*anteà*, pp. 387–389) and compared with larvæ of *Mimas tiliae* and *Smerinthus ocellata*.

very much more distinct and broader than the others, the subdorsal is much less distinct than in the first stadium; the caudal horn is pale yellow, looks long, but this appearance of length is really due to the shortness of the body ; the mammillæ or bases of shagreen hairs appear to be less numerous than in the larvæ of *M. tiliae* and *S. ocellata*, at any rate they are less noticeable. *Third stadium:* The larva is very short and thick, much larger than those of *M. tiliae* and *S. ocellata* are after the 2nd moult, in fact as large as is *M. tiliae* after its third moult. The head is broader, the cheeks somewhat prominent; four rather large mammillary elevations on the apex of the head, two on each lobe, but these are much smaller than the similar processes on the larval heads of *M. tiliae* and *S. ocellata*; the mammillæ or shagreen hair-bases scattered over the dorsal area much larger in front of the 1st pair of oblique stripes than are those behind them; the subdorsal stripes very faint, altogether wanting behind the 4th abdominal segment, and usually all trace of them is lost after the next moult; the 1st and 7th pairs of oblique stripes are much broader and more conspicuous than any of the others, the mammillæ on them being so large and so closely crowded together that they are ridges rather than lines ; the caudal horn is still slightly bifid, each tip surmounted by one long hair. *Fourth stadium:* Still stouter and heavier-looking than the larva of *S. ocellata*, but the difference between the larvæ not nearly so marked in the adult as in the earlier stages. The head somewhat smaller than that of *S. ocellata*, broader, and not so pointed; the 2nd to 6th oblique lateral stripes are well-marked, the 1st and 7th not standing out so markedly stronger than they, and there is a sign of a dark border in front of the stripes, chiefly confined to the 2nd to 6th pairs; the caudal horn is short and thin, is not so stiff or curved as that of *S. ocellata*, and is not bifid ; there was no trace observed of forked hairs in this stadium. The larvæ had only three moults, one less than those of *M. tiliae* and *S. ocellata* (Bacot). The *newly hatched larvae* (July 3rd) are of the tenderest tint of green, with very long caudal horn * ; the larvæ grew rapidly, whilst the horn remained of same size, hence they appeared more proportionate in length; on July 6th the pale yellowish oblique side stripes were already visible, also a yellowish subdorsal stripe and spots on the back of the thoracic segments; the skin likewise assumed its rough character. On July 11th most had *moulted the first time* and were half an inch in length, and their skin was now rough with innumerable raised points ; the whitish, slanting side stripes were most conspicuous on the tenth and fifth segments, that on the fifth extending to the end of the dorsal part of the sixth segment, and that on the tenth reaching to the base of the twelfth segment; these two were stouter stripes than the rest, which were but thin lines. On the 14th of July most of the larvæ had *moulted the second time*, and their increase in size and more bluish-green tint were remarkable ; in

* One larva that had eaten the greater part of its eggshell waited by the remains of the shell apparently to digest its meal, and, in the meantime, its long tail began to wither at the end for more than half its length, and then shrivelled and turned blackish at the point of the round portion, which eventually proved to be the tip of the caudal horn, all beyond falling away (Buckler).

a few hours they were three-quarters of an inch in length. On the thoracic segments were thin subdorsal and spiracular lines of whitish points, and similar spots were on the back of the second to fifth segments and along the front of the second segment, where they formed a margin; on the head also a line of white spots was to be seen down the side of each lobe from the conical crown; indeed one may say that all the segments were roughened or shagreened with fine whitish points. On the 19th and 20th of July, some *moulted the third time*, others a few days later, the shagreened roughness, the increased stoutness and the fuller and yellow-green colour were at once very marked. They now grew very rapidly and they *moulted the fourth time** on the 27th, 28th, and 29th of July, some were then marked with crimson spots one on each segment along the subdorsal region, others had these spots only on the end of the 8th, 9th, 10th, 11th, and 12th segments, those on the 8th and 12th being larger than the rest; the narrow oval spiracles were whitish, edged with crimson, and just in front of each spiracle was a narrow oblong crimson spot and a similar spot behind each spiracle, and just behind each ventral proleg was a bar of yellow, followed by a bar of crimson. The ground-colour of these larvæ was then of a very brilliant yellowish-green, studded with rough yellow points, of which the largest and most prominent formed the slanting yellow lateral stripes, of these the two thickest passed upwards and backwards from the side of the 5th to the back of the 6th segment, and from the 10th to the tip of the caudal horn, which was likewise yellow. One larva was bluish-green, with the points and the stripes quite pale yellow (Buckler). *Second stadium* (well advanced in the second stage): Yellowish-green in colour, 13mm. long when extended at rest; the yellow marginal lines of the face terminate upwards in two apical tubercles †, which are especially large, but not predominant, and are without any distinctive colour. Two dorsal tubercles are especially distinct upon the 2nd and the 3rd thoracic segments, continuing anteriorly the direction of the barely recognisable eighth stripe, as in the young larva of *Sphinx ligustri* in which, however, the marking is far more distinct and persistent. A semicircular crown, of especially large tubercles, extends in the vertical plane immediately behind the head upon the most anterior annulus of the 1st thoracic segment. There are about 15 tubercles in the semicircle, and they are directed forwards and produce a very striking effect. The 1st and 7th stripes are especially large and distinct; the stripes and the subdorsal are chiefly made up of tubercles, but there is some suffusion of the ground-colour, which is (as usual) complete in the posterior part of the 7th stripe upon the 8th abdominal segment. The first stripe extends anteriorly as a line of tubercles on to the thoracic segments, becoming at first horizontal and parallel with the subdorsal, but appearing to rise on the 1st thoracic segment, and joining the ends of the semicircular crown; but in the anterior part of its course the line becomes very difficult to follow. The 7th stripe is also

* It is to be noted that Bacot's larvæ only moulted three times, and pupated at the end of their 4th stadium.

† Poulton uses the word "tubercles" in the sense of mammillæ, or mammillary points, not in the restricted sense in which it is now used when describing larvæ.

continued forwards to the anterior limits of the 6th abdominal segment. There are oblique stripes (chiefly made up of shagreen dots) just above the claspers on the 3rd, 4th, and 5th abdominal segments. These lines are more nearly horizontal than the ordinary oblique stripes, and their relation to the latter is doubtful. They may represent the forward extension of the 4th, 5th, and 6th oblique stripes respectively, but they have also the appearance of a sub-spiracular line twisted into partial parallelism with the oblique stripes. An examination of the larva in this stadium, therefore, adds nothing to our knowledge of these lines, which are found during the whole subsequent life of the larva, and which have previously been described in the last stage (see, *Trans. Ent. Soc. Lond.*, 1885, p. 297). The extension of the first stripe and the semicircular crown are not equally distinct in later stages, but the latter is easily recognisable. The 8th stripe disappears. The whole comparison strongly confirms Weismann's conclusion as to the extreme uniformity, and, therefore, the ancestral character, of the appearances witnessed in the ontogeny of this species (Poulton, *Trans. Ent. Soc. London*, 1887, pp. 281—282). For notes on the dichotomous hairs of this larva see *Trans. Ent. Soc. Lond.*, 1885, p. 296. Notes on moulting have already been given (*anteà*, ii., pp. 17 and 59).

Variation of larva.—The larvæ of *A. populi*, like those of *S. ocellata*, vary considerably in colour in their later stages, ranging from dull green or sage-green to quite a bright yellow. The spiracles are often surrounded by a red spot, and it is not uncommon to get larvæ with an entire or partial subdorsal row of similar spots. These spots are said to simulate the small red galls so often found on willow and poplar leaves. In one larva that I bred this year, the spots of the lower row were absent from the thoracic segments, whilst those of the upper row were present on those segments. I used to have a notion that the different forms were from different broods, chiefly because I had usually found the dull green forms on black poplar and the bright ones on Lombardy poplar, sallow or willow. It is true that I have occasionally found the latter on black poplar, but I do not remember ever taking the dull forms on Lombardy poplar. This year, however, I bred both forms from eggs laid by a single female, and Buckell has had the same experience (Bacot). Poulton has made many observations on the red-spotted form of the larva of this species (*Trans. Ent. Soc. London*, 1885, p. 297; 1886, pp. 284 *et seq.*), and observes that the spots may be present in the early stadia, and that the peculiarity may be increased, or, on the other hand, the spots may decrease or altogether disappear in the later stadia, and he considers it probable that the spots are present upon a much larger proportion of young larvæ than upon those in the later stages, although, in a certain proportion of the latter, the character reaches a pitch of perfection not hitherto described in the earlier stages. Based upon the examination of 22 specimens, White observes (*loc. cit.*, p. xxv) that the spots in the dorsal and spiracular rows usually develop on the segments in the following order:

Dorsal row	3, 7, 4, 2t, 5, 1, 6, 2, 3t, 1t, 8.
Spiracular row	4, 3, 5, 2t, 7, 6, 2, 8, 1, 3t, 1t.

He shows that the dorsal is the more important series, and that this row commences most frequently on the 3rd abdominal segment, whilst the spiracular series commences most frequently on the 4th abdominal. Poulton further shows (*loc. cit.*, p. 285) that the 3rd and 7th abdominal segments are predominant in the dorsal row. The latter also notes a reddening of the upperside of the base of the horn in some larvæ, whilst the prolegs are frequently all marked with red, but this character is usually not well-developed. A red mark is also occasionally found on the head in the area of the ocelli, and the apex of the head is sometimes suffused with the red colour. Poulton further gives (*loc. cit.*, p. 287) a table which shows the results of the examination of a brood of larvæ from a single batch of eggs, and all fed under the same conditions, in which it is seen that the tint of the ground-colour and the development of the spots are produced in a very heterogeneous manner. Miss Gould figures and describes (*Trans. Ent. Soc. London*, 1892, p. 241, pl. xi., figs. 11—13) a red-spotted larva of *Amorpha populi* in detail, and compares it with the analogous form of the larva of *Mimas tiliae*. She notes how, on August 19th, 1890, a change took place in the spiracular row of spots without any moult. These were at first merely irregular, roundish, red spots, but became, at this date, more ocellated, the pupil (the spiracle itself) yellowish-red, the iris green, boldly outlined with red. Further details are given of the appearance of the spots after the larva had undergone its last moult. Elliot connects the peculiar form of the larva having on each segment, except the 1st, 2nd and 12th, a rather large purplish blotch just above the spiracles, with *Populus nigra*, and says that he repeatedly finds it on this plant; Dawson records (*Ent.*, v., p. 184) a larva with an extra row of eight rosy subdorsal spots on either side, on the 2nd, 3rd, 5th, 6th, 7th, 8th, 9th, and 11th segments, the horn also rosy above and below, at Driffield; others similar taken at Shepherd's Bush and Acton (Clifford); at Palmerston Park, near Dublin, a marked variety of the larva was taken on September 1st, 1880, by Flemyng, "ornamented on each side with a double row of 10 reddish-brown spots; the first five upper spots (counting from the head) are small, 6, 7, and 8 large, 9 small, 10 large; the ten lower spots are all of much the same size, *i.e.*, a little smaller than the large spots of the upper series. When the larva was found the spots were of a bright (almost maroon) colour, but have become duller as the pupal state is fast approaching. The red spot that is always found underneath the horn is present, also a red spot at the bottom of the horn on the upperside, and another at the top of the head" (*Ent.*, xiii., pp. 243—244); a similar variety to that recorded by Flemyng, with two rows of 10 red spots on each side was found feeding on willow (Graham); a form of the larva occurs with two longitudinal lateral series of delicately pink blotches—the first series is what might be called subdorsal, being visible from above looking down on the dorsal area; the second series is spiracular, each spiracle being seated in the middle of a blotch; the ground colour is pale glaucous, so that the blotches are thrown up as it were in a very beautiful manner (Newman); larvæ vary much at Corsemalzie, some are very pale, others are of a rich dark green, some are ornamented with red spots (Gordon); larvæ were found in July, 1881, in North Devon, and, later, a second brood, the latter of the beautiful golden-green form, with subdorsal row of large red spots rarely to be seen among larvæ of the 1st brood (Mathew), an albino variety of larva was found feeding on aspen in the autumn at Mansfield, remarkably transparent, it died in pupa; and another with red spiracles and several rather large crimson-lake spots above the spiracular lines (Daws); aberrations of the larva of *A. populi* found on same row of poplars at Moseley, near Birmingham, were described by Barnes (*Ent.*, iii., p. 364) as: (*a*) August 21st, 1867. Ground colour paler than the typical examples with which it was found, and having a row of pink blotches of the same size, along the side by the spiracles, and another row above along the back. (*b*) September 16th, 1867. Fullgrown, the ground-colour very pale glaucous, with pink blotches as in *a*, except that they become smaller as they approach the head. (*c*) September 17th, 1867. Two of a pale whitish-green, with blotches along the spiracles, no spots at all along the back. (*d*) September 17th, 1867. Also two more fullgrown ones, with ground-colour much darker than any before found, pink blotches along the spiracles, and two pink blotches just behind the head, two about middle of back, and two at base of horn. Schilde records (*Ent. Nachr.*, vii., p. 100) a hornless larva of *A. populi* which was brought to him in the autumn of 1880, but which proved to be ichneumoned. In place of the horn, there was a perfectly sound, smooth surface of skin, somewhat depressed, because the two shagreen-stripes, which on the sides run upwards obliquely to the place of the horn, overtopped a little at the end, much as in the larvæ of *Apatura iris* and *A. ilia* a part of the oblique stripes project somewhat. Norman notes the larvæ as abounding at Forres, those found on *Populus alba* wonderfully matching the colour of their foodplants, being of a pale glaucous-white hue, sometimes blotched with red.

Comparison of the red-spotted larvæ of Amorpha populi and Mimas tiliæ.—Poulton notes (*Trans. Ent. Soc. Lond.*, 1886, p. 139; 1887, pp. 287—288) the similarity that the red markings on the larvæ of certain larvæ of *Mimas tiliae* have, in their broad aspects, to the earliest traces of the purple borders of the larvæ of *Sphinx ligustri*, contracting and becoming broader in the later stadia, and finally appearing as somewhat elongate spots on the anterior margins of the oblique stripes, and he suggests that his observations indicate that these features in *M. tiliae* have arisen from a modification of a normal coloured border. Miss Gould says (*Trans. Ent. Soc. London*, 1892, p. 242): "The red spots on the larva of *Amorpha populi* are unlike those on the larva of *Mimas tiliae* in general effect, being rounder, bolder, and not in the least linear; and their appearance suggests that they are strongly protective from their resemblance to the dark spots or blotches commonly seen on the leaves of the poplar. Viewed from underneath, with the light shining through them, the leat spots were of a red exactly corresponding with that of the red of the larval spots and much the same size, etc. In *M. tiliae* I could see nothing in the spots which would have led me to connect them with coloured borders until the second larva reached its last stage, but the appearance of the spots in this individual was so linear and so unmistakably border-like that it seemed impossible to doubt the correspondence." Miss Gould considers that it would have been natural to conclude from appearances that the spots are merely protective in *A. populi* and in *M. tiliae* have either degenerated from coloured borders or are on the way to become such, but that it seems unlikely that the character can have a different significance in the two species. She considers that spot marking is the more ancestral, and that *M. tiliae* represents a stage of its modification into stripes, etc., but the material on which the observations were made was too small for safe generalisation.

Pupation and cocoon.—The larva usually prepares for and undergoes its pupation quite on the surface of the soil. Hellins says that home-bred larvæ burrowed an inch or two into loose soil, but that, when pupa-digging, the pupa is found barely hidden, and there seems to be scarcely any silk used in spinning. Bacot says the larva never appears to spin any silk, nor is the pupa enclosed in a cell, although an abundance of material be supplied; as a rule, the larva burrows only just beneath the surface and then pupates. The larva generally burrows, but comes to the surface again before pupating, however much earth be given it (Arbuthnott); of more than 50 pupæ dug at High Wycombe between 1892-1899, only two were found under willow, all the rest under poplar (Peachell); pupæ at Oxton, mostly at roots of elm (Studd); pupæ dug at roots of poplar, also at roots of elm where no poplar trees existed (Russell); in the ground about 10in. deep (!) (Lambillion); pupa taken at the roots of species of poplar, May 27th, 1901, at Burnley (Clutten); larva buried October 24th, 1886, cocoon just below surface, slightly exposed, and did not pupate until November 23rd, *i.e.*, in 4 weeks and 2 days, although I have often turned pupæ out in half this time; pupæ dug commonly, October—April, under willows at Clapton, under poplars at Stamford Hill; on August 15th-16th, 1887, at Clapton, under aspen (James); pupæ under willow and Lombardy poplar (Eddrup); the larvæ pupate in the ground, and are sometimes found at the roots of lime trees (Clark); rather common at foot of poplar (Hollands); common in September and October, 1859 and 1860, at roots of poplar (Fenn); frequently dug at roots of Lombardy poplar in Gloucester and Surrey from September—Febuary (Prideaux).

Pupa.—Length 33mm.—36mm., width 10mm. (♂) to 13mm. (♀); these are average rather than extreme dimensions. Colour: black, with a suspicion that it is rather an extreme of brown than an actual black, intersegmental membrane brownish. The general structure is Amorphid, *i.e.*, ordinary obtect, with labrum ventral, and glazed eye with convexity forwards. The form is less cylindrical than in the other species, *i.e.*, it is more decidedly thicker at the 4th abdominal segment, tapering to either end. Thus, the diameters of a specimen are, at mesothorax 10mm., at the 2nd abdominal segment 11mm., at the 4th segment 12mm.. at the 5th segment 11mm., and at the 6th segment 10mm. Except some dorsal depression on either side of the metathorax and 1st abdominal segment, which affects also the wings adjacent, forming a "waist," the transverse section would everywhere be very nearly circular. The curvature anteriorly is, however, almost entirely dorsal, the front of appendages being nearly straight. From labrum down venter the lengths are—to end of maxillæ 6·5mm., to end of first legs 9·5mm., of antenna 10mm., of second legs 11·5mm., to end of wings 15mm., the costæ of wings being thus in apposition for from 3·5mm. to 4mm. The appendages are defined from each other by polished lines, as though traces of chitin that ought to be covered were exposed; it appears, however, to be normal. That this is not certain, however, may be deduced from the fact that, in some specimens, the hind margins of wings appear to lie upon the 4th abdominal segment, with a surface at a higher level than that of the segment, and that, on the other hand, a proportion of specimens too large to be considered abnormal or pathological have the wing-surface at a rather lower level than that of the segment, and that the margin of segment at edge of wing, by which it rises to its higher level, is glazed, and has all the appearance of being meant to receive the end of wing, which has not quite reached it. There is some variation in the mouth region; one specimen has a point here from which five sutures radiate, dividing off five almost equal angular portions, *viz.*, 2 maxillæ, 2 cheeks and 1 labrum. More normally, however, the central portion is a square of black chitin, with a minutely rough wrinkled surface, and divided into a larger upper and smaller lower piece by a faint suture, and with some suspicion of a notch in lower piece. This is the labrum; above it is the face proper, divided by a slight suture running up from upper angles of labrum; below this are two angles, often a little raised, which look like mandibles, but are probably parts of face or cheek, not being separated by suture; below are the two maxillæ, their upper margins extending outwards half-way to antennæ. The glazed eye is a fine glazed curved line, with delicate striæ extending inwards, and on the outer convex margin is an area of very minutely pointed surface that might be taken as representing eye facets, sometimes this area appears to be striate just as on the other side of the glazed line. The antennæ have a series of very marked transverse ridges, apparently two to a segment of the antenna, the two ridges are united at the centre of the segment into a somewhat higher point; the ridges are very sharp, and have furrowed and hollowed sides, that make them somewhat irregular. They vary from this to transverse rows of rough points, or even to minute points, with no very determinable arrangement. The rough sculpturing of the legs tends to arrange itself into transverse lines; that of the maxillæ is more irregular and rather rougher, and often shows a false suture for a little distance down its middle, a similar one may sometimes be seen on first leg. The first leg extends upwards beside the cheek, which thus forms a right angle at the point where the maxilla and first leg meet, and the leg appears to extend upwards till it is cut off by the antenna. In the pupa of *S. ocellata*, the face makes a very obtuse angle here, and the leg is cut off by two oblique lines equally by the face and by the antenna, and ends in a right angle where the two lines meet. In *M. tiliae* the lower margin of the face is even less angulated, and the leg is cut off by the face rather than by the antenna. The second leg terminates upwards rather less sharply than in *M. tiliae* and *S. ocellata*. In some specimens these differences may be less marked, but are always sufficiently obvious. The wings are very variable in surface; in all cases the hindwing shows a little strip down to middle of 3rd abdominal segment, where it disappears under the rounded extension formed by the anal angle of forewing. In some specimens the wing presents nothing but uniform finely granulated or rough surface. In a well-marked one, however, the rough points arrange themselves in transverse lines, interrupted by fine, impressed, longitudinal lines representing the nervures, against which they are rather stronger; in other cases these higher points coalesce and represent the nervures by a ridge, without the impressed line. Poulton's line is very vaguely expressed by the surface being sloped off to the margin by a rounded chamfer and by a little change of surface texture. At the centre of the wing base is often a small, smooth, almost glazed surface, with a distinct rounded nodule, usually polished and different from the roughnesses of the general sculpturing. The dorsal sculpturing of the mesothorax may be minute and fairly uniform; there is, however, usually a vague suture marking off the wing-base, and a longitudinal central one extending to the head and into the first abdominal segment; this may be a single or double ridge. The general character of the sculpturing over these segments is a set of rather sharp points tending to get into continuous ridges, something like those on antennæ. The abdominal segments present the usual subsegmentation with varying distinctness. The intersegmental subsegment is very distinct laterally on 3, 4, 5, 6 and 7; in front of this, four other subsegments may be made out, usually very obviously on the 3rd abdominal, but more frequently on the other segments two only can be distinguished with any certainty; that they are, however, there substantially, is evidenced by slight indications in the arrangement of the rough ridges, even in the specimens in which they are most obscure; a faint indication of a narrow subsegment in front of these often exists on abdominal segments 3 and 4. The sculpturing of these abdominal segments is very labyrinthine, in some lights one takes it to be longitudinal, in others transverse. The fine, rather sharp ridges run into one another in a wave-like manner, with more or less fusiform hollows between; dorsally, a longitudinal arrangement is dominant, with much stronger ridges at the anterior borders of the segments, ventrally, a somewhat more transverse direction prevails; the anterior border of abdominal segments 5 and 6 has a rather sharp edge, only seen when the incisions are well opened, when, also, further smaller and smaller transverse ridges are seen to succeed each other right up to the intersegmental membrane; below this, on abdominal segments 5, 6, and 7, is another transverse ridge, followed by two or three others in the spiracular region; these are really parts of the general arrangement of sculptured ridges, but are here very prominent, and separated from the others by their special direction, and the diminution comparatively of the subsidiary interlacing ridges; they produce, on these three segments, a definite projection overhanging the spiracle; on the 5th and 6th, the margin marking off the intersegmental subsegment is a definite raised line; the scar of the caudal horn may be quite obsolete, but is usually a depression, with sometimes a prominence at its anterior margin. The scars of the ventral prolegs are not absent in any specimen examined, but are so various that apparently they might be; in some they are merely a small smooth spot from which the ridges of sculpturing radiate, in others are a small, or even a rather deep, hollow, often with a small additional pit at its outer extremity. The scars of the anal prolegs are usually absent. When present they are smooth depressions on the summits of the lateral eminences of the 10th segment, so placed as to form with the anal depression and the points on 9, a square. On the 9th abdominal segment in the male pupa, ventrally, is a somewhat slender circular ridge, within which project side by side two prominences, which are rough and irregular, in a way similar to the general surface; the 10th abdominal segment has terminally an antero-posterior or narrow depression, the anal scar, with a slight prominence on either side, and a depression cutting these off from the general surface, in front of this is a smoother spot from which radiate forwards several straight, sharp, fine ridges, and backwards the depression of the anal scar. On either side is a large prominence, that looks as if it represented the claspers, but which is, however, as above noted, merely a scar on its surface; this, together with the 9th abdominal segment, is covered with a coarse reticulation of fine ridges. The cremastral armature is a conical spike, generally not unlike that of *M. tiliae* or *S. ocellata*. It is cut off by a deep groove from the two prominences just described. Viewed laterally, this spine is 2mm. long, and 1·3mm. broad at the base, with a tendency to be bent forwards at first, and then at the tip backwards. In front of it the terminal prominences stand out with an anterior and posterior knob or horn. Viewed terminally, but a little from the venter, these 4 knobs form a square, the scars of claspers being just behind the anterior ones. Seen dorsally, the cremastral spine is 1·8mm. broad at base. This spine has no rough points or spikes as in *M. tiliae* and *S. ocellata*, the ridges from below fade out on it into longitudinal lines, leaving the terminal ·8mm. almost smooth. The spiracles are narrow brownish slits round which the sculpturing curves, almost forming an outer false spiracle. Some little way behind the spiracle of the 3rd abdominal is a small depression, which may be quite a foveola, at which a subsegmental line of division ends. The ♀ pupa differs from the ♂ only in the stretching forwards of the 9th segment ventrally into the 8th, so that it is difficult to say that it does not reach its anterior borders; the double papilla of the ♂ 9th segment is here on the 8th (or produced 9th), or it may be so smoothed away as not to be observable (Chapman). Poulton describes and figures (*Ext. Morph. of Lep. Pupa*, pp. 203—204, pl. xx., figs. 8—11) the terminal abdominal segments of the pupa of this species. In a *female pupa*, seen ventrally, the anus is sometimes concealed, owing to the exceptional size of the anal cushions, which occasionally even retain the form of the larval claspers. An elongated opening, surrounded by a raised border, is situated in the normal position in front of the apex of the narrow median prolongation from the 10th abdominal segment. The opening is seen to be divided in two; it is probable that the posterior division represents the mouth of the oviducts; the anterior division corresponds to the bursa copulatrix. (The remarkable sculpture of the surface is indicated in the figure.) Seen from the left side the scar of the caudal horn is distinct, and the remarkable size and shape of the left anal cushion is better seen than from the ventral aspect.

Viewed from the left side and behind, the relative positions of the terminal spine, the anus and anal cushions are seen to bear precisely the same relation to each other as the anal flap, the anus, and anal claspers of the larva, thus supporting other observations which prove that these parts are respectively homologous. In the *male pupa*, seen ventrally, the opening of the male generative organs is distinct on the 9th abdominal segment; its direction is somewhat oblique, an irregularity which is not uncommon, and probably follows from the extremely ancestral character of the organs. The lateral lips are flattened, and marked with a sculpture which is different from that of the surface of the 9th abdominal segment. (See also *anteà*, vol, ii., pp. 53, 56.) Poulton further observes (*anteà*, ii., p. 59) that he has observed the light oblique stripes, with their dark green borders, of the larvæ of this species and *S. ocellata*, conspicuously appearing upon the surface just after pupation.

FOODPLANTS.—Willow, poplar (Peachell), aspen (Musham), *Populus*, *Salix* (Himsl), small species of moorland willow (Gordon), almost all plants of order *Rosaceae*, rose, poplar, willow, sallow, birch,* laurel, laurustinus,* (Merrin), osier (Bower), hawthorn (Prideaux), *Salix rubra* (Linné), all kinds of poplar (Hellins); *Populus dilatata*, *P. tremula*, *P. balsamifera*, *Fraxinus*, *Cotoneaster* (Siebke), birch* (Stainton), common laurel, laurustinus (Newman), apple (Bacot), black poplar, Lombardy poplar (Ransom).

PARASITES.—*Trogus lutorius*, Fab. (Fitch), *Paniscus testaceus*, Grav. (Marshall), *Ichneumon pisorius*, Linn. (Bouché), *Amblyteles monitorius*, Panz. (Giraud), *A. proteus*, Christ (Vollenhoven), *Cryptus fugitivus*, Grav. (Fallou), *Microplitis ocellatae*, Bouché [62 examples of this parasite emerged from one larva sent by Fenn to Bignell (*Ent.*, xviii., p. 327), the usual number is from 12 to 20 (Bignell)].

HABITS AND HABITAT.—Some contradiction appears in the various accounts as to the time of emergence of the imago, but although there is some variation, it is essentially a species that emerges at night, between 8 p.m. and 8 a.m. The imagines emerge late at night, the usual time about midnight, although they may emerge as early as 9.30 p.m., and as late as 8 a.m. (Bacot); in confinement the moths always emerge in the early morning, before 9.30 a.m. (Ransom); one emerged between 8 p.m. and 10 p.m., and remained in the same position till the next evening at sundown (Cowl); the imago emerges between 6 a.m. and 8 a.m. (Russell); imagines always emerge before sunrise (Merrifield). By day the imago rests on the trunks and branches of its various foodplants; on trunks and small branches of poplar, about Burnley (Clutten), also on the trunks of willow, as well as poplar, at Nottingham (Wright); the ♀ rests on tree-trunks, at about a foot from the ground, and remains there to pair (Bartlett). Both sexes fly at dusk, and we have repeatedly taken the ♀s flying over the tops of the tall poplar hedges at Deal after dark. The moth flies heavily at dusk, its flight slow and laboured, like that of *Manduca atropos*, which I frequently saw on the wing in India some years ago (Arbuthnott); both sexes fly at dusk;

* Bacot attempted to rear larvæ on birch and laurustinus, but the attempt failed utterly, the larvæ refusing to eat either of these reputed foodplants.

on one occasion, June 11th, 1896, some 30 examples were seen at one time flying about some sallow-bushes at the side of the high road at Corsemalzie (Gordon). The ♂ s assemble to a virgin ♀, generally late in the evening; and they are also attracted freely to light—commonly at Worcester (Rea), ♂ s at Weymouth (Peachell), at West Dulwich (Fletcher), at Lincoln (Musham), in the Wye Valley (Vaughan), commonly in the light traps at Oxton (Studd), at the electric lamps at Hampstead (Hopson), and Chester (Arkle), especially abundant on the street lamps at Gosport, often as many as 3 on a lamp (Pearce). Prideaux also notes a ♀ on a gas-lamp which had laid an egg on one of the glass panes. The habitats of this species are varied—poplar and willow plantations, borders of woods and parks, in gardens, by roadsides, in lanes, on moors, and more especially by ditches, on marshes, and by riversides, as well as on railway banks, in fact any locality that produces willow, sallow, aspen, or poplar may be looked upon as a likely place for this species.

TIME OF APPEARANCE.—Normally in May and June, in late seasons occasionally in July; in early seasons a partial second brood emerges in late July and August from pupæ of the year after a pupal period of only 3 or 4 weeks. Fritsch gives dates from April 28th—July 29th for Austro-Hungary; May 5th, 1888, at Benzûs Bay (Walker); May-June in the Linz district, June 5th—18th, 1896, at Ottensheim, June 29th — 30th at Gelgenheit (Himsl); May 28th, 1898, at Karu-Baglar (Bachmetjew); end of June in Namur district (Lambillion); from mid-May to mid-June in the Baltic Provinces (Nolcken); June 19th, 1898, at Hoel Renebo in Norway (Bingham-Newland), &c. Borkhausen notes the occurrence of a second brood at Giessen, and Unterberger observes (*Illus. Zeits. für Ent.*, iii., p. 119) that at Georgenswalde (Samland) four larvæ of *A. populi* pupated in July, 1879, that of these 3 emerged on August 19th, after being only three weeks in pupal stage —2 ♂ s and 1 ♀. These were under normal size, measuring, the ♂ s 5·2cm., the ♀ 5·1cm., the normal size being from 7cm.—9cm. Partial second broods are not uncommon in the south of Europe—the species is common in May-June, and rare in August-September in Piedmont, Tuscany and Liguria, September in Lombardy, April-May and August in the Haute-Garonne, May-June and August in Roumania, partial second brood in August at Hildesheim (Grote); May-June and August-September in Epiries, May-June and August at Budapesth; Fritsch notes one imago captured on October 26th at Linz; at light on August 29th, 1899, at St. Jean-de-Luz (Dupont); July 19th—23rd, 1890, at Tancarville (Leech). In Britain most of the following dates suggest first broods: two bred May 1st, 1844, two captured June 13th, 1844, May 23rd, 25th, 28th, June 2nd, May 13th, 25th, 30th, caught ♂ June 2nd, 1846, ♂ May 31st at Kensington, July 2nd, 1847, ♂ at Chelsea, July 17th, 1849, two *in cop.*, May 20th — June 1st, 1859, all at Brighton (Merrifield); April 4th—6th, 1857, May 15th, 1858, imagines taken July 27th—28th, 1898, at Brighton (Image); July 11th, 1855, July 14th, 1864, at Chertsey, May 28th, 1868, at Taplow, June 16th-26th, 1890, July 14th-20th 1892, at Kensington (Clarke); May 27th, 1858, and onwards at Barnstaple (Mathew); May 30th, 1859, at Stoke Newington, bred April 9th—June 10th, 1861, April 29th—

May 16th, 1862, May 17th, 1865, at light, bred May 10th, 1866, April 19th, 1876, May 29th — June 16th, 1885, June 12th—July 15th, 1887, May 24th—June 8th, June 25th, 1888, at light, May 23rd—June 30th, 1889, May 23rd, 1890, May 6th—10th, 1891, May 28th—July 18th, 1892, June 6th, 1893, July 7th, 1894, May 13th, 1896, all at Lee (Fenn) ; April 9th—15th, 1860, April 30th, 1861, at Worcester (Edmunds) ; May 30th, 1860, at Mansfield (Brameld); June 25th, 1860, at Ruthin (Ward) ; ♂ July 28th, 1860, ♀ July 29th, another on the morning of July 31st, on the morning of August 1st, the first two had paired (*Ent. Wk. Int.*, ix., p. 165), May 4th, July 1st and July 31st, 1861, July 13th, 1862, on Wandsworth Common, May 17th, June 4th, 1862, on Wimbledon Common, May 8th, 1863, at Mitcham, June 22nd, 1884, at light at Folkestone (T. Briggs) ; May 5th, 1861, at Islington (Huckett) ; May 7th, 1862, at Charlton, May 5th, 1867, at Eltham, June 11th, 1877, at Wicken Fen (A. H. Jones), bred May 26th, 1866, at Northleach (Todd) ; June 9th, 1868, at Contin (White) ; May 23rd, 1871, at Wanstead, May 20th, 1885, June 9th and July 2nd, 1887, at Brentwood (Burrows) ; June 1st, 1871, at Butterwood, June 3rd, 1880, at Bulmershe Park, June 14th, 1882, June 10th, 1886 at Reading ; often partly double-brooded (Holland) ; May 20th, 1873, June 14th, 1876, at road lamp, May 28th, 1883, June 27th, 1887, all at Lee, June 14th, 1882, on fence, May 29th, 1898, at road lamp at Eltham (Bower) ; a ♀ captured July 16th, 1873, at Wells, laid 160 eggs (Livett) ; May 30th, 1879, at Rugby (Solly) ; June 14th—26th, 1880, at Wicken (Porritt), July 2nd, 1884, at Norbury (Hall), July 1st, 1885, at Ladbroke Square (Rendall), July 12th, 1885, July 5th, 1889, May 25th, 1892, May 7th, 1893, July 11th, 1896, July 4th, 1898, May 31st, 1899, all in London (Middlesex) district; June 21st, 1900, abundant at electric light at Highgate Hill, August 31st, 1894, at Waldringfield, the latest date I have ever seen the species at large, July 25th, 1898, a fair male at light at Wicken Fen (James), July 9th—14th, 1886, June 9th—July 2nd, 1887, at Brentwood, June 15th, 1895, at Panton, June 12th, 1897, at Ulting, July 1st, 1900, at Hazeleigh (Raynor), ♀, May, 1887, at Bristol, ♂, June 29th, 1889, at Ashtead, ♂, June 14th, 1891, at Bristol, April 10th, 1892, at Roydon, ♂, April 10th, 1893, at Croydon, July 8th, 1897, at Norwood, ♂, June 5th, 1899, at Reigate, all at light, a ♀ on July 19th, 1887, at Plymouth, netted at dusk, a very small specimen, probably of 2nd brood (Prideaux), July 5th, 1887, at Glenferness (Scott), July 4th, 1888, captured ♂ on outside of breeding-cage which contained a newly-emerged and virgin ♀ (Griffiths), July 20th, 1888, common, bred May 12th—June 25th, 1896, at Chester, August 12th, 1896, at Rhyl (Arkle), May 19th, 1889, June 19th—22nd, 1890, May 20th—22nd, 1894, May 17th, 1896, May 21st, 1898, at Carlisle (Wilkinson), May 20th—27th, 1890, April 7th, 1891, at Tottenham and Clapton (Clark), June 23rd, 1890, at rest on fence at Harlesden, June 10th, 1891, June 9th, 1893, at gas lamp, May 19th, 1895, July 8th, 1897, at Ealing (Montgomery), assembled a ♂ June 22nd, 1890, at Southsea (Pearce), 1 ♂, July 29th, 1891, 2 ♂ s, 2 ♀ s, May 31st, 1 ♂, 2 ♀ s, July 4th, 1892, 1 ♂, July 11th, 1894, 1 ♂ at light, May 18th, 1895, at West Dulwich (Fletcher), May 13th—18th, 1892, May 15th, 1895, at

Woodford, May 16th, 1894, May 14th, 1896, May 21st, 1900, at Sandown, June 3rd—6th, 1898, at Aberdeen, June 21st, July 8th, 1898, June 6th, 1900, at Dalston, June 3rd, 1898, at Chingford (Prout), May 23rd, July 29th, 1892, pair *in cop.*, May 19th, 1893, June 13th, 1896, June 26th, 1897, July 31st, 1900, pair *in cop.*, at Reading (Butler), first imago June 1st, 1892, at Cheltenham (Brooke), common at Guildford, ♀ captured April 30th, 1893 (Grover), May 8th, 1893, May 3rd—16th, 1896, at Wisbech (Glenny), May 9th, 1893, at light at Enniskillen (Partridge), May 10th, 1893, June 11th—23rd, 1894, May 23rd, 1897, all in Cumberland (F. H. Day), May 16th, 1893, May 12th, 1895, pair *in cop.*, July 11th, 1898, pair *in cop.* at Bristol (Bartlett), May 29th, June 10th, 1893, at Margate, June 1st, 1896, at Hackney, June 19th, 1896, at Cromer, July 26th, 1898, June 12th, 1900, at Leytonstone (McIntyre), July 7th, 1893, July 6th, 1899, at Chiswick (Sich), July 15th—24th, 1893, at light at Wicken (Mitchell), June 26th, 1894, June 16th—24th, 1895, May 25th —June 9th, 1896, June 8th—July 9th, 1900, at Oxton, bred April 2nd —3rd, 1894, and March 17th, 1897, forced (Studd), larvæ on dwarf sallows September 5th—8th, 1894 at Enniskillen gave imagines that emerged May 22nd—June 4th, 1895 (Brown), larvæ fullfed at Llanstephan on September 30th, 1894, imagines emerged May 9th, 1895, larvæ July 23rd, 1896, at Mallow, imagines emerged May 20th, 1897 (Bingham-Newland), July 17th, 1895, April 23rd, 1896, June 8th, 1897, at Worcester (Rea), May 4th, 1896 (the earliest date over many years), and throughout June at Mansfield (Daws), May 5th, June 5th—11th, 1896, at Conway (Bland), May 12th, 1896, at Winchester (Broome), May 18th—June 2nd, 1896, June 24th, 1899, at Chelmsford (Miller), imago at light May 29th, 1896, at Newtown (Tetley), June 11th, 1896, June 10th—19th, 1898, abundant, June 22nd, 1899, at Corsemalzie (Gordon), pair *in cop.* first week in July, 1896, another pair August 7th (Mitchell), July 13th—16th, 1896, at Bath (Greer), pupæ September, 1896, gave imagines May 14th, 1897, pupæ September, 1897, produced imagines that emerged May 9th—13th, 1898, larvæ in August, 1898, gave imagines May 11th—21st, and one on June 12th, 1899, all from Fleet, pupæ at Otford on October 22nd, 1897, from which imagines emerged May 15th, 1898 (Russell), bred March 9th, 15th, 18th, 1897, March 16th, 17th, 20th, 21st, 28th, April 3rd, 6th, 1898, at Cambridge (Thornhill), May 30th, 1897, at Rugeley (Freer), July 2nd, 1897, pair *in cop.*, 1 fresh out on poplar treetrunk on May 29th, 1900, at 8.45 a.m., cold morning, easterly breeze, at Middlesborough (Lofthouse), May 24th, July 9th, 1898, at Hayling Island (May), May 28th—June 15th, 1898, in Isle of Man (Clarke), May 29th, 1898, at Eltham at light (Bower), June 30th, 1898, at Rainford, June 21st, 1900, at St. Helens (Cotton), April and May, 1899, bred from Cheltenham pupæ (Robertson), May 12th, 1899, at light, July 2nd, 1899, at Weymouth (Peachell), May 20th, 1899, at Ingleby Greenhow (Elgee), June 15th, 1899, imagines drying their wings, on trunks of poplar, June 7th—14th, 1900, at Burnley (Clutten), May 21st, June 6th, 7th, 1899, at York (Hewett), June 19th, 1899, at Bournemouth (Cowl), ♂ June 25th, 1899, at Sydenham, ♂ and ♀ July 16th, 18th at Dulwich, ♀ laid 183 eggs—is 94mm. in expanse (Swain), July 6th, 1899, on Norfolk Broads (Freeman), May 28th—June 3rd, 1900, at Hackney (Pickett), July 3rd, 1900, at Brockenhurst (Alderson), July 22nd, 1900, at Lichfield (Redmayne). The following suggest second or partial second broods: On poplar two autumnal examples at York (Wilson), a second-brooded ♀ came out at the end of August, and a ♂ at beginning of September, 1844, at Brighton (Merrifield), ♂ and ♀ taken May 25th, 1858, eggs hatched June 9th, first emergence of imagines from these August 13th, several following; the pupæ were kept quite naturally (Foster), pair found June 4th, 1859, at Huddersfield, eggs laid, which hatched June 15th, larvæ went down end of July, and beginning of August, imagines appeared from these on August 15th and following days, pairings and eggs being obtained (Tindall), August 23rd, 1866, ♂ drying wings, no doubt belonging to a 2nd brood at Worcester (Edmunds), pair bred middle of June, 1859, produced eggs which hatched, the larvæ pupating August 2nd and following days, and the imagines appearing August 16th on; other imagines appeared same time from wild larvæ taken in the summer which were fed out of doors at Barnstaple (Mathew), July 17th, 1861, captured at dusk, bred July 18th—25th, 1862, July 14th, 1863, at light, July 24th, 1864, took two *in cop.* on palings, July 12th, 19th, 1885, at light, July 7th, August 3rd, 1886, August 13th, 1887, all at Lee (Fenn), larva June, 1868, pupated first week in July, imago August 3rd, at Folkestone (Taylor), freshly emerged 1st week in August, 1868, at Oxford (Matthew), imago emerged December, 1870, from September 1870 pupa at Bristol (Hudd), pair *in cop.* taken April 27th, 1872, —eggs obtained and larvæ from which went down June 17th—24th, 2 imagines on July 8th, and from then to July 15th 30 more (Craik), an imago found at root of a poplar, wings quite limp, at Hertford, January 20th, 1873 (Simmons, *Ent.*, v., 317), on August 6th, 1873, a ♀ emerged from pupa bred from a caterpillar that only went to earth July 16th at Beckenham (Browne), eggs May, 1883, pupated July, 10 imagines bred beginning of August (Mitchell), larva fullfed July 14th, 1883, pupated July 19th, imago August 17th at Walthamstow (Jobson), larva pupated June, 1884, imago August 2nd, 1884, at Norbury (Hall), eggs June 18th, 1887, from Canterbury, larvæ fed up and 6 pupated from which two imagines, one on August 18th and the other August 20th, emerged the same year, the others emerged next year, May 13th—June 11th (T. H. Briggs), ova laid (bred parents) April 23rd, 1887, hatched May 26th, larvæ commenced to bury June 26th, ♂ emerged July 26th, remainder normally next year; pairing from bred specimens, unforced, on May 20th, 1892, 1 ♂ emerged (unforced) August 31st, 1892, remainder normally next year (James), several imagines in August, 1889, from ova laid three months before (Adye), fullfed larvæ pupated July 14th, 1889, imagines emerged August 14th at Southsea (Pearce), about 40 larvæ pupated end of June, 1892, 6 of which produced imagines in August of the same year, also assembled a wild newly-emerged ♂ in August to one of these bred ♀ s, others emerged from May 3rd, 1893, at Clapton (Bacot), from 1893 larvæ one ♂ was bred July 28th, 1893, rest emerged June and July, 1894 at Guildford (Grover), larva June 28th, 1896, pupa June 30th, imago August 15th, 1896, at Ealing (Bell-Marley), from pupæ taken at Fleet in September, 1896, an imago emerged November 20th, the rest going over to next year (Russell), August 5th, 1898, at Hazeleigh (Raynor), imago August 6th, 1898, at Lee, larvæ at same time (Carr), August 10th, 1898, on Norfolk Broads (Freeman), at Dorking, ova June 4th, larvæ fullfed July 4th, 1901, imagines July 25th, and following days (both sexes), eggs obtained July 30th, hatched August 6th, larvæ fed slowly, and only 7 had pupated by September 3rd, 1901 (Oldaker), May 25th, 1898, eggs June 9th, several imagines August 13th and following days at Hayling Island (Forster), bred a ♂ September 16th, 1898, from an egg laid in June, 1898, at Penzance (Daws), five imagines emerged August, 1899, from pupæ of the year at Brighton (Cardinall), partial second-brood, three years in succession, at Larkfield, one larva pupated, among others, on July 26th, 1899, and the imago emerged August 28th, 1899 (Saxby). Carrington observes that by feeding the larvæ liberally in a warm greenhouse, three broods may be reared in a year, and Rössler states that in Nassau, in warm summers, three broods have sometimes been noted in nature, whilst West records that in April, 1893, he obtained eggs which had resulted in imagines in July, 1893, from these he obtained eggs, resulting in pupæ in August, some of which disclosed imagines September, 1893, the rest going over till the spring of 1894 (*Proc. Sth. Lond. Ent. Soc.*, 1894, p. 44).

LOCALITIES.—Abundant throughout Ireland from Malin Head to Cork (Kane), also generally distributed in Scotland to Ross and Sutherland. ABERDEEN: common throughout (Reid), Aberdeen (Prout). ANGLESEA: common throughout (Day). ANTRIM: Glenarm, near Larne (Brunton). ARGYLL: Kilberry (Cottingham), Dunoon (Chapman). ARMAGH: Armagh (Johnson). AYR: frequent Ballantrae (Dalglish), Kilmarnock (G. Rose), Ayr (Fergusson), Cloncaird Castle (Anderson). BEDFORD: Bedford (Steuart). BERKS: Hurst (Broome), Reading dist., common (Henderson), Bulmershe Park, Burghfield, Tilehurst (Holland). BUCKS: Buckingham, common (Slade), High Wycombe (Peachell), Taplow (Clarke), Halton, very common, Wavendon (Stainton). BUTE: Arran (Arbuthnott). CAMBRIDGE: common throughout Fen district (Balding), Ely (Stephens), Quy, Cherryhinton (Peachell), Wicken Fen (Tutt), Cambridge (Waters), Boxworth (Thornhill), Wisbech (Glenny). CARNARVON: common throughout (Day), Conway, Trefriw (Bland). CARMARTHEN: Llanstephan (Bingham-Newland), Llanelly (Baker), Langharne (Kaye). CHESHIRE: common throughout (Ellis), Sandbach (Heap), Chester, abundant (Arkle), Macclesfield (South), Birkenhead, common (Stainton). CORK: Mallow (Bingham-Newland), Timoleague, rather common, Glandore (Donovan). CUMBERLAND: tolerably abundant throughout—Orton, Salkeld, Cummersdale, &c. (F. H. Day), Carlisle district, common (Wilkinson), Lake district, common (Stainton), Cockermouth (Robinson), Keswick, not uncommon (Beadle), Wear, Hayton, Castle Carrock (Routledge). CORNWALL: Paul, near Penzance, common (Daws), Truro, common (Stainton). DENBIGH: common throughout (Day), Ruthin (Ward). DERBY: common everywhere (Payne), Derby (Sheldon), Burton dist., common throughout (Brown), Burton-on-Trent, very common (Stainton). DEVON: Oxton, common (Studd), Braunton (Bartlett), Barnstaple (Mathew), Sidmouth (Wells), Stoke (Harvie), Dartmoor (Still), Plymouth (Bignell), Exeter, common, Teignmouth (Stainton), Morthoe (Longstaff), Ilfracombe (Henderson), Honiton district, common (Riding). DONEGAL: Derry district (Campbell). DORSET: common throughout (Dale), Weymouth (Peachell), West Bournemouth (Robertson), Blandford (Stainton). DUBLIN: Howth (Fitzgibbon), Palmerston Park, near Dublin (Flemyng), Blackrock (Greer). DUMFRIES: Moffat (Somerville), Dumfries (Lennon). DUMBARTON: Garelochhead, common (Henderson), Milngavie (Dalglish), Bonhill (J. S. R. M.). DURHAM: generally distributed, Hartlepool, Monk-Hesleden (Robson), Bishop Auckland (Ross), Durham, fairly common (Maddison), Valley of Derwent and south banks of Tyne (Hedworth), Middleton-in-Teesdale (Lees), Darlington (Backhouse), Stockton (Sibson), Teesdale district (Bower). EDINBURGH: Edinburgh district, common (Evans). ELGIN: common throughout (Horne), Forres, abundant (Norman). ESSEX: generally common throughout—Colchester, &c. (Harwood), Wanstead, Brentwood, Rainham, Mucking (Burrows), Eastwood, Southend (Whittle), Feering Bury, very common (Reid), Chelmsford (Miller), Ulting, Hazeleigh (Raynor), Sudbury district, common (Ransom), Chingford (Prout), Woodford (Bishop), Forest Gate (Mera), Walthamstow (Jobson), Leytonstone (McIntyre), Ilford (Adams), Epping, common (Stainton). FERMANAGH: Enniskillen (Allen). FLINT: common throughout (Day), Rhyl (Arkle). GALWAY: Galway (Dillon), St. Clevans, &c. (Lawless). GLAMORGAN: Swansea (Robertson). GLOUCESTER: Bristol, common (Bartlett), Cheltenham district, very common (Robertson), Painswick district (Watkins), Lower Guiting (Stainton), Northleach (Todd), Stonehouse (Nash), Cirencester (Harman), Cheltenham (Brooke), Cotham, Clifton (Griffiths), Tewkesbury district (Fox). HANTS: Basingstoke (Holdaway), Bisterne (? Bitterne) (*Subs.*, p. 20), Winchester (Broome), Fleet (Russell), Sandown (Prout), St. Helens, near Ryde (Jordan), Brockenhurst (Alderson), Southsea, Portsmouth district, Gosport (Pearce), Ringwood (Fowler), New Forest (Adkin), Christchurch (Adye), Burghclere (Alderson), Southampton (Moberly), Hayling Island (May), Greswell, Butterwood, near Odiham (Holland), Bournemouth, Winchfield (Robertson). HEREFORD: Leominster (Hutchinson), Tarrington (Wood), Hereford (Chapman). HERTS: Hitchin, Knebworth (Griffith), Hertford (Simmons), Roydon (Prideaux), Baldock (Wood). HUNTINGDON: St. Ives (Norris). ISLE OF MAN: generally distributed—Tholt-e-Will, Sulby, Lezayre, Cranstal Loch, Kirkbride, Douglas, Peel, Ramsey, Castletown (Clarke). KENT: common, even in London district (Tutt), Wye and Ashford district (Theobald), Eltham, Bexley, Grove Park, Darenth, Bromley, Stone (Bower), Beckenham (Browne), Folkestone, Canterbury (T. Briggs), Charlton (Jones), Otford, Ashford (Russell), Deal (Tutt), Rochester and Chatham district, not uncommon (Chaney), Lewisham (Stainton), Lee (Carr), Ramsgate (Willson), Sydenham (Swain), Tonbridge (Raynor), Margate (McIntyre), Tenterden, common (Stainton), Northfleet (Andrews), Larkfield (Saxby), Greenwich, etc. (West). KERRY: Garinish Island, common (Lawless). KINCARDINE: common throughout (Horne). KIRKCUDBRIGHT: Douglas, abundant (Robinson). LANARK: common, Possil, Cambuslang (Dalglish), Glasgow, very common (Stainton), Lighthill (Ord), Kelvingrove (Eggleton). LANCS: common throughout (Ellis), common in north Lancashire (Murray), Rainsford, Knowsley Park, St. Helens (Cotton), Hulme (Adamson), Burnley (Clutten), Dutton (Shuttleworth), Chat Moss (Auld), Prescot (Freeman), Newchurch, in Rissendale (Eddrup), Halliwell, near Bolton (Whittaker), Grange (Booth), Preston, common, Manchester, very common (Stainton). LEICESTER: very common, Aylestone, Knighton, Quorn, Gumley, &c. (Bouskell), Leicester (Stainton). LINCOLN: common (Carr), Panton (Raynor), Grimsby (Nicholson), Lincoln (Musham). LONDONDERRY: Derry (Campbell). MAYO: Mayo (Fetherstonhaugh). MERIONETH: Harlech district (Graves). MIDDLESEX: generally common (Godwin), Bedford Park, Chiswick Park (Cockerell), Kingsbury (Bond), Hampstead (Hopson), Chiswick (Sich), Upper Clapton (Raynor), West Drayton (Burrows), Hackney Marshes (Anderson), Highbury (Hodge), Harrow-Weald (Brown), Paddington, Hampstead (Phillips), Earl's Court, Kensington (Clarke), Dalston, Stamford Hill, Tottenham district (Prout), Canonbury, Islington (Buckell), St. James' Park (Tarbat), Hendon, Mill Hill, St John's Wood (South), Bloomsbury (Brit. Mus. Coll.), Isleworth (Myers), Harrow district (Rothschild), Kilburn, Willesden (Wormald), Ealing (Bell-Marley), Stoke Newington (Fenn), Enfield (Sykes), Ladbroke Square (Rendall), Haverstock Hill (Hill), Highgate, Crouch End (James), Harlesden, (Montgomery), Acton (Clifford), Waltham Cross (Bowles). MONMOUTH: Wye Valley (Vaughan). MONTGOMERY: Newtown (Tetley). NAIRN: Ardclach district, rare, Glenferness (Scott). NORFOLK: Norwich (Harris), Whitwell, Norfolk Broads (Freeman), Great Yarmouth (Miller), Cromer (McIntyre). NORTHAMPTON: Kettering (Sturgess), Northampton (Imms), Peterborough (Morley). NORTHUMBERLAND: widely distributed, Twizell (Robson), Morpeth (Finlay), Newcastle (Maling). NOTTS: Mansfield, common (Daws), Newark (Gascoyne), Worksop (Alderson), Chilwell, Bramcote (Pearson), Nottingham (Wright). OXFORD: Oxford (Mathews), Chinnor (Spiller), Warren, Goring (Holland), Caversham (Henderson). PERTH: not uncommon, Forth, Earn, Gowrie, Perth and Rannoch districts, Greyfriars, Woody Island (F. B. White). RENFREW: common, Crookston, Pollokshields (Dalglish), Paisley (Smith), Johnstone (Watson), Bridge-of-Weir (Arbuthnott). ROSS: Contin (White). ROXBURGH: Hawick district, common (Guthrie), Galashiels, common (Haggart), Jedburgh, very common, Laurieston (Elliot). RUTLAND: Uppingham (Bell). SHROPSHIRE: Market Drayton district, common (Woodforde), Shrewsbury (Stainton). SOMERSET: Bath (Greer), Taunton (Buckland), Bristol coalfield district, common (Hudd), Castle Cary, frequent (Macmillan), Weston-super-

Mare (Drakeford), Wells (Livett). STAFFS: common in north Staffs (Daltry), Lichfield (Redmayne), Stone, fairly common (Masefield), Burnt Woods and Market Drayton district, very common (Woodforde), Burton-on-Trent district (Brown), Leek (Hill), Rugeley and Cannock Chase (Freer). STIRLING: Fintry (Eggleton). SUFFOLK: common (Bloomfield), Sudbury district, common (Ransom), Bentley (Burrows), Ipswich (Pyett), Lowestoft, Waldringfield (James), Stowmarket, common (Stainton). SURREY: Barnes, Wandsworth Common, Wimbledon Common, Mitcham (T. Briggs), West Dulwich (Fletcher), Reigate, Norwood (Prideaux), Streatham, Herne Hill, Tulse Hill (Henderson), Chertsey, Worcester Park (Kaye), Kingston-on-Thames (Cooper), Nunhead (Barrett), Dorking district, common (Oldaker), Croydon (Sheldon), Guildford (Grover). SUSSEX: generally common in East Sussex (Jenner), Bognor (Lloyd), Bersted, Worthing (Fletcher), Lewes (Nicholson), Brighton (Fry), Hastings, St. Leonard's (Bloomfield), Cuckfield (Merrifield), Chichester (Anderson), Groombridge (Blaber). SUTHERLAND (Stainton). WARWICK: Rugby (Peachell), Birmingham (Imms), Aston (Henderson). WATERFORD: Portlaw, common (Flemyng). WESTMEATH: Mullingar (Middleton). WESTMORLAND: common in all the districts bordering on north Lancashire (Murray), Kendal district (Moss). WIGTOWN: common, Stranraer (Dalglish), distributed over the county—Monreith, Portwilliam, Corsemalzie (Gordon). WILTS: Calne (Eddrup). WORCESTER: very common—Worcester (Rea). YORK: common all over the county (Porritt), Hull district, common (Boult), Huddersfield (Tindall), Norbury (Hall), Cleveland district (Gribble), Middlesborough (Lofthouse), Ingleby Greenhow (Elgee), Scarborough (Finch), Teesdale district (Bower), Selby district (Ash), Driffield (Dawson), York, common (Stainton), Whitby (Sich), Saltburn (I'Anson), Rotherham (Rodgers).

DISTRIBUTION.—All Europe, except the Polar region, as far as Transcaucasia, also throughout south-eastern and central Asia to the Kuku-Nor district, to the south in Mauretania (var. *austauti*). AFRICA: Algeria, Morocco (Austaut). ASIA: everywhere to the Altai (Speyer), Persia—Irak (Young), Syria—Akbèr (Oberthür), Turkestan (var. *populeti*) (Erschoff), Kouldja district (var. *populeti*) (Alphéraky), Pamir—Oche (var. *populetorum*) (Grum-Grshimailo), south-west Siberia, Tobolsk, Uralsk, Turgai, Akmolinsk, Semipalatinsk—the Altai on the upper Irtish, between Ust-Kamenogorsk and Ust-Buchtarminskaja, Tomsk, Jenisseisk, Irkutsk (*teste* Bartel), Saisan (Staudinger). AUSTRO-HUNGARY: Bukovina, distributed (Hormuzaki), Pressburg (Rozsay), Bohemia, everywhere (Nickerl), Galicia—Sambor, Lemberg, &c. (Nowicki), Cracow (Zebrawski), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Hermannstadt (Czekelius), Epiries, common (Husz), Hungary—Kocsocz (Vángel), Gölnitz (Hudák), Tyrol, not rare (Hinterwaldner), Lavantthal (Höfner), Taufers, Innsbruck (Weiler), near Fiume (Mann), Upper Styria — St. Lambrecht (Kodermann), Upper Austria — Linz district, everywhere, Ottensheim, Gelgenheit, Inn valleys, not rare (Himsl), Carinthia — Friesach, Lower Austria — Vienna, Bohemia —Prague, Carlsbad, Moravia — Mährisch-Trübau, Brünn, Ungarisch-Brod, Tarnów, Szklo, Stanislawczyk, Brody, Transylvania, Kaschau, Leutschau, Rosenau, Neusohl, Raab, Budapest, common, Heveser Comitat, Grosswardein, Fünfkirchen, Croatia, Josefsthal (*teste* Bartel). BELGIUM: common (Donckier), very abundant, Namur (Colignon), Frameries, Quaregnon, rare, Valley of the Molignée, common (Derenne), all over the country, very common (Lambillion). BULGARIA: Karu-Baglar (Bachmetjew). CHANNEL ISLANDS: Guernsey, not uncommon (Luff), Jersey (Jordan). DENMARK: common everywhere (Bang-Haas). FINLAND: south and south-east Finland (Lampa), Aland, Kristinestad (Reuter). FRANCE: common everywhere—Rennes, Besançon, Digne, Châteaudun, Evreux, near Paris, Vernet-les-Bains, Château du Loir (Oberthür), Le Havre (Dupont), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne (Sand), Eure-et-Loir (Guénée), Haute-Garonne, everywhere, very common (Caradja), Puy-de-Dôme (Guillemot), Var (Cantener), Morbihan (Griffith), Gironde (Trimoulet), Aude (Mabille), Saone-et-Loire (Constant), Seine-Inférieure (Viret), St. Quentin (Dubus), Sarthe (Desportes), Doubs (Bruand), Basses-Pyrénées — St. Jean de Luz (Dupont), dept. du Nord, common everywhere (Paux), Normandy — Tancarville (Leech), Paris—Port Marly (Walker), Loire-Inférieure, somewhat common—Savenay, Nantes, La-Chapelle-sur-Erdre (Bonjour). GERMANY: everywhere, not rare (Heinemann), Silesia, everwhere common (Assmann), north-west Germany, general (Jordan), Rhine Palatinate (Bertram), Wurtemberg (Seyffler), Giessen

(Dickore), Lower Elbe district, common everywhere (Zimmermann), Waldeck (Speyer), Erfurt (Keferstein), Biedenkopf (Glaser), Darmstadt (Borkhausen), Zeitz-on-the-Elster (Wilde), Halle (Stange), Munich, common (Kranz), Rudolstadt, common (Meurer), Mecklenberg, common (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia (Schütze), Dresden (Steinert), Thuringia (Krieghoff), Prussia (Schmidt), Upper Lusatia, very common (Moeschler), Nassau (Rössler), Ratisbon (Schmid), Pomerania, common and variable (Hering), Dessau (Richter), Alsace (Peyerimhoff), Nassau (Rössler), Wernigerode (Fischer), Chemnitz (Pabst), Brunswick (Heinemann), Hanover, sometimes common (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), Cassel (Sich), Königswinter, near Drachenfels (Jordan), Heligoland (Gätke), Hildesheim, common (Grote), Berlin district, everywhere common (Pfützner), Holstein, Hamburg, Lüneburg, Crefeld, Barmen, Elberfeld, Cologne, Bonn, Ober-Harz, Halle-a.-S., Leipzig, Stuttgart, Kempten, Frankfort-on-Main, Wiesbaden, Wetterau, Trier (*teste* Bartel), Baden, everywhere—Constance, Carlsruhe, &c. (Reutti). ITALY: throughout, rather rare in the south, also in Sardinia and Corsica (Curò), Modena (Fiori), Roman Campagna, common (Calberla), Lombardy, Piedmont, Liguria, Tuscany, Sicily — Monreale, near Palermo (*teste* Bartel). NETHERLANDS: in all provinces, very common (Snellen), Breda, very common (Heylaerts). PORTUGAL (*teste* Bartel). ROUMANIA: everywhere—Grumazesti, Comanesti, Tulcea, &c. (Caradja). RUSSIA: Baltic Provinces — throughout and common (Nolcken), Moscow district (Albrecht), Volga district, not rare (Eversmann), St. Petersburg (Erschoff), Transcaucasia—Borjom, rather frequent, Ourmous, Lagodekhi, Helenendorf (Romanoff), govts. Archangelsk, Oblonez, Pskow, Mogilew — Gorki, Volhynia, Kiev, Podolia — Kamenez-Podolskii, Bessarabia, Cherson, Jekaterinoslaw, Poltawa—Lubny, Charkow, Orel, Kaluga, Tambow, Lower Volga district, Kasan, not rare, Simbirsk, Ufa, Orenburg, Samara, Saratov, Astrachan — Sarepta, Taganrog on the Sea of Azov, Tawritschesk, Stavropol, North Caucasus (*teste* Bartel). SCANDINAVIA: generally common (Wallengren), Hoel Renebo (Bingham-Newland), Norway and Sweden, common up to 66° N. lat. (Aurivillius), very rare at Bergen, Christiania, Aamot, Aaset, Drammen, Odalen, Naes Vaerk, Hardangeria (Siebke), South Sweden — Helsingland, Umeå, south and central Norway (Lampa), Lapland—East Gothland, Gothland, &c. (Zetterstedt). SPAIN: Andalusia—Malaga (Rambur), Teruel—Valderrobres, Huesca, common (Zapater), Galicia—Santiago (Macho-Velado), Barcelona, &c. (Cuní y Martorell), Catalonia (Martorell y Peña), Bilbao, not frequent (Seebold), Navarre — Alsasua (Oberthür), Benzûs Bay, Gibraltar (Walker). SWITZERLAND: throughout, reaching to the mountain-region (Frey), in Cantons St. Gallen and Glarus (Heer), Grisons (Killias), Weissenburg (Huguenin), Thun (Jordan), Bechburg (Riggenbach-Stehlin), Bern, not very common (Hiltbold), Cours-sous-Lausanne (Chaumette). TURKEY: Gallipoli (Mathew).

ADDENDA RELATING TO THE AMORPHIDS.

AMORPHA HYBR. INVERSA, Tutt (page 395).

We have (*anteà*, pp. 395—396) thrown some doubt on the parentage of certain moths said to have been bred from ♂ *A. populi* × ♀ *S. ocellata*. Since we wrote our notes on the species, Standfuss has successfully reared two imagines of this crossing, one March 20th, 1902, the other May 11th, 1902, from pupæ obtained in the autumn of 1901, a pairing on June 25th—26th, 1901, having yielded 18 larvæ, only two of which pupated. The imagines are nearer *A. populi* than are normal examples of *Smerinthus* hybr. *hybridus*, but yet have unmistakable traces of the ocellated spot of *S. ocellata* on the hindwings (see *Ent. Rec.*, July, 1902).

MIMAS TILIÆ (page 401).

VARIATION. — Standfuss has made (*Insekten-Börse*, xix., p. 163) various experimental crossings directed to ascertaining the respective influence of the progeny of phylogenetically older and newer forms, when crossed—(1) Within the limits of a single species. (2) Different species of the same genus. (3) Different genera. Under the first heading he gives the following statistics for *M. tiliae* paired with a new aberrational form, in which the central fascia is more or less obsolete:

1. ♂ type × ♀ aberr.—Brood = 72 moths, all normal.
2. ♂ type × ♀ aberr.—Brood = 65 moths, all normal.
3. ♂ aberr. × ♀ type.—Brood = 69 moths, 1 ♀ slightly aberrant.
4. ♂ aberr. × ♀ type.—Brood = 52 moths, one ♀ resembling the aberrative ♂ parent, rest normal.
5. ♂ aberr. × ♀ type.—Brood = 81 moths, 1 ♂ and 1 ♀ intermediate between aberr. and type, also one pair similar to aberrative ♂, 77 normal.

Standfuss observes that the aberration used was a rather rare one, and the experiment was only possible through having at disposal, at the same time, more than 1000 dug pupæ from all parts of central Europe. The reversion to type forms a very high percentage, and the aberration appears in such very small numbers that it is pretty certain that it is not able to maintain itself in a state of nature.

Family: SPHINGIDÆ *.

The *Sphingidae* form the second great family of the superfamily SPHINGIDES, and comprise the following main branches—*Pterogoninae*, *Hemarinae*, *Sesiinae (Macroglossinae)*, *Eumorphinae*, *Manducinae* and *Sphinginae*—represented in the Palæarctic fauna, there being possibly other important subfamilies among the tropical and subtropical species, where the superfamily has its metropolis. The number of species and their remarkable specialisation in certain respects are facts that immediately arrest the attention of the student, but, in spite of their large size and their general abundance in the imaginal state in collections, our detailed knowledge of the early stages of the great mass of the species is practically *nil*, and hence any attempt at classification, based on the broader characters furnished by the egg, larva, pupa, as well as imago, must be recognised as merely tentative and open to considerable modification as material comes to hand. Chapman and Bacot have undertaken for this work to formulate their opinions based on the examination

* Jordan, to whom we have submitted proof of our work, and who is now engaged on a revision of the *Sphingidae*, which is to be published in *Novitates Zoologicae*, writes (*in litt.*): "The hawk-moths fall into two sharply separated groups which we have termed *Sphingidae-Asemanophorae* and *Sphingidae-Semanophorae* in the revision of the *Sphingidae*; for details see *Novitates Zoologicae*, ix. suppl. (1902) which will be published during the year. To the first group belong what is termed (*anteà*, pp. 366—367) *Amorphidae*, *Manducinae*, and *Sphinginae*; while the rest comes into the second group. There are no connecting links between the six divisions. Each division has its own tendency of development. The *Sphingidae-Asemanophorae*, represented in the European fauna by a few specialised forms, show a marked tendency of becoming specialised by the reduction or loss of organs, while the prevailing tendency among the *Sphingidae-Semanophorae* (*Macroglossinae*, *Eumorphinae*, &c.) is to develop new structures. The *Amorphidae* and *Sphinginae* of Chapman's classification (*anteà*, p. 367) both contain forms which have lost the frenulum, and have a functionless tongue. Chapman is quite correct in associating the so-called *Ambulicinae* with his *Amorphinae*, there is, in fact, nothing to separate the two. Chapman's division of the Sphingids, according to the pupa (*anteà*, p. 367) does not take cognizance of those *Sphinginae* in which the proboscis does not reach to the extremities of the wings. A number of *Macroglossinae* have the abdomen not tufted. The small head and retractile front segments, attributed above only to the *Eumorphinae* and *Macroglossinae*, are found also in some *Sphinginae* of Australia. The peculiarly curved-shaped horn of the larva of *Manducinae* is met with among *Sphinginae*. The head of some Sphingine larvæ is small, sometimes triangular as in *Amorphidae*."

of such pupæ and larvæ respectively as they have been able to accumulate, and the former furnishes the following important contribution to the phylogeny of the group. He writes *(in litt.)*: "In dealing with the phylogeny of the *Sphingidae*, it is necessary to review the whole group, and it is impossible to escape the division into *Amorphidae* (Smerinthids) and *Sphingidae*, which is pointed out by so many differences, and has been recognised, apparently easily by so many observers. But here at once we have to reconcile this position with the fact to which Bacot calls our attention, and which is a fundamental one. He shows us that the Eumorphids in the earliest larval stage possess discrete thoracic tubercles, whilst all the other divisions have them conjoined; unless, therefore, we postulate a diphyletic origin for the group, for which there is really no other good reason, we must believe that the primitive Sphingid had such a larva, *i.e.*, with the thoracic tubercles discrete and not conjoined. This position is not affected by any question as to the homologies of these tubercles and what they are to be called. This was the character of the larva of the primitive Sphingid, but only in its first stages. The adult Sphingid larva may have been much the same as that we now find in any of the groups, I am not now concerned to guess which. This character taken alone places the *Eumorphinae* alone as primitive, and throws together the *Sphinginae*, *Amorphidae*, *Sesiinae (Macroglossinae)* and *Hemarinae*, into one group *(anteà*, p. 366). The pupal facts flatly contradict this; they show that the Sphingids, as distinguished not only from the Amorphids but from all other lepidoptera, have a specialised structure, which one cannot believe to have been diphyletic without the very clearest and most cogent evidence. Can anything of this kind be said about the larval tubercles? The larval tubercles are often of very persistent type throughout large groups, and their evidence is not to be regarded as otherwise than very strong; still this change from a separate to a conjoined condition is one that is very frequent, and occurs over and over again throughout the lepidoptera; that it should occur twice over instead of only once within one particular family is perhaps a little unusual, but still more or less in the ordinary course of things. The primitive Sphingids then had discrete thoracic tubercles in the first larval stage, but they had not the pupa of the *Sphingidae*. It was a pupa more like that of *Smerinthus* but not necessarily the same. Did the proboscis of this pupa reach to the end of the wings? If we assume that it did not, but followed the type of *Amorpha*, then we may believe that the difficulties of again separating the wings and getting the proboscis to their tips, led to the attempt to accommodate the proboscis by throwing the head backwards. If we assume that it did, then the throwing back of the head was a variation, the precise reason of which is not clear, any more than we know why precisely similar requirements led to a pouch being formed at the end of the wings in *Plusia* and *Cucullia*. Something of this sort had to be done, *Plusia* did it in one way, *Sphinx* did it in another, why, we do not know, but if this be so, one ought to have some hope of meeting with a pupa, essentially Amorphid, but with the proboscis to the end of the wings, not as a special modification of either the Amorphid or Sphingid pupa, but as a reminiscence of the ancestor of both, and without necessarily expecting any other ancestral features. Such a pupa we appear to have in *Ceratomia amyntor*. After the division into Sphingids and Amorphids occurred, one of the first variations to take place in the latter was in the 1st stage larva acquiring (independently) conjoined tubercles. The extraordinary resemblance of *Deidamia*, a Sphingid, to *Smerinthus*, both in imago and in pupa, may be merely a result of convergence, but it at least gives one a suspicion that some such form of imago and of pupa obtained in the primitive Sphingid. The essential difference between the Amorphids and Sphingids in the pupal state appears to be the existence in the Amorphids of a dorsal thoracic suture opening on dehiscence, and which is absent on the Sphingid side. This is a definite structural difference, a generalised character in the Amorphids, specialised in the Sphingids. The broad descriptions given of the pupæ of the several groups are applicable to the great mass in each group, and are not upset by exceptions, which are, on the contrary, most useful as indications of the points at which the several groups parted their ways. One such pupa is that of *Daremma undulosa*, whose pupa, at first sight, is distinctly an Amorphid—eyes frontal, wings meeting; it even has the free pupal surface scale often seen in Amorphid pupæ, and so frequent, for example, in the pupa of *Mimas tiliae*. Not only is the pupa very Amorphid in appearance, but so unquestionably is the moth in several particulars. We find, however, on closer examination, that the dorsal suture of the thorax is absent, showing it to be definitely on the Sphingid side of the dividing line, even if very close to it. *Ceratomia amyntor* is a very similar pupa, but further from the Amorphids in having the proboscis extended to the wing-apices. It is a *Sphinx* in everything except that the dorsal movement of the head had not commenced; this is never so pronounced in moths belonging to the subfamily *Sphinginae* as in other *Sphingidae*, the pupal tongue-horn relieving pressure before it had advanced much, whilst in Eumorphids no pupal tongue-horn appeared until the labrum had been forced to a dorsal position. *Everyx myron*, *E. choerilus* and *Daraspa versicolor* have pupæ with head-parts ventrad as in Amorphids; they are, however, without dorsal suture, and, in most other respects, are Eumorphids. The imagines, nevertheless, have a very Amorphid facies, with Amorphid antennæ, in full accordance with the Amorphid characters of the pupa. We cannot doubt that here again, this time on the Eumorphid branch, we are somewhere near the common base. When we come to the Sesiid (Macroglossid) division we find three branches that we may call the *Pterogoninae*, *Hemarinae* and *Sesiinae (Macroglossinae)*, which have almost equal claim to separate rank with the *Sphinginae* and *Eumorphinae*. The Pterogonids again, as in *Deidamia*, present many Amorphid features. The *Pterogoninae* are certainly the most basal of these divisions, with the *Hemarinae* as a possible branch, quite separate from and lower than the Sesiid (Macroglossid) division, which presents so many features parallel to the Eumorphids that one is not at all sure that it did not arise from that instead of the Pterogonid division. Further, that group of Sphingids of which we may take *Philampelus* as the type, and which is, in many ways, very similar to and parallel with the Eumorphids, seems to be a distinct branch, originating in the Pterogonids, and having no direct descent from the true Eumorphids, whose oldest traces are probably in the "*Myron*" group. This branch would probably include *Pachylia* and *Dilophonota*, and *Manduca** might possibly be a branch here. This question can only be resolved satisfactorily by a study of the young larvæ. All these divisions, originating practically together and not one from another, have to be reconciled with the generalised state of the young larvæ in Eumorphids, otherwise one of the most specialised groups. If we consider that the groups did so arise, *i.e.*, together, a certain confusion of characters in the lower portions of the branches is not only very probable but practically inevitable. A special group, like the Sphingids or the butterflies probably arose, one might almost say, fully developed. For some reason, say a rapid change of conditions—climatic, floral, parasitical, or what not—or a sudden access of variability in some special direction in the ancestral species or genus, threw open as it were to competition, a whole new world, to which they were able to adapt themselves; this they colonised by rapid and abundant variation in all directions, and, at this period, various distinct lines might easily acquire similar structures quite independently of each other. When this new world was fully colonised, so to speak, evolution would fall back into its more regular and humdrum routine."

The ova of the *Sphingidae* are, in their broad aspects, very uniform, and are very similar to those of the *Amorphidae*. Such specialisation as there is, is found to be either in the direction of small size, or in the reduction of the surface reticulations in order to obtain a smooth surface.

The larvæ of the *Sphingidae*, as we have already noted (*anteà*, pp. 367—368), although extremely specialised in colour, form, and resting-position, are structurally, especially so far as the tubercular setæ are concerned, of a generalised type, the tubercles consisting almost always of single-haired chitinous buttons, and placed in generalised position on the abdominal segments, except that v is obsolete, and an accessory prespiracular is present. One structural peculiarity, however, occurs, and this is giving our phylogenists much trouble. On the meso- and metathorax of the *Eumorphidi*—*Eumorpha (elpenor)*, *Theretra (porcellus)*, *Celerio (gallii, euphorbiae)*—i and ii are situated on separate subsegments, whilst in the other subfamilies these are pushed up so as to be on the same subsegment and either arise quite near each other (Amorphids), or else from a common raised base (Hemarids), or on the same chitinous button (Sphingids *sens. strict.*). Strangely, too, the Eumorphid larvæ have none of the bifid hairs, in their earlier stages, that characterise the early larval stages of the *Amorphidae*, *Hemarinae*, *Sesiinae*, and, to a slight extent, the *Sphinginae*. It is, we believe, true that these bifid hairs are not present in all the *Sphinginae*, nor are they noted as occurring in *Manducinae*, still, with some

* One might point out here that the Manducid larva agrees with the Sphingid and not at all with the Sesiid (Macroglossid) larva. Both the Manducid and Sphingid larvæ have tumid and pellucid-looking thoracic segments, whilst no Sesiid larva that I have handled or seen figured shows any traces of this distinctive feature (Bacot).

exceptions, they may be described as being generally distributed throughout the superfamily, except among the Eumorphids. Whether these hairs should not be considered a generalised rather than a specialised character is still open to doubt. They are certainly found in quite separate and distant superfamilies. One is further inclined to look upon the tumid thoracic segments exhibited in *Sphinginae* and the swollen 1st and 2nd abdominals of the *Eumorphidi* as specialised characters, for there can be little doubt, one suspects, that the more uniformly cylindrical-shaped larvæ have retained, in this particular, and as a necessity of their environment, what one supposes must have been the ancestral form. The loss of the caudal horn, within the phylum itself, must also, it appears to us, be looked upon as a specialisation. It is really remarkable how few useful structural larval characters one appears to find in the Sphingids, *i.e.*, characters sufficiently marked to be of service in allowing one to feel comparatively safe in discussing the phylogeny. The tumid thoracic segments of the Sphingids and Manducids, for example, suggest to us a distinct alliance, as also do the swollen 1st and 2nd abdominals of the various Eumorphid branches, in spite of the possible advantages of these structures for the purpose of protection.

Chapman's notes on the pupa (*antea*, pp. 371—373) suggest that in this stage the most marked modifications of the superfamily are written. Viewed broadly the Sphingids must be looked upon as one of the most successful groups of large lepidoptera in the struggle for existence; their ability to feed upon the wing and their capacity for amazingly rapid and long-continued flight are their marked characteristics, and hence the modification of tongue and wings have been two of the most marked features leading to success in the struggle for existence, and the modification of the pupa to meet the requirements with regard to these organs forms a fruitful basis for study. As compared with the Amorphid pupa, the Sphingid pupa is longer, more attenuated towards the anal end, has a much smoother skin-surface, and exhibits, in some cases, considerable power of movement. In spite of the smooth appearance of the Sphingid pupal skin, Chapman has discovered the presence of unquestionable hairs or bristles of microscopic size on various pupæ, *viz.*, *Sesia stellatarum*, *Hippotion celerio*, *Eumorpha elpenor*, *Manduca atropos*, *Smerinthus ocellata*, &c. These bristles are placed in a circular opening in the chitin, are there jointed, and then diminish regularly to a sharp point, like typical tactile bristles. They are in considerable numbers on the pupæ of *H. celerio* and *E. elpenor*, occupying exactly the same positions as in *S. stellatarum*, *viz.*, the anterior borders of the segments ventrally, and especially on the modified portions close to the intersegmental membrane. In *M. atropos* and *S. ocellata* they are smaller and less abundant, but here they occur on the central zone of the segments and are not found near either the anterior or posterior borders. The hairs are not to be seen unless a piece of the pupa be prepared and mounted; sufficient material has been examined to suggest that probably all Sphingid pupæ have these hairs, and that their distribution is almost identical in *Sesia* (*Macroglossum*) and *Eumorpha*, different in *Amorpha* and *Sphinx*.

With regard to the imagines, there is great variation in the proboscis, the eyes, antennæ, wing-shape, scaling and frenulum. The variation in the proboscis is, of course, correlated with the parallel modification of the pupa, and the modification of the eyes, especially with regard to position, is also to be referred to the specialisation of the tongue. Chapman observes that "the dominant specialisation of the Sphinges is the great development of the proboscis. This acts on the pupa in several directions that give characters to that stage found nowhere else in the lepidoptera. It has also caused various correlated changes in the imago, which cannot always be directly traced to its influence, but in two cases, at least, the connection is fairly obvious. One of these is the immense development of the head, in many cases, really, an immense development of the eyes. This does not occur in those genera in which the proboscis is badly developed, or in those forms that are especially day-flying. Most nocturnal moths find the antennæ as olfactory organs meet their requirements for finding their way about, either for the ♂ to discover the ♀, the ♀ to find the foodplant for oviposition, or for either to find some saccharine pabulum. When the place is found, a little searching about on foot is quite unobjectionable, but in *Sphinx*, flowers have not only to be found, but the precise spot for introducing the proboscis has to be seen, and consequently it is evident that a larger eye to collect more of the dim light is a necessity. The other specialisation, similarly found in the well-proboscised groups, is the development of the extremity of the antenna as a tactile and not as an olfactory organ; precisely why this is necessary is not perhaps fully evident, but it may be useful in their rapid flight as an advance guard, more probably it is of use when the proboscis is introduced into the tubes of flowers in telling when the approach to the flower is getting too close." We have already detailed (*antea*, p. 379) Kellogg's notes on the scale-structure and the relation of the scales to the character of the flight. Concerning this Jordan writes (*in litt.*): "The Sphingids of slow flight are more specialised than their swift-flying near relations. Shagginess of the scaling of the body and wings is not at all a sign of the insect being more generalised than its smooth-scaled ally. On the contrary, the shaggy body of several Macroglossids and Amorphids is a decidedly new acquisition, *e.g.*, *Philampelus* (*recte Pholus*) has a more generalised scaling (see *antea*, p. 379), and the rough-scaled *Triptogon modesta* is derived from a more smooth-scaled ancestor."

Details of the condition of the frenula of some of the species belonging to characteristic genera are thus described by Griffiths (*in litt.*):

	SPINA OF ♂.	SPINULÆ OF ♀.	RETINACULUM OF ♂.
Pterogon proserpina	Rather slender		Short and close
Hemaris fuciformis	Very dark in colour and highly polished	Compact group of spinulæ, 8 in number	Flat and broad; more thickly scaled than in *H. tityus*
Hemaris tityus	Somewhat lighter in colour, smaller than in *H. fuciformis*		Shorter than in *H. fuciformis*

	SPINA OF ♂.	SPINULÆ OF ♀.	RETINACULUM OF ♂.
Sesia stellatarum	Whitish, fairly long	12 spinulæ of varying lengths	Long and tightly compressed at extremity
Eumorpha elpenor	Long, somewhat slender, light in colour	Very compact, forming a sharp claw	Closely gripping at extremity
Theretra porcellus	Long, but still more slender than in *elpenor*, light in colour	Smaller in proportion than in *elpenor*, but very compact	Strong and very close, conspicuous from its white colour on the pink ground of wing-surface
Hippotion celerio	Long and very thick		Rather short but strong
Daphnis nerii	Long	A powerful bunch of spinulæ, but more separated at the tips than in above species	Short but strongly developed
Celerio euphorbiae	Long and of a brown colour	Very close and compact, forming a broad pointed blade	Very long and tightly curled at extremity
Celerio gallii *	Long	Very compact and similar to above	Strong and compact, but not so long as in *euphorbiae*
Phryxus livornica	Long, whitish		Rather broad, not so long as in *euphorbiae*
Manduca atropos, M. morta, M. styx	Strong and dark	Strong and compact	Short and broad, but closely gripping
Sphinx ligustri	Long and fairly thick	Strong and numerous forming a sharp claw	Short but powerful
Agrius convolvuli †	Somewhat shorter than in *ligustri*, but strong	do.	do.

The peculiar lateral asymmetry exhibited in the Hemarid genitalia will be dealt with in our consideration of the *Hemarinae*. The other imaginal specialisations will also be considered when we deal with the various subfamilies.

Subfam: HEMARINÆ.

The clearwinged Sphingids, of which *Hemaris fuciformis* is figured by Réaumur (*Mèm.*, ii., pl. xii., figs. 9—10), had already received the name "d'aîles vitrées" when Réaumur changed (*loc. cit.*, p. 277) it to "Papillons mouches." Owing to their superficial

* I cannot discriminate the North American species, *C. chamoenerii*, from European *C. gallii*, and I see by Butler that Strecker (*Can. Ent.*, iv., p. 206) considers them identical (Griffiths).

† Though the frenulum agrees fairly well with that of *S. ligustri*, I cannot help thinking that British entomologists ought to separate this species generically from *S. ligustri*. In development of haustellum, shape of pupa and general characters it agrees much more closely with *Protoparce celeus*, *cingulata*, *carolina* and other species with which genus Butler places it. The Australian specimens of *A. convolvuli* seem to differ from European and African forms in my cabinet (Griffiths).

resemblance to some of the species of the true clearwings, these members of two quite distinct superfamilies were more or less united for over 150 years. Although both belong to flat-egged stirpes, yet, in the egg, larval, pupal and imaginal characters, there is really no close connection between the Hemarids and the Ægeriids, and one suspects that the systematists of the younger school will no longer blindly follow the incongruous groupings of Linné and Fabricius as have most of our British lepidopterists, even those who have published the most recent work on the subject.

The Hemarid egg is typically Sphingid, of the flat type, smooth, green, and laid on the leaves of the foodplant. Compared with the egg of *Sesia (stellatarum)*, this is larger, more oval, *i.e.*, less circular in outline, possibly the smaller size of the latter is a specialisation due to its position among the flower-buds of *Galium*, which in their minutest forms it has to resemble. The egg stage in those species of which we have information is somewhat short, both in the Palæarctic and Nearctic species. Fischer describes the eggs of *Hemaris tenuis (Can. Ent.*, xvi., p. 143) as small, round and green, and states that the egg period lasts about 10 days. Smyth, however, states *(Ent. News*, xi., p. 584) that eggs of this species laid June 1st, 1900, hatched on the evening of June 6th.

The Hemarid larva has a very distinct facies, readily seen by examination of the figures of the larvæ of *H. fuciformis* and *H. tityus* (Buckler, *Larvae*, &c., ii., pl. xxvi., figs. 3—3*b*, 4—4*a)* and of that of *Cochrania croatica** (Millière, *Icon.*, pl. 141, fig. 79). The superficial differences between these and the Sesiid larva, as illustrated by *Sesia (stellatarum) (vide* Buckler, *Larvae*, &c., ii., pl. xxvi., figs. 2—2*b)*, are very evident. The larva is characteristically Sphingid, with well-developed caudal horn, cleft at apex and carrying two stout setæ, the horn covered with minute bifid bristles. The tubercles i, ii, iii, iv and the accessory prespiracular are all distinct, and each of them carries a single deeply bifid seta, those on i and ii being on a common base on the meso- and metathorax. The skin is also covered, after the first moult, with a clothing of small bifid hairs, which becomes less prominent as the larva increases in age. The bifid character of the primary hairs appears to attain its highest development in this group, judged by the British species, the only other larvæ that approach them in this respect being those of the Sesiids, but, although in these they are more forked than is normal, they are far less so than in the Hemarids.

Seasonal dimorphism appears to be exhibited in the larvæ of some American species. The autumnal imagines of *Hemaris tenuis* oviposit in August, and the larvæ are fullgrown by the end of September. Fischer observes *(Can. Ent.*, xvi., p. 143) that, whereas the larvæ of the early summer brood are greenish-white in tint, those of the later brood vary considerably from reddish-brown with a slight purple tinge to the hue of the spring larvæ. Holland, however, states *(loc. cit.*, xviii., p. 101) that a part of each brood is light

* This species is placed in *Macroglossum* with *stellatarum* by Staudinger and others. It is certainly a Hemarid, in most of its characters agreeing almost exactly with *H. fuciformis* and *H. tityus.* Its thick, smooth scaling, in which it differs so greatly from these species, and its pupal peculiarities lead us to place it in a separate genus and for that purpose we suggest the name *Cochrania.*

apple-green and the other part reddish-brown, both varieties being found on the same plant at the same time. Smyth gives (*Ent. News*, xi., pp. 587—589) detailed descriptions of the five larval instars of *H. tenuis*, and these are most useful for comparison with the corresponding stadia of the larvæ of our British species. The fullfed larva changes colour just before pupation, the whole of the dorsal area becoming wine-coloured.

The Hemarid pupæ are very closely alike, *i.e.*, those of *Cochrania croatica*, *Hemaris fuciformis* and *H. tityus*. These are characterised by (1) a thick coating of minute hairs on the clypeus, and on the dorsum of thorax and abdomen, (2) a wide base to the maxillæ (a characteristic Sphingid as apart from Amorphid character), whilst (3) the cremaster is exceedingly strong and well-developed, and is well provided with hooks which hold most effectively to the silk of the cocoon. The labrum is pushed quite frontal, and the proboscis extends to the end of the wings. It would appear that the least specialised of the pupæ of all the true *Sphingidae* are those of the Pterogonids and Hemarids, which are superficially almost identical and are really very close; these have done all they can to make room for the proboscis by pushing, as we have just noticed, the labrum quite to the front and extending the proboscis-case to the end of the wings, but there is no tongue-horn, nor even any keeling. The only point in which the Hemarid pupa agrees with that of *Sesia* (*stellatarum*) is in wanting the 1st femur. Comparing the pupæ of the Pterogonids, Hemarids and Sesiids, three subfamilies which have been suspected of being structurally so close as to be included in the same genus, Chapman gives us the following tabulation:

1. Pupa brown, circular section, often long tapering abdomen, labrum anterior.
   a. With callosities on metathorax, face and anal spine smooth, first femur exposed .. PTEROGONINÆ.
   b. Metathoracic callosities nearly obsolete, no first femur, facial spines present or indicated; anal spine, with fine spiculæ pointing distad HEMARINÆ.
2. Pupa pale (cocoon in rubbish, not subterranean), antero-posteriorly flattened, abdomen short (comparatively), labrum dorsal .. .. SESIINÆ.

The above table is based on pupæ of *Hemaris fuciformis*, *H. tityus*, *Cochrania croatica*, *Sesia stellatarum*, *Pterogon proserpina* and *Deidamia inscripta*. Possibly some exotic forms belong to further divisions. For comparison, the imagines of these three divisions may be tabulated as follows:

1. Hind margin angulated .. .. PTEROGONINÆ.
2. Hind margin smooth
   a. Markings irregular .. .. SESIINÆ.
   b. Markings smooth, parallel with hind margin HEMARINÆ (including *croatica*).

The Hemarid cocoon is made on the surface of the ground and usually consists of a few leaves spun together with silk. That of *Hemaris tenuis* is moderately compact, spun among dried leaves on the surface of the ground and composed of deep brown silk (*Can. Ent.*, xviii., p. 102).

The Hemarid imagines are essentially specialised for day-flying and feeding at flowers on the wing, whilst the undoubted mimicry of bees by some of the species, by the loss of scales on the wings, has resulted in their having obtained the popular name of the Sphingid clearwings. Some, however, *e.g.*, *Cochrania croatica*, are exceedingly well-scaled, and it is remarkable that, although superficially *H. fuciformis* has a facies quite intermediate between *C. croatica* and *H. tityus*, yet Chapman finds the genitalia of *C. croatica* to be nearer those of *H. tityus* than those of *H. fuciformis*. Taking these three species as typical of the form of scaling found in the Hemarids, one finds that the wings of *C. croatica* are wholly covered with smooth scales; *H. fuciformis* is also smooth-scaled, but with a very marked tendency to lose the scales from the centre of the wings, whilst *H. tityus* is roughly-haired, and has the wings markedly transparent; one observes also that *H. fuciformis* has strong scaling down the centre of the cell (median nervure), the nervure itself beneath being hardly indicated. Holland observes (*Can. Ent.*, xviii., p. 101) that, when newly-emerged, *Hemaris tenuis* is covered with scales on those parts of the wing that are pellucid in flown examples. Smyth observes that examples of *H. tenuis*, killed before the wings have been fluttered, are really Strecker's *fumosa*, they show the even inner margin of the forewings, and the colours are light lemon-yellow and black, whilst the sides of the abdomen show blue spots. The Hemarid imagines have a long and effective tongue, the frenulum is well-developed and they rest with their wings drawn back and placed flatly, not very unlike the Eumorphids. The character of the frenula suggests strongly that the Hemarids are rightly separated from the Sesiids (Macroglossids). Griffiths gives (*in litt.*) the following details:

(1) *Fuciformis*.—♂. The spina is very dark in colour, smooth and highly polished. The retinaculum is rather broad and flat and thickly scaled. ♀. With a compact bunch of spinulæ of fairly even length and 8 in number.

(2) *Tityus*.—Almost exactly as in *H. fuciformis*, but the retinaculum a trifle shorter.

The frenula of *H. thysbe* (United States) and *H. saundersi* (India) also resemble the above in the form of the retinaculum.

(3) *Stellatarum*.—♂. The spina light in colour. The retinaculum twisted, tightly knotted and compressed at the extremity and almost bare of scales. ♀. The spinulæ more spreading than in *Hemaris*, and of varying lengths; 12 in number.

A ♀ of a *Sesia* (sp. ?) from India has 5 long and 5 short spinulæ, but this and other Eastern species of this group agree with *S. stellatarum* in having the spinulæ less compact than *Hemaris*; the ♂s also have the strong compressed form of retinaculum of *S. stellatarum*, and this form is like that of the Eumorphids in every respect.

The most remarkable peculiarity of the Hemarid imagines is the asymmetry of the ♂ genitalia. Chapman observes that in *Cephonodes hylas*, the right clasp is larger, rounded, but very imperfectly articulated to the base, so as to be capable of very little movement, otherwise, and compared with other Hemarid genitalia, one would call this the normal clasp. The left clasp looks at first as though it had been the same as the right, but had met with some accident that had removed a large terminal disc, leaving two lateral cusps. It is shorter than the right as about 3 to 5, and the arrangement of bristles and spines is quite different from that on the right, if it be indeed possible to compare these very different forms. It is much more movable than the right clasp. The arrangement suggests that it is intended to facilitate a lateral instead of a medial approach in the capture of the female. The upper appendage or tegumen is also twisted, so as no doubt to correspond with the obliqueness of the whole appendage, as most definitely seen in the clasps.

Grote asserts (*Can. Ent.*, xix., p. 79) that "the American *Hemaris axillaris* and *H. tenuis* are outgrowths of the Palæarctic *H. fuciformis*, whilst the American *H. gracilis* is strictly congeneric with the European *H. bombyliformis*."

The imagines appear to be day-fliers and to haunt the flowers much as do the Sesiids (Macroglossids), nor is this habit confined to the Palæarctic species, for, in southern Manitoba, in spring, the bloom of the wild plum is visited by *Hemaris thysbe* and *H. tenuis* (Heath, *Can. Ent.*, xxxiii., p. 99). On the other hand, Mrs. Nicholl observes that, in the Val d'Ombla, *Cochrania croatica* haunts the hot rock faces, hovering over the broiling masses of limestone exactly in the same manner as does *Sesia stellatarum* in England.

Tribe: HEMARIDI.

Hübner includes (*Verz.*, p. 131) the Hemarids in his coitus *Cephonodae*, defining this as having "The wings almost scaleless, the body variegated — *Cephonodes hylas*, Fab., *bombyliformis*, Esp., *fuciformis*, Linn., *pelasgus*, Cram., *croatica*, Esp." It will be observed that Hübner here places *croatica* with the Hemarids and not in *Psithyros* with *stellatarum*.

Really the Hemarids (*sens. strict.*) form a very solid tribe, as solid as the Manducids. All the species appear to be very close indeed, and to give no really sound basis for even generic division. The real differences of the imagines of this section are:

1. Smoothness of scaling.
2. Extent of wing-clearness.
3. Character of the small clear spot at anal angle of hindwing.

One suspects that the larvæ, habits, specialisation to foodplant, &c., give much more definite data as to the specific distinctness or otherwise of the different forms. The second section, represented by *Cephonodes** (*hylas*), is abundantly distinct, both in the pupal and imaginal conditions. The Hemarids (*sens. strict.*) are most numerous in the Nearctic region, but several species are Palæarctic. On the other hand the Cephonodids are "the tropical representatives of the Hemarids, being found almost throughout the Ethiopian, Indo-Malayan, and Austro-Malayan regions. The wings are longer and more pointed than in the Hemarids and transparent, except the nervures and the borders which are often very narrow (Kirby)."

Bartel follows the usual continental arrangement of grouping *Cochrania croatica* with *Sesia stellatarum* on the character "wings scaled throughout." Bartel's classification of the Palæarctic species, omitting the Sesiids (Macroglossids) which he groups with *C. croatica*, works out as follows:

* Curiously in the British Museum collection *Cochrania croatica* is rightly separated from *Sesia stellatarum*, with which Staudinger and others erroneously place it, but is placed, not with *Hemaris* where it belongs, but in *Cephonodes* from which it is amply distinct.

I. Wings scaled throughout.
  A. Forewings yellowish olive-grey, lighter exteriorly — *Croatica*, Esp.

II. Wings to a great extent scaled, only behind the middle with a narrow transparent-band, which is divided into single spots by the nervures which traverse it. Forewing with the scales greenish-olive in colour, with a broad dark brown outer band. Hindwing predominantly red-brown in colour .. *Ducalis*, Stgr.

III. Wings to a great extent transparent.
  A. Median cell of forewing longitudinally divided by a dark fold which appears as a continuation of nervure 5.
    a. Outer margin of the wings brown.
      a. In the scaled inner marginal part of the hindwing no transparent cell is present.
        1. Base of forewing and inner marginal part of hindwing with the scales yellowish or greenish olive-colour .. *Bombyliformis*, O.
        2. The base of forewing and inner marginal part of hindwing with the scales brown-red, scarcely greenish haired.. *Beresowskii*, Alph.
      b. Inner marginal part of hindwing with a small oblong transparent-spot, which is very finely divided by the intersecting nervure .. .. *Ganssuensis*, Grum.
    b. Outer band of the wings blackish, not brown.
      a. Outer band interiorly cut off almost straight, hence does not project in the form of rays .. *Affinis*, Brem.
      b. Outer band sends out towards the base long actiniform teeth.
        1. Base and inner marginal part of hindwing blackish .. .. *Alternata*, Butl.
        2. Base and inner marginal part of hindwing gold-yellow .. .. .. *Radians*, Walk.
  B. The median cell of forewing not divided by dark fold *Fuciformis*, O. *(nec L.)*.

Jordan says *(in litt.)* that the American species are different from the Palæarctic, but all belong to the same genus, and that the remarkable seasonal variation of some species has misled entomologists into describing more species than are distinct. Smyth has shown *(Ent. News*, xi., pp. 584 *et seq.)* that *Hemaris tenuis* and *H. diffinis* are seasonal forms of one species, their relation being the same as that already proven in the case of *H. ruficaudis* and *H. thysbe*. In the first case *tenuis* is the spring form from wintering pupæ, and *diffinis* the summer form from eggs of *tenuis*. He proved that eggs laid in captivity by a ♀ *diffinis* in August disclosed *tenuis* the following May, and from eggs laid by a *tenuis* ♀ in June, *diffinis* in various varietal (as well as the typical) forms was disclosed the same summer in July. Further proof is given by Smyth *(loc. cit.*, xiii., p. 82). Here he states that some 18 summer pupæ did not disclose imagines of *diffinis* in the autumn, that these emerged in the spring, when 13 were of the spring form, 3 were very nearly of this form, whilst 2 showed a distinct approach to the summer form.

Meyrick treats our tribe as a single genus, *Hemaris*, and notes it as "a moderate genus, distributed throughout the northern hemisphere, but mainly American and Asiatic. Imago day-flying, feeding on the wing; immediately after emergence the wings are furnished with very fugitive scales."

It may be here noted that Christy captured, on May 5th

1894, a ♂ *H. fuciformis in copulâ* with a ♀ *H. tityus;* they were resting on a flower in the New Forest when taken.

SYNONYMIC NOTE ON THE TWO BRITISH HEMARID SPECIES*.

The synonymy of the two British Hemarid species is most unsatisfactory (see *Entom.*, xxix., pp. 39—40). The following appear to be the facts: Linné named (*Syst. Nat.*, ed. 10) three species, which have at one time or another been referred to the two British ones, namely, *fuciformis*, *tityus* and *bombyliformis*, but in the 12th edition he sinks the latter as a variety of his *Sphinx porcellus*, and it ought never to have been resuscitated for a Hemarid species. We quote the diagnoses of the other two under their respective species (see *infrà*), and it is sufficient here to remark that the comparatively little regard which has been paid to the 10th edition, and the fact that Linné united the two species under the one name—*fuciformis*—in his later works, have resulted in much uncertainty and controversy as to the correct identification of that name. Esper uses (*Schmett. Eur.*, ii., p. 118) the name *fuciformis* for the broad-bordered species, giving a mixture of citations from earlier works. He makes no critical comments, not being then acquainted with a second species. He says (on p. 122) that Linné mentions also a var. *tityus*, quotes his diagnosis, and concludes that it may probably be a worn *fuciformis*. Later (*tom. cit.*, p. 180) he erects *bombyliformis* as a new species, pointing out that Linné's *bombyliformis* was an unimportant aberration, or worn specimen, of *porcellus*, and that he "believes himself justified in now transferring the name *bombyliformis* to a new species." Schiffermüller and Denis (*Wien. Schmett.*, p. 44) also only cite one species, namely the "*Scabiosa*-Sphinx," which they give as *fuciformis*, L. Illiger, in his edition of the same work (pp. 24—26), discusses the synonymy, and unhesitatingly concludes that the *bombyliformis* of Esper and Hübner (=*tityus*) is thetrue *fuciformis* of Linné, his chief ground being that Linné describes the abdominal band as "black," whilst in the broad-bordered species it is decidedly "red-brown." Laspeyres, Ochsenheimer and Treitschke all accept Illiger's conclusions. Dalman (*K. Vet. Ac. Handl.*, 1816, pp. 216—217), retaining the name *fuciformis*, L., for the honeysuckle-species, and *bombyliformis*, Esp., for the scabious-feeder, remarks: "Post omnia quæ de præcedentibus duabus speciebus ab auctoribus sunt scripta et disputata, ut in posteriorem Linnei synonyma cadere evinciatur, tamen nequeo non talem habere opinionem, Linneum sine dubio ambas species sub una commixtas pro oculis habuisse, unde ortum, ut diagnoses et descriptiones ejus breves nunc uni nunc alteri melius conveniant. Verba '*margine atro purpurascente*' quæ sunt in *Syst. Nat.*, ed. xii., sine dubio ad *fuciformem* nostram spectare videntur, cum tale de *bombyliformi* vix dici potuerit. Deficientibus aliis criteriis, Rœselii figura citata magni esse debebat momenti pro ea specie quæ ibi manifeste est dilineata." He goes on to protest against Laspeyres' upsetting of the synonymy on such dubious grounds. Most of the British authors (excepting Stephens) have also continued to follow Esper and Hübner, although Kirby's

* For this synonymic section we are indebted entirely to Mr. L. B. Prout.

"European Butterflies and Moths" (translating Heinemann's edition of Berge) and South's "Synonymic List" (adapting Staudinger's "Catalog," ed. 2) follow the German usage, and the greatest confusion has resulted. Zeller, in reviewing Wallengren's "Skandinaviens Heterocer-Fjärilar" (*Stett. Ent. Zeit.*, xxx., p. 387), called attention to the confusion, and suggested a somewhat drastic remedy, namely, the substitution of the names *lonicerae* or *caprifolii* and *scabiosae* or *knautiae* for the two species, according to their foodplants. He writes: "The author (Wallengren) has overlooked the distinctive feature by which the two species, even in quite worn specimens, are to be differentiated with certainty. The *Lonicera*-hawk has the median cell divided longitudinally by a dark line which is caused by a fold; this line is always wanting in the *Scabiosa*-hawk. The names *fuciformis* and *bombyliformis*, as applied by Ochsenheimer, are here inverted, as Wallengren, with Dalman and the English, accepts the *Lonicera*-Sphinx for Linné's *S. fuciformis*, while Ochsenheimer takes the *Scabiosa*-Sphinx for it." He quotes Linné's diagnosis from the *Fauna Suecica* *, and adds that it denotes so surely the scabious species that he cannot do otherwise than agree with Illiger, that Linné's citation of Rösel and the "habitat in *Lonicera*" are incorrect, like so many of Linné's citations, and that thus there is not even any proof that he has "without doubt mixed the two," as Dalman asserted. Zeller does not know on what ground the English agree with Wallengren's view; even if a type in the Linnean collection supported it, he (Zeller) would still prefer to rely on the indubitableness of Linné's words. Kirby (*Zool. Rec.*, vi., p. 382) adds a note: "The former [*i.e.*, *lonicerae*, Zell.] is certainly *fuciformis*, L.; his description of *bombyliformis* (*Sys. Nat.*, ed. 10) is less satisfactory, and the two species seem to be confounded in his subsequent works." "Former" in this note may be a *lapsus* for "latter," for in 1871 we find him inclining to follow the German usage; he says (*Proc. Ent. Soc. Lond.*, 1871, p. xxi) that, in the 10th edition of the *Systema Naturae*, Linné described the broad-bordered species as *bombyliformis* and the narrow as *fuciformis*; in the 2nd edition of the *Fauna Suecica* he described the narrow-bordered as *fuciformis*, while in *Syst. Nat.*, ed. 12, he described the broad-bordered species under this name, and referred *bombyliformis* as a variety to *porcellus*, and adds, "Under these circumstances the only way to avoid confusion appears to be to go back to the 10th edition, as has been done on the Continent, and apply the name *bombyliformis* to the broad-bordered and *fuciformis* to the narrow-bordered species." But subsequent and closer investigation of the 10th edition led Kirby to modify his views, and, in 1896, he makes out a good case (*Ent.*, xxix., pp. 39—40) for the restoration of the name *fuciformis*, L., to the honeysuckle species, and the resuscitation of the name *tityus*, L.—which had been allowed to lapse entirely—for the scabious species. His note is so readily accessible that it is needless to quote it at length, but his conclusions are stated as follows: "(1) The type of Linné's species (*fuciformis*) was the broad-bordered species, feeding on *Lonicera*. (2) In his *Fauna Suecica*

* Unfortunately, Zeller had not access to the 10th edition of the *Systema Naturae*, on which rests the principal elucidation of Linné's action.

he mixed it up with specimens of his *S. tityus*, and added a character properly applicable to the latter. (3) In the 12th edition of the *Systema Naturae*, Linné, discovering that he had mixed two forms, separated the second as 'β,' distinguishing it by the very character which, from those given, would at once separate his *Sphinx tityus* as the narrow-bordered bee-hawk, feeding on scabious." Aurivillius, in his "Recensio Lep. Mus. Lud. Ulr.," throws a little further light on the probable determination of Linné's *Sphinx tityus*. He writes (*Sv. Vet. Ak. Handl.*, xix., no. 5, p. 170): "*Sphinx tityus*, Linn., *Syst. Nat.*, ed. x., p. 493, no. 24. In schedulâ, quæ sine dubio huc pertinet, scriptum est: '*Phalaena Sphinx* ano barbato, cingulo nigro.—Statura *Bombylii.*—Corpus flavum, hirsutum; abdomen versus basin cinctum fasciâ latâ nigrâ; pone hanc fasciam a tergo fulvum est abdomen. Cauda atra barbâ fastigiatâ, sed supra flavescens. Alæ margine nigro. Antennæ cæruleo—nigræ, muticæ, clavatæ.' Hæc descriptio adeo bene in *Macroglossa (Hemaris) bombyliformis* (Esp.) quadrat, ut verisimiliter ad eam speciem pertineat. Quum autem descriptio a Linné *publicata* nimium brevis sit, optimium puto, nomen *tityus* huic speciei non conservari." Staudinger has (*Hor. Soc. Ent. Ross.*, xiv., p. 301) a note on the synonymy, in which he states that: (1) The specimen in Linné's collection, labelled "*fuciformis*" in Linné's handwriting, is an example of the "broad-bordered" species. (2) He gathers from the Linnean descriptions that originally *fuciformis* must have been the "narrow-bordered" species, and *bombyliformis* the "broad-bordered." (3) In his later works Linné united the two, and attached his label *fuciformis* to what was his earlier *bombyliformis*. The specimens which are extant in Linné's collection give us little assistance; but it is to be borne in mind that the type of his *tityus* was probably never in his collection, as the letters "M. L. U." show that it was in that of the Queen of Sweden. The specimen in Linné's cabinet, which actually bears the label *fuciformis* in his handwriting, is a "broad-border," but an unlabelled specimen of the "narrow-border," apparently of Linné's setting, is present beside it, and as the label has been re-pinned, it may have once been attached to this other specimen, but there is no evidence whatever to show that this was so.

Genus: Hemaris, Dalman.

Synonymy.—Genus: *Hemaris*, Dalm., "Vet. Ak. Handl.," xxxvii., p. 215 (1816); Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 518 (1876); Kirby, "Eur. Butts. and Moths," p. 75, pl. xx., figs. 3 *a*—*c* (1879); "Cat.," p. 625 (1892); "Handbook, &c.," iv., pp. 4—5 (1897); "Ent.," xxix., p. 40 (1896); Meyr., "Handbook, &c.," p. 294 (1896); Prout, "Ent.," xxxii., p. 60 (1899); Staud., "Cat.," 3rd ed., p. 104 (1901). *Sphinx*, Linn., "Sys. Nat.," xth ed., p. 493 (1758); xiith ed., p. 803 (1767); "Faun. Suec.," ii., p. 289 (1761); Poda, "Ins. Mus. Græc.," p. 12, pl. ii., fig. 6 (1761); Scop., "Ent. Carn.," p. 188 (1763); Müll., "Faun. Frid.," p. 37 (1764); "Mél. Ac. Sci. Turin," iii., p. 193 (1766); "Zool. Dan. Prod.," p. 187 (1776); Hfn., "Berl. Mag.," ii., pp. 184, 194 (1766); [Schiff.,] "Schmett. Wein.," p. 44 (1775); Ill. n. Ausg., p. 22 (1801); Esp., "Schmett. Eur.," ii., p. 118, pl. xiv., fig. 1 (1779); Retz., "Gen. et Spec. Ins.," p. 33 (1783); Geoff., "Fourc. Ent. Paris.," ii., p. 252 (1785); Bork., "Sys. Besch.," ii., pp. 52, 133, 176 (1789); F. J. A. D., "Bork. Rhein. Mag.," p. 313 (1793); Don., "Brit. Ins.," iii., p. 37, pl. lxxxvii (1795); Hb., "Eur. Schmett.," figs. 55—56 (1796); "Larvæ Lep.," ii., Sph. iii., Legit. A. a. fig. 1 *a*; A. b., fig. 1 *a*—*d* (*circ.* 1800); text p. 93 (*circ.* 1805); Panz., "Faun. Ins. Germ.," vi., pt. 69, no. 23 (1798); Schrk., "Faun. Boica," ii., Abth. i., p. 230 (1801); Haw., "Lep. Brit.," i., p. 67 (1803); Lasp., "Ill. Mag.," ii., p. 37 (1803); Latr., "Hist. Nat.," iii., p. 401 (1802); xiv., p. 133 (1805); "Gen. Crust. et Ins.," iv., p. 210 (1809); Ochs., "Die Schmett.," ii., p. 189 (1808); Godt., "Hist. Nat.," iii., p. 58 (1821). *Sesia*, Fab., "Sys. Ent.," p. 548 (1775); "Spec. Ins.," ii., p. 156 (1781); "Mant.," ii., p. 99 (1787); "Ent. Sys.," iii., pt. 1, p. 381 (1793); "Ill. Mag.," vi., p. 287 (1807); Leske, "Anf. der Nat.," p. 458 (1779); Lamk., "Sys. An. sans Vert.," p. 281 (1801); Leach, "Edin. Encycl.," ix., p. 131 (1815); Sam., "Ent. Comp.," p. 244 (1819); Curt., "Brit. Ent.," expl. pl. xl (1824); Stphs., "Ill. Haust.," i., p. 135 (1828); "Cat. Br. Ins.," p. 34 (1829); "List Br. An. B. Mus.," p. 30 (1850); Dunc., "Brit. Moths," p. 168 (1836); Wood, "Ind. Ent.," p. 21 (1839); Westd., "Gen. Syn.," p. 89 (1840); Humph. and Westd., "Brit. Moths," i., p. 26 (1841); Dbldy., "List Br. Lep.," p. 3 (1847); Sta., "Man.," i., p. 99 (1857); Humph., "Gen. Brit. Moths," p. 12 (1860); Buckl., "Larvæ," etc., ii., p. 121, pl. xxvi., fig. 3 (1887). *Setia*, Oken, "Lehrb. Zool.," i., p. 749 (1815). *Macroglossa*, Ochs., "Die Schmett.," iv., pp. 41, 42 (1816); Bdv., "Eur. Lep. Ind. Meth.," p. 32 (1829); "Gen. et Ind. Meth.," p. 45 (1840); "Icon. Chen.," pl. x., figs. 3—4 (*circ.* 1840); "Hist. Nat. Sphing.," p. 367 (1875); Meig., "Eur. Schmett.," ii., p. 126 (1830); Dup., "Hist. Nat.," supp. ii., p. 164 (1835); "Cat. Méth.," p. 43 (1844); Zett., "Ins. Lapp.," p. 917 (1840); Evers., "Faun. Volg.-Ural.," p. 106 (1844); H.-Sch., "Sys. Bearb.," ii., p. 83 (1846); Heydrch., "Lep. Eur. Cat. Meth.," 3rd ed., p. 19 (1851); Speyer, "Geog. Verb. Schmett.," i., p. 313 (1858); ii., p. 280 (1862); Staud., "Cat.," ed. i., p. 17 (1861); 2nd ed., p. 38 (1871); Wallgrn., "Skand. Het.," i., p. 54 (1863); Ramb., "Cat. Lép. And.," p. 123 (1866); Snell., "De Vlind.," p. 91 (1867); Berce, "Faun. Franç.," ii., p. 32 (1868); Nolck., "Lep. Fn. Estl.," i., p. 91 (1868); Zell., "Stett. Ent. Zeit.," xxx., p. 387 (1869); Newm., "Brit. Moths," p. 11 (1869); Mill., "Cat. Lép. Alp.-Mar.," p. 121 (1872); Bang-Haas, "Nat. Tids.," (3), ix., p. 400 (1874); Cuní y Mart., "Lep. Barc.," p. 42 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 114 (1875); Frey, "Lep. Schweiz," p. 59 (1880); Auriv., "Sv. Vet. Hand.," xix., p. 170 (1882); "Nord. Fjär.," p. 47 (1889); Minà-Pal., "Nat. Sic.," vii., p. 135 (1888); Barr., "Lep. Brit.," ii., p. 70, pl. liv., figs. 3, 3a (1893); Lucas, "Brit. Hawk-Moths," p. 143 (1895); Tutt, "Brit. Moths," p. 37, pl. i., fig. 5 (1896); Bartel, "Palæark. Gross-Schmett.," ii., p. 223 (1900); Cann., "Riv. Ital.," xxi., p. 16 (1901). *Macroglossum*, Lamk., "Hist. Nat. An. sans Vert.," iv., p. 9 (1817). *Cephonodes*, Hb., "Verz.," p. 131 (*circ.* 1822); Stphs, "Ill. Haust.," iv., app. p. 5 (1835). *Bombylia*, Hb., "Franck Cat.," p. 89 (1825). *Trochilium*, Westd., "Ent. Textbook," p. 395 (1838).

The genus is diagnosed (*Vetenskaps Academiens Handlingar*, 1816, pp. 207—208) by Dalman, as follows:

HEMARIS.—*Caput* prominulum palpis magnis densissime squamatis l. pilosis, obtusis, marginem superiorem oculorum attingentibus; prominulis. *Lingua* distincta longitudine corporis. *Antennae* rigidæ distinctius clavatæ apice acuminato (maris cylindrico-prismaticæ subtus scobinæformes ciliatæ, feminæ muticæ). *Alae* breves minus angustatæ, sæpe fenestratæ. *Abdomen* crassum, lateribus fasciculosum, ano barbato. *Larva* elongata lævis, cornu anali; capite globoso. *Puppa* intra folia l. quisquilias subfolliculata. TYPUS GENERIS: *Hemaris fuciformis*.

This author's genus was heterogeneric, since he included (*loc. cit.*, pp. 215—216) *stellatarum* as well as *fuciformis* and *tityus* (*bombyliformis*) therein, but as he selected *fuciformis* as the type, this restricts its use to the clear-winged species. The characters are sufficiently wide, however, to include our subfamily *Sesiinae*. Meyrick described the genus (restricting it to the clear-winged species) as follows (*Handbook*, p. 293):

Tongue strongly developed. Antennæ over half, gradually thickened to near apex, then pointed, apex slender, hooked. Abdomen broad, hairy, with broad, truncate, expansible anal tufts. Tibiæ densely hairy. Wings with disc transparent.

He discriminates the two British species as:

Hindwings with a blackish terminal line .. .. .. *bombyliformis*.
Hindwings with a dark red-brown terminal fascia .. .. *fuciformis*.

Hemaris fuciformis, Linné.

Synonymy.—Species: *Fuciformis*, Linn., "Sys. Nat.," xth ed., p. 493 (1758); xiith ed., p. 803 (1767); (?) "Faun. Suec.," ii., p. 289 (1761); Müll., "Faun. Frid.," p. 37 (1764); Fb., "Syst. Ent.," p. 548 (1775); "Spec. Ins.," ii., p. 156 (1781); "Mant.," ii., p. 99 (1787); "Ent. Syst.," iii., pt. 1, p. 381 (1793); "Ill. Mag.," vi., p. 287 (1807); Leske, "Anfangs. der Naturg.," p. 458 (1779); Esp., "Die Schmett.," ii., p. 118, pl. xiv., fig. 1 (1779); Geoff., "Fourc. Ent. Paris.," ii., p. 252 (1785); Bork., "Eur. Schmett.," ii., pp. 52, 133, 176 (1789); F. J. A. D., "Bork. Rhein. Mag.," p. 313 (1793); Don., "Brit. Ins.," iii., p. 37, pl. 87 (1796); Hb., "Eur. Schmett.," fig. 55 (1796); "Sph.," iii., Legit. A. b, figs. 1 *a—d* (*circ.* 1800); text p. 93 (*circ.* 1805); "Verz.," p. 131 (*circ.* 1822); "Franck Cat.," p. 89 (1825); Panz., "Faun. Ins. Germ.," vi., p. 230 (1798); Lamk., "Sys. Anim. sans Vert.," p. 281 (1801); Schrk., "Faun. Boic.," ii., 1, p. 230 (1801); Haw., "Lep. Brit.," 1, p. 67 (1803); Latr., "Hist. Nat.," iii., p. 401 (1802); "Gen. Crust. et Ins.," iv., p. 210 (1809); Dalm., "Vet. Ak. Handl.," xxxvii., p. 215 (1816); Godt., "Hist. Nat.," iii., p. 58, pl. xix., fig. 4 (1821); Meigen, "Eur. Schmett.," ii., p. 126 (1830); Dunc., "Brit. Moths," p. 168 (1836); Zett., "Ins. Lapp.," p. 917 (1840); Humph. and Westd., "Brit. Moths," i., p. 26 (1841); Dbldy., "List Brit. Lep.," p. 3 (1847); Stephs., "Ill. Haust.," iv., app. p. 5 (1835); "List An. B. Mus.," p. 30 (1850); Chaum., "Zool.," ix., p. 3244 (1851); Sta., "Man.," i., p. 99 (1857); Humph., "Gen. Brit. Moths," p. 12 (1860); Wallgrn., "Skand. Het.," i., p. 54 (1863); Newm., "Brit. Moths," p. 11 (1869); Buckl., "Larvæ," &c., ii., p. 121, pl. xxvi., figs. 3 *a—c* (1887); Auriv., "Nord. Fjär.," p. 47 (1889); Kirby, "Cat.," p. 625 (1892); "Ent.," xxix., p. 40 (1896); "Handbook," iv., p. 4 (1897); Dale, "Ent.," xxix., p. 80 (1896); Barr., "Lep. Brit.," p. 70 (1893); Meyr., "Handbook," p. 294 (1895); Lucas, "Brit. Hawk-Moths," p. 143 (1895); Staud., "Cat.," ed. 3, p. 104 (1901); Cann., "Riv. Ital.," xxi., p. 16 (1901). *Variegata*, Müll., "Mél. Acad. Sci. Turin," iii., p. 193 (1766). *Musca*, Retz., "Gen. et Spec. Ins.," p. 33 (1783). *Bombyliformis*, Lasp., "Ill. Mag.," ii., p. 37 (1803); Ochs., "Die Schmett.," ii., p. 189 (1808); iv., pp. 41, 42 (1816); Oken, "Lehrb. Zool.," i., 749 (1815); Stephs., "Ill. Haust.," i., p. 135 (1828); "Cat. Br. Ins.," ii., p. 34 (1829); Bdv., "Eur. Lep. Ind. Meth.," p. 32 (1829); "Gen. et Ind. Meth.," p. 45 (1840); "Hist. Nat. Sphing.," p. 367 (1875); Dup., "Hist. Nat.," supp. ii., p. 164 (1835); "Cat. Méth.," p. 43 (1844); Wood, "Ind. Ent.," p. 21 (1839); Evers., "Faun. Volg.-Ural.," p. 106 (1844); H.-Sch., "Sys. Bearb.," ii., p. 83 (1846); Heydrch., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Speyer, "Geog. Verb. Schmett.," i., p. 313 (1858); ii., p. 280 (1862); "Staud., "Cat.," ed. i., p. 17 (1861); ed. 2, p. 38 (1871); Snell., "De Vlind.," p. 91 (1867); Berce, "Faun. Franç.," ii., p. 32 (1868); Nolck., "Lep. Fn. Estl.," i., p. 91 (1868); Zell., "Stett. Ent. Zeit.," xxx., p. 387 (1869); Mill., "Cat. Lép. Alp.-Mar.," p. 121 (1872); Bang-Haas, "Nat. Tids.," (3), ix., p. 400 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 42 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 114 (1875); Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 518 (1876); Kirby, "Eur. Butts. and Moths," p. 75, pl. xx., figs. 3 *a—c* (1879); Frey, "Lep. Schweiz," p. 59 (1880); Minà-Pal., "Nat. Sic.," vii., p. 135 (1888); Tutt, "Brit. Moths," p. 37, pl. i., fig. 5 (1896); Bartel, "Palæark. Gross-Schmett.," ii., p. 223 (1900). *Fusiformis*, Leach, "Edinb. Ency.," ix., p. 131 (1815); Sam., "Ent. Comp.," p. 244 (1819); Westd., "Gen. Synop.," p. 89 (1840). *Fuciforme*, Latr., "Hist. Nat.," xiv., p. 133 (1805); Lamk., "Hist. Nat. Anim. sans Vert.," iv., p. 9 (1817). *Bombyliforme*, Westd., "Ent. Textbook," p. 395 (1838). *Lonicerae*, Zell., "Stett. Ent. Zeit.," xxx., p. 387 (1869). *Caprifolii*, Zell., *loc. cit.* *Simillima*, Moore, "Proc. Zool. Soc. Lond.," p. 391 (1888).

Original description.—*Sphinx fuciformis*, abdomine barbato nigro: fascia flavescente, alis hyalinis margine nigro. Bradl., *Nat.*, 26, f. 1. B. Roes., *Ins.*, app. 231, t. 38. Habitat in Europa (Linné, *Sys. Nat.*, xth ed., p. 493, no. 28). Later descriptions by Linné read: [*Sphinx fuciformis.* Abdomine barbato nigro: fascia flavescente, alis hyalinis margine nigro. Roes., "Ins.," 3, t. 38 et 4, t. 34, f. 1—4. Habitat in *Lonicera.* Magnitudo *Bombylii.*

Corpus griseum. Abdomen cingulo nigro; barba laterali pone cingulum albida. Anus barba nigra. Antennæ nigræ (*Faun. Suec.*, ii., p. 289).] *Sphinx fuciformis.* Abdomine barbato nigro: fascia flavescente, alis fenestratis margine nigro atro-purpurascente. *Faun. Suec.*, 1092. Scop., *Carn.*, 475. Bradl., *Nat.*, 26, f. i. B. Roes., *Ins.*, app. 231, t. 38; 4, t. 34. f. 1—4. Sultze [*sic*], *Ins.*, t. 15, p. 82, n. 4. Habitat in *Lonicera.* Barba abdominis in medio alba est (*Sys. Nat.*, xiith ed., pp. 803-804).

IMAGO *.—42mm.—50mm. Anterior wings with the greater part somewhat transparent; nervures dark red-brown; the base and costa black-brown, dusted with ochreous-green; a dark red-brown discal mark, and a broad red-brown hind-marginal band. Posterior wings more or less transparent with dark nervures and a moderately broad dark red-brown hind-marginal band; basal area densely scaled. Thorax ochreous-green; abdomen greenish-ochreous with a dark red-brown median band.

VARIATION.—There appears to be some variation in this species, the Asiatic examples being different from those usually found in Europe. Slight aberrations in the amount of scaling retained, in the width and tint of the marginal borders, and also in size, are recorded. Caradja, for example, records two Roumanian specimens, in both of which the dark outer margin is somewhat narrower than usual. Fowler observes that bred examples have the wings quite covered with rich brown scales, &c. The following are the described forms:

a. ab. *heynei*, Bartel, "Ent. Nach.," xxiv., p. 337 (Nov., 1898); "Palæark. Gross-Schmett.," p. 228 (1900); Rey, "Berl. Ent. Zeits.," xlv., Sitz. p. 18 (1900).—The size of both sexes is 42mm.—45mm.; it is thus considerably smaller than *fuciformis*, of which I have specimens before me measuring 50mm., while the extreme measurement of *tityus* is only 43mm. The form of the wings agrees with the former species, while the outer margin also, both on the fore- and hind-wings, is as broad as in this species. The colour of the forewings is much darker than that of the hindwings, yet not red-brown as in *fuciformis*, but much more dusky, more blackish, thus similar to that of *tityus*. Only on close examination is any brown tinge (very faint) visible therein. The elongate spot on the transverse nervure of the forewing, which so well distinguishes *fuciformis* from *tityus*, is much broader than in the former species, although still not so broad as in the var. *robusta*, Alph., from the Thian-Schan. The basal area and the main part of the inner margin are on both wings filled up with dark colour, which extends the same distance in *heynei* as in *fuciformis*, is grey-brown in one specimen, inclined to greenish in another, and to yellowish in the other two. The underside shows no important peculiarities excepting the notably darkened margins. Only the marginal band terminates at the inner angle of the hindwing in a far darker broad spot than in *fuciformis*, of which I have compared more than 60 specimens. One may regard this as a character of *tityus*, in which the black border widens at the anal angle into a more or less intense black spot. In the antennæ no special differences are observable, but in the body such are very pronounced. Head, thorax, and first two abdominal segments incline in colour more to *tityus* than to *fuciformis*; they are yellowish, without, however, being quite as light as in the former species. The abdomen far more resembles *tityus* than *fuciformis* in form. The 3rd and 4th abdominal segments are quite

* The whole surface of the wings is covered before flight with large loose dark red scales, which in the broad central portions of the wings are so loosely attached that they are shaken off at the first flutter. These scales give the specimens which have been killed before flight a dusky semitransparent appearance (Barrett). Merrifield states that the fugitive scales which cover the centre of the wing, and almost immediately after emergence become detached, may be rendered adherent by allowing a very weak solution of indiarubber, in benzoline, to run over the wings.

black as in *tityus;* in *fuciformis* they are coloured red-brown like the border. The following segments are intermediate in colour between the two species named, being lighter ochre-yellow than in *tityus;* also the anal tuft agrees fairly well in colour and size with the latter species. The first three abdominal segments are somewhat paler on the underside, more blackish-coloured and intermixed with light yellowish hairs, the following segments yellowish. Anal tuft on the underside mixed with brownish. The colouring of the breast, the legs and the palpi agrees with *fuciformis* and *tityus.* This interesting form is further characterised on the upperside of the abdomen by a slight bluish dusting in the middle of the black girdle, but no special weight is to be laid on this, as it is just as often present in *fuciformis* as absent. I am unfortunately not able to name the exact locality of these four specimens from Heyne's collection, as it was not indicated on them. On the other hand one may probably accept with tolerable certainty that they are from Central Europe, whence came all the rest of Herr Heyne's *fuciformis* and *tityus;* but Innsbruck can be given as a surer locality, as Herr Alexander Heyne received two others from there. Whether this is the product of a cross between *fuciformis* and *tityus*, as I regard it, or whether it is only a variety will have to be settled by further observations (Bartel).

Rey states (*Berl. Ent. Zeits.*, xlv., Sitz. p. 18) that this is merely a colour aberration of *H. fuciformis*, having the broad wing-border of *H. fuciformis* but the abdomen as in *H. tityus.* Later he exhibited at a meeting of the Entomological Society of Berlin a series of *H. fuciformis* which showed distinct transitions to ab. *heynei*, while *H. tityus* showed at once definite distinguishing features, and he considered that there could be no doubt that *heynei* was an aberration of *H. fuciformis.* At the same meeting Dönitz remarked that he had bred this unimportant aberration with typical specimens from larvæ taken in Taufers.

β. var. *simillima*, Moore, "Proc. Zool. Soc. Lond.," p. 391 (1888); Kirby, "Cat.," p. 625 (1892). — *Hemaris simillima*, n. sp. Nearest allied to *H. fuciformis.* Forewings with a vinous-black costal, outer, and posterior marginal band, the outer band somewhat narrower than in *H. fuciformis*, the posterior band sparsely covered with olive-green scales; hindwing with a cupreous-red marginal band, the abdominal border prominently white-speckled. Head, thorax, and base of abdomen pale, dull, ochraceous olive-brown, the two red bands of a dull chestnut tint, basal segments yellowish-ochreous, anal lateral tuft black. Expanse, $1\frac{7}{10}$ inch. *Hab.* Kangra Valley [Himalayas]. In coll. British Museum.

In treating this as a variety of *H. fuciformis*, we do so without knowledge of the insect. Kirby sinks it (*Cat.*, p. 624) as a mere synonym of the latter species. Jordan simply states (*in litt.*): "*Simillima* differs from *H. fuciformis* in the forewings being somewhat more elongate, *i.e.*, narrower."

γ. var. *robusta*, Staud., "Stett. Ent. Zeit.," xlii., p. 394 (Sept. 1881); "Cat.," 3rd ed., p. 105 (1901); Alph., "Hor. Soc. Ent. Ross.," xvii., p. 17 (Dec., 1882); Kirby, "Cat.," p. 626 (1892); Bart., "Palæark. Gross-Schmett.," ii., p. 227 (1900).—Two smaller, tolerably fresh specimens which were caught at Lepsa, one on May 13th, the other on August 27th, show that this species has there two broods. Otherwise they scarcely differ from European specimens, only the transverse nervure of the forewing is somewhat more broadly dusted with brown. This is still more the case in the larger specimens from northern Persia and the Thian-Schan, where also the outer margin is broader, yet they scarcely deserve on this account to be brought forward as a local form under the proposed name var. *robusta* (Staudinger). Varietas major, viridior, alis anticis limbo latissimo, 47mm.—48mm. (Alphéraky).

Alphéraky notes (*Hor. Soc. Ent. Ross.*, xvii., pp. 17—18): "Staudinger thinks (*Stett. Ent. Zeit.*, 1881, p. 394) that the Thian-Schan form of this species hardly merits to be distinguished from the type. It is, in fact, not a very specialised race, but, being constant, it ought to be distinctively named. The following characters distinguish all the Thian-Schan examples: La taille toujours plus forte, une coloration plus verdâtre du corps, la bordure extérieure infiment plus large et la nervure transversale plus largement écaillée de brun. The form was everywhere common from 3000ft.—8000ft. altitude, and flew during the whole summer. It was also found by Staudinger in northern Persia. This large form being constant in the Thian-Schan, I am astonished to learn that Haberhauer found a rather small form in the comparatively near district of Lepsa. Individuals of var. *robusta* have also been received from Mauzarte (also in the Thian-Schan)." Bartel notes: "47mm.—48mm. (♂, ♀), larger on an average than European specimens of *M. bombyliformis* (=*fuciformis*). The transverse nervure of forewing and the outer margins of both wings are considerably more broadly brown-scaled; body more greenish in colour; does not otherwise differ from the European type. According to Alphéraky, this form is constant in the Thian-Schan, since all the specimens caught by him possess the same characters. According to Staudinger, var. *robusta* also occurs in North Persia. Large specimens of *M. bombyliformis* (=*fuciformis*) from central Europe, which show the above-named characters, may also belong to this form." Kirby curiously sinks (*Cat. Lep. Het.*, i., p. 626) this as a synonym of ab. *milesiformis*, Tr. Jordan notes (*in litt.*): "I think *robusta* of Alphéraky has no standing."

δ. ab. *milesiformis*, Tr., "Die Schmett.," x., pt. 1, p. 125 (1834); Nick., "Lep. Böhm.," p. 27 (1850); Kirby, "Cat.," p. 626 (1892); Bart., "Palæark. Gross-Schmett.," ii., p. 227 (1900); Staud., "Cat.," 3rd ed., p. 105 (1901). —Macr. alis fenestratis; anticis basi ex viridi flavescentibus atomis, stigmate medio margineque externo purpurascentibus; abdomine viride flavo, fascio purpurascente. The true *fuciformis* *, L., is larger than *tityus*. On the contrary, *milesiformis* scarcely reaches the size of *tityus*. Also in the form of the body it resembles *tityus* much more, while *fuciformis* (especially the ♂) comes nearer to *croatica* and *stellatarum* in its broad flatter build. The antennæ are likewise shorter; in the ♂ remarkably strong, black-brown. Thorax and abdomen yellow, almost without admixture of green. The girdle is here *bright red-brown*. The anal tuft, which in *fuciformis* is almost entirely black above, with only a few yellow hairs in the middle, and almost always broad, is in *milesiformis* pointed, black at the sides, but yellow in the middle; underside in the former black, in the latter with only the tip black. Wings narrower and shorter than in *fuciformis*, the border of a *decided coffee-brown*, the nervures disappearing therein. At the base they are covered with thick hairs, the central streak is smaller. The whole surface bears, even after the insect has flown some time, a *scattered light-brown dusting*, while *fuciformis* shows directly after emergence a *few blackish specks only* on the otherwise glassy wings. On the underside, the inner margins of *milesiformis* are yellow, the outer red-ochre; in *fuciformis* darker. The glassy surface of the last-named shows, when turned towards the sun, a fine bright blue colour, almost violet, which does not appear at all in *milesiformis*, or only presents a somewhat red-yellow appearance. I have always taken *fuciformis* in the middle of May, together with *tityus*, there is also said to be a partial second brood at the end of July and beginning of August. It is always rare; in Hungary it is of a specially fine and bright olive-green colour. *Milesiformis* has been obtained by Dahl and myself from Franconia and Bavaria, where it is a tolerably common moth. I suspect that the larvæ figured and distributed by Hübner and Freyer as *fuciformis* belong to *milesiformis*; Rösel's iv., pl. xxxiv., figs. 1—2 on the other hand represent the true *fuciformis* (Treitschke). DISTRIBUTION. — AUSTRO-HUNGARY: Hraszt (Mann), Lavantthal (Höfner). BELGIUM: Liège (Donckier). GERMANY: Stuttgart (Seyffler), Lower Elbe dist. (Zimmermann), Waldeck, singly (Speyer), Dantzig (Grentzenberg), Marbuch,

* Nomenclature reduced to that of Kirby in order to avoid confusion.

rare (Hoffmann), Osterode, Neuhaldensleben, Rheingau (Jordan), Berlin district, rare (Pfützner), Freiburg, Lahr, Würtemberg (Reutti). RUSSIA: Baltic Provinces (Nolcken).

Nickerl notes *milesiformis* as a form of the species with narrower wings, the larvæ and the foodplants being identical. Staudinger writes: "Minor dilutior, gen. æstiva (?)." Bartel writes (p. 227): "♂, ♀. Treitschke's types in the National Museum, Budapest, belong to a somewhat smaller form of *M. bombyliformis (fuciformis)*, which does not even reach the expanse of (the on an average somewhat smaller) *M. fuciformis (tityus)*. The part of the wing at the immediate base is thickly dusted with dark scales on both wings. The scaling on the transverse nervure of the forewing is not so extended. In this respect ab. *milesiformis*, therefore, forms the direct antithesis of var. *robusta*, Alph. The outer margin of the wings is lighter red-brown scaled, and sends out towards the base small teeth into the single cells. On the underside the inner margins are lighter yellow than in *M. bombyliformis (fuciformis)*. The thorax and abdomen are more yellow in colour and show hardly any green admixture at all. Girdle bright red-brown (in other specimens in the Museum black-brown). Anal tuft pointed, yellow in the middle, black at the sides, underneath with black tip. Only small and lighter specimens of *M. bombyliformis (fuciformis)* may be considered as ab. *milesiformis*. As most of the differences given by Treitschke are not constant, the principal characters of this form are only the more narrowly scaled transverse nervure of the forewing, the lighter red-brown outer margin of the wings, the in-projecting teeth, the yellower body, and the lighter red-brown girdle of the abdomen. Occurs everywhere among the type."

EGGLAYING.—The moths appear to lay their eggs at any time during the day, and as far as my observation goes they do not lay them on the wing, but alight for a moment to deposit an egg and then fly away again (Head). Three eggs sent by Mr. Head on July 10th, 1901, were laid on the underside of a leaf of honeysuckle, being firmly attached to the surface; all are laid somewhat near the margin, two touching each other, the other separate (Tutt). The species is reported by Harwood (*Buckler's Larvae*, vol. ii., p. 121) to lay her eggs whilst on the wing, curling up the abdomen so as to place the egg on the undersurface of a leaf. Sladen also records (*Ent.*, xxi., p. 14) the species as laying its eggs whilst on the wing; he observed it doing so at Burghclere in 1886. Freeman observes that the eggs are very easy to find, being laid on either side of small leaves of honeysuckle on June 30th, 1899, at Aylsham, and Barrett notes that the eggs are deposited upon the leaves, while hovering over honeysuckle sprays, and are easily found. Bartel says that the spherical pale green egg is attached to the underside of a leaf of the foodplant, and if the leaf be torn off and allowed to become dry the eggs fail to develop.

OVUM.—1·1mm. in length, 1mm. in width, height about ·9mm.; oval in outline, to the naked eye approaching a circular outline; plump; slightly flattened on upper surface but with no depression; the two ends—the micropylar and its nadir—almost equally rounded; the surface almost smooth, shiny, but with very slight traces of an exceedingly faint polygonal reticulation rather better developed towards the ends, and appearing rather as shallow longitudinal wrinkles; colour bright pea-green, the embryo showing whitish through the shell (Received from Mr. Head, and described July 10th, 1901). The empty eggshell is quite transparent, almost smooth, with the appearance of silk; the caterpillar escapes from the upper part of the egg, towards (but above and not directly from) one of the poles. Hatched July 6th, 1899 (Tutt).

HABITS OF LARVA.—When young the larva rests underneath a leaf of honeysuckle, and has the power of dropping by a thread if disturbed (Bacot); its whereabouts are easily detected, owing to its habit of eating round holes through the leaves when young (Holland); usually these holes are in pairs, one hole opposite and on each side of the midrib, about 3 pairs to a leaf (Sich); afterwards the larvæ are highly protected by their resemblance to the narrow leaves of the honeysuckle, and are sometimes most difficult to see. They turn deep purplish-brown before leaving the plant for pupation (Griffiths). The larvæ were very plentiful at Wimborne in July and August, 1888 (Fowler), of varying sizes in July, 1890, in New Forest, some only just hatched and others fullfed; also fullfed larvæ July 18th-31st, 1891, at Brockenhurst (Mitchell); larvæ on July 3rd, 1883, at Butterwood, June 28th, 1886, at Tilehurst, July 5th, 1891, in great plenty at Aldermaston (Holland); June 9th, 1886, already fullfed at Brentwood (Burrows); July 12th-19th, 1890, at Brockenhurst (Ogden); ova and young larvæ at late as July 11th-31st, 1891; larger larvæ July 6th, 1892, near Emsworth; also on July 8th-9th, 1891, June 22nd, 1892, and May 20th, 1894, in the New Forest (Christy); 13 larvæ on August 13th, 1898, on honeysuckle growing among heather at Oxshott (South); young larvæ on July 5th, 1899, at Aylsham (Freeman); nearly fullfed August 7th, 1899, at Market Rasen (Mason); also very small at Reading, on July 20th, 1900 (Butler); July 28th, 1900, between Loughton and Theydon Bois (Lane); July 8th-11th, at East Hoathly (Sich); almost fullfed at Tuors Pensch, August 12th, 1875 (Zeller).

LARVA.—*First instar* (newly-hatched): Length about 3mm. Head large, more noticeably in height than width; rounded in outline; colour pale cream; surface granular, dull, with a few scattered hairs all markedly bifid, though the branches are not quite so long as those of the body hairs. Body short and thick; segments distinctly marked; scutellum distinct; colour opaque creamy-white without lines; the tubercular points i, ii, iii, iv, and accessory prespiracular, tall and cone-shaped but not large, they are single-haired; these hairs borne on the tubercles are large and very markedly bifid, each fork being about three times the length of the undivided or stem portion, the branches tapering gradually to a point; traces of serrations are sometimes discernible on the hairs. Caudal horn about one-half the length of the body, thick, soft, fleshy-looking, dark purple-black in colour; the terminal hairs (setæ of i) long, and the horn itself slightly bifid; covered with a dense growth of short hairs slightly bifid at tip. *First instar* (full-grown): The caudal horn very similar to that of the larva of *Sphinx ligustri*, but the apical bisection deeper; the hairs at tip not noticeably bifid, suggesting that the wide forks of the hairs carried by the tubercles i, ii, iii iv &c. are probably of more recent origin than the less strongly bifid ones on the caudal horn; the dorsal tubercles (i and ii) on the meso- and metathoracic segments are united as in the larva of *Sphinx (ligustri)* and bear two setæ (i and ii). On the abdominal segments they are separate. The lateral tubercles—iii (supraspiracular), iv (subspiracular), and the characteristic accessory prespiracular—each carry a single deeply-cleft hair. There are no traces of any secondary hairs (July 9th). *Second instar:* Head still rounded, not very large, bears rather long dark hairs slightly notched at apex, colour faint greenish with a semi-transparent appearance. Body of the same colour as in the first instar but rather more opaque; the scutellum very large and distinct, bearing some large dark-coloured hairs rather more forked at tip than those on head; segmental incisions distinct, subsegmental divisions also fairly well marked; the caudal horn purplish-black, large, thick, about one-third the length of the body, still slightly bifid at tip, each branch bearing one long tapering pointed seta, the horn still thickly covered with short dark-coloured hairs well forked at their apices; the body now covered, Amorphid-like, with a coat of fine, short, markedly bifid hairs, though not branched so much as are the primary hairs borne on the tubercles in the 1st stadium; the primary setæ on the tubercles are still noticeably larger than these secondary hairs, but bear no comparison with those of 1st stadium either in length or extent of bifurcation of bifid tip, being now merely slightly larger than the secondary hairs; no trace yet of lateral stripes (July 16th) (Bacot). *Penultimate instar:* The larvæ were set with rough points before their last moult, otherwise much as when in their last stadium. *Final instar*: The fullgrown larva is about 35mm. long, stoutest at segments 9 and 10, tapering forwards, but not rapidly; the face slightly wider at the mouth than above, the lobes set with some small points; the skin with eight folds to each segment, bearing dots, but really smooth; the horn on segment 12 rough, curved, and sharp at the tip; the general colour a beautiful green, the back whiter green, with a dorsal line showing at the folds; the subdorsal line yellow, ending at the horn, which has the base lilac, the middle claret-brown, and the tip brown; the spiracles bright rust-red in colour, with a white dot above and below; in one specimen the spiracles were surrounded by reddish-brown pear-shaped spots; the belly red-brown, with a yellow line edging it, the anal flap edged with yellow; the head of a bluer green than the body (Hellins). The larva when full-grown is 40mm.—50mm. in length. It is light green, mixed with whitish dorsally, and densely covered with fine yellowish dots which stand together in rows. The larva has a yellow longitudinal line at each side of the dorsum, uniting on the horn. In the middle the dark dorsal vessels are visible, through which a light line runs. Spiracles white, margined with reddish, or brown-red. The thick, curved, shagreened horn is brown, at the apex yellowish. A violet tinge appears above the legs. On the belly a broad brown-red stripe runs from the head to the anal claspers; it colours the legs, or a part of them, brown-red. Head dark or dirty grey-green, rough. Before pupating the larva becomes a dirty violet-grey (Bartel). The larva is elongated, covered with small tubercular spots, which give it a rough granulated appearance about 2ins. in length when full-grown; bright green in colour, speckled with pale yellow tubercular spots, getting lighter on the back; a darker green dorsal line, a pale yellow longitudinal line on either side which terminates at the horn; the latter brownish-purple and minutely granulated; head round, green, and minutely speckled with whitish-green; the mandibles light brown; the abdomen chocolate-coloured, or brownish-purple, or violet; the stigmata scarlet; the thoracic legs pink, tinged with plum-colour; the prolegs brownish-violet, tipped with greyish fawn-colour; there is a narrow yellow line just behind the head; the edges of the anus are bordered by a yellow line. When the larva is about to undergo its change to the pupal stage, it turns to a dark brownish-purple colour (Chaumette, *Zool.*, ix., p. 3100).

VARIATION OF LARVA.—Hellins mentions a larva in which the spiracles were surrounded by reddish-brown pear-shaped spots. Buckler figures (*Larvae*, etc., pl. xxvi., figs. 3, 3a, 3b) three different forms of the larva. (1) Brown, with a very dark mediodorsal line. (2) Green, with a broad yellow spiracular lateral band extending from the subdorsal line to the subspiracular line. (3) With a deep claret-red subspiracular line, dividing the spiracular area from the ventral area. The green larvæ "become dark-brown just before changing to pupæ" (Buckler).

COMPARISON OF LARVA OF HEMARIS FUCIFORMIS WITH OTHER SPHINGID LARVÆ.—The head of the larva of *H. fuciformis* appears to be tall and approaching the oval Sphingid outline; the scutellum is rough and prominent, a character that is somewhat marked in the larva of *H. tityus*; the oblique stripes (or slashes) very faint. It may be noted that the larva of *H. fuciformis* shows the graceful tapering outline of the larva of *Mimas tiliae* from the 4th or 5th abdominal segment to the head, and not the abrupt outline from the 1st or 2nd abdominal segments to the head as exhibited in the larva of *Sesia stellatarum*. Possibly the ground-feeding habit of the latter and the bush-feeding habit of *H. fuciformis* are responsible for much of the difference; it may also be partly due to the fact that the larvæ of *H. fuciformis* examined are not adult. The caudal horn of the larva of *H. fuciformis* is distinctly longer and more prominent than that of *H. tityus** (Bacot).

COCOON.—The larva forms a very open cocoon on the surface of the ground, of dirty whitish and pinkish silk, stuck over with bits of earth, &c. (Hellins); the dusky purple pupa is enclosed in a slight cocoon amongst moss or roots of grass (Crewe); a larva put in a box without material, spun a slight web, in which it remained 4 weeks before pupating (Bingham-Newland); the cocoon is made on the surface of the ground, much silk and little earth being used in its construction (Freeman); pupates between leaves which are merely drawn together by a few threads, or under moss (Bartel); spins a loose open network cocoon among moss, grass-roots, &c. (Barrett).

PUPA.—The pupa is Sphingid (*sens. rest.*) in the orientation of the face-parts, but differs from all other Sphingids, in having a long tapering abdomen, in presenting no portion of the first

* The larvæ of *H. fuciformis* and *H. tityus* on which this comparison was made had been preserved by inflation (Bacot).

femur, and in possessing a very special anal armature. The long tapering abdomen is a Hemarid characteristic which it has in common with the pupa of *Cephonodes*. The want of the first femur is a character it possesses in common with (the Amorphids and) the Sesiids (Macroglossids), and which distinguishes it from the Pterogonids. The anal armature is a special generic or tribal character, and unites *fuciformis*, *tityus* and *croatica* ; these three pupæ are in fact almost identical, and with trifling variations the description of that of *H. fuciformis* will serve for the other two species. The long tapering abdomen is due to the exposure of much intersegmental membrane at the free incisions, and is not so apparent in a dead, dry and shrivelled pupa. The fourth abdominal segment is the largest, and thence it tapers backwards, more so from the 7th abdominal segment, whence, viewed dorsally, it tapers regularly to the extreme point of the anal spine (see *tityus*). Viewed laterally, the pupa is equally thick at the 3rd and 4th abdominal segments ; forwards the dorsum goes on fairly straight but the ventral aspect retreats, the tapering of the last segments would be as regular as in a dorsal view, but for the hollow in front of the anal spine. The length of the pupa is 28mm. of which 15·5mm. are from front to end of wings. Extreme width, 7·6mm., depth, *i.e.*, antero-posterior diameter, 7·4mm. There is a little dorsal flattening, otherwise there is nothing like the flattening characteristic of Sesiid (Macroglossid) pupæ. The colour is dark, quite black in some, in others with more or less brown. The brown is especially dorsal and may absorb the whole mesothorax, and usually appears as the colour of some subsegments on each segment. The labrum is absolutely anterior, whilst on either side of it, and a little ventral to it, the angles of the cheeks carry a short thick spine or horn, with a moderately sharp edge running longitudinally on its front. There is a suture along the head and prothorax, but not on mesothorax. From the labrum the first legs reach 10mm., second to 11·5mm., and antenna to 13mm., end of maxillæ, 15·5mm. The sculpturing of the appendage-cases consists of transverse wrinkles (or rugæ), on the legs often with a zigzag arrangement, on the antennæ each segment has two ridges united at their ends, on the wings they are rather bolder along the costa. Poulton's line is well marked as well as down the narrow slip of hindwing. The neuration is marked by impressed lines cutting across the rugæ, and are also marked by two brown stripes from the base of the wing, dividing into brown lines for each nervure from the middle of the wing in all pupæ with brown markings. In the dorsal thoracic sculpturing, the rugæ tend to break up into minute islets, and at the centre of the wing-base are some specialised folds, but nothing to be called a spine. The thoracic spiracular opening is wide, with smooth margins. It is curved with the concavity behind, and often has the concave margin smooth and tumid, but sometimes the ordinary rugose surface comes to the margin. The metathorax is very narrow, especially medially, the posterior margin is raised, and in front of this is another ridge, broken dorsally by the narrowing of the segment into two portions, which correspond with the callosities often existing here (*Manduca atropos*, &c.). The following segments have a black posterior border, very minutely wrinkled (on 7 and 8 practically smooth), the intersegmental subsegment, broader laterally and especially in front (on 7), but disappearing suddenly on 5 and 6 at scars of prolegs. In front of this is a narrow subsegment of brown (or yellow) colour, whose rugæ are quite independent of those of the last-described (intersegmental) subsegment, but continuous with those in front; then a dark subsegment, broad dorsally, narrow laterally, and including the spiracles, with some indication of a division into two on 2nd and 3rd segments. In front of this is another subsegment, not very definitely marked off on 1, 2, 3 and 4, except by colour; on 5, 6 and 7 it forms, dorsally and subdorsally, a slightly raised rib of reddish-brown colour, and some differentiation in the wrinkling laterally; it is a little broader, reaching to close above the spiracles. Here on 5 and 6 it has the sculpturing in the form of 5 or 6 transverse wrinkles, rounded on 5 and rather sharp on 6, on 7 the area is merely finely pitted, its margin above the spiracle, however, stands up as a distinct ridge on 7, less so on 6, and hardly at all on 5; in all, however, the subsegment slopes inward from this ridge to the anterior border of the segment; it is hardly visible except when the pupa is bent. The intersegmental membrane is pale reddish-brown, and its shagreening extremely fine. The proleg scars on 5 and 6 are small, smooth areas, towards which the lines of wrinkling radiate as they approach and then fade out; sometimes they also present the aspect of raised areas with central hollows; a smooth area, sometimes raised, sometimes hollow, marks the position of the larval horn. The anal spine is about 2mm. long, 1·6mm. broad at base, and about ·9mm. thick. The margins are slightly curved, otherwise it is roughly triangular. It terminates in a fine spine, carrying two points, diverging laterally, but somewhat dorsally. The specialisation of the anal spine in these species (the genus ?) is shown in the clothing that it carries of very fine spines on raised bases, and all pointing very nearly directly backwards; viewed dorsally, 10 are seen on each side at tolerably regular intervals, with three or four more crowded, but less typical, at the base; they clothe also the whole dorsum and half the basal aspect, and there is a small group on each side of the segment ventrally at the base of the spine. The anal scar is a rather deep cruciform hollow, whilst some concentric striæ mark the position of the claspers. The ♂ pore is quite at the posterior border of the 9th segment, and has the usual structure rather flattened down. The ♀ pore is quite at the posterior border of 8, with 9 presenting a slight central suture. There is practically no invasion of the area of 8 by 9, and at first one takes the ♀ pupa for a ♂, till the very different position of the ♂ pore is compared with it. In one specimen the whole of this region is very smooth; it is judged to be a ♀ from a slight invasion of 8, with a doubtful appearance of a pore there. In a good light, with a strong glass, a considerable number of fine hairs may be seen on the dorsum of the head and of the 1st and 2nd thoracic segments (Chapman). The pupa is 24mm. long, cylindrical, stout across the wing-cases, tapering to the head, which is conically rounded; the abdomen tapers off considerably to the tail, which has a flat, triangular, sharpish spike. The pupa-skin is granulated, but rather glossy, the colour rich brown, with a blackish shade on the centre of each segment, and blackish outlines on the wing- and antenna-cases (Hellins). Black, shiny, but rugose, with red-brown intersegmental membrane, the head covered with short red-brown hairs. Head prominent, with two projecting papillæ (one on each side of the base of the maxillæ), forming nose-horn like spines, distinct but not conspicuous, owing to the prominence of the mouth-parts. Antennæ set in at the junction of the dorsal face-piece and prothorax. The latter not well-developed, the prothoracic spiracle in contact with the antennæ and on the line of separation between the pro- and mesothorax, the mesothorax not very prominent dorsally, the metathorax very ill-developed. The wing-surface folded transversely. Movable incisions between abdominal segments 4—5, 5—6, 6—7. The abdominal spiracles very inconspicuous, a very narrow slit at base of a slight depression. The cremaster flattened, hollowed ventrally, ending in a bifid tip, and bearing lateral rows of hooked points. Sexual organs conspicuous. Ventrally the maxillæ reach to the apex of the wings, and end on the first movable incision. Two pairs of legs only visible, and these end just short of the tips of the antennæ, which extend about $\frac{2}{3}$ along the costa of the wing. The glazed eye exists as a narrow, black, shiny lunule, extending from the base of the first pair of legs to the base of the antenna (Tutt).

Comparision of pupæ of Hemaris tityus, H. fuciformis and Cochrania croatica.—In the pupa of *H. tityus*, the facial spines or horns, instead of forming a summit ridge, are rather directed forward and end in a sharp point directed ventrally. The prespiracular ridges are most marked on 5, nearly evanescent on 6. The anal spine is perhaps narrower, and its margin (seen dorsally) is more in line with the outline of segments 8, 9, and 10, whilst in the pupa of *H. fuciformis* there is an evident narrowing at the base of the spine. *C. croatica* has a much smoother pupa, the wrinkles being very slight and almost evanescent on the abdominal segments, the face-spines forming very low mammillæ, that would escape observation if not looked for, the wing-cases very smooth ; the spicules on the anal spines are perhaps rather fewer and stronger, the prespiracular ridges very strongly marked on the 5th abdominal (Chapman).

Pupal habits.—The pupal stage usually extends from July to the following May or June; in warmer climates some imagines emerge in August after a pupal period of only three weeks. Not infrequently the species passes two winters in the pupal stage at Wernigerode (Fischer).

Foodplants.—*Lonicera* (Linné), all the garden varieties of honeysuckle (Hellins), variegated honeysuckle (Bingham-Newland), *Lonicera xylosteum*, *L. caprifolium* (Nickerl), *Symphoricarpus racemosus* (Bristowe). [Herrich-Schäffer states that the larvæ feed on *Lonicera* and *Galium*; Heinemann gives *Galium verum* only; Caradja gives *Galium*, and Himsl *Scabiosa arvensis* (evidently referring to *H. tityus*). Zeller criticised the statements of Herrich-Schäffer and Heinemann as to *Galium* being a foodplant, and Kranz long since pointed out that the larvæ of this insect would not eat *Galium*, *Knautia* or *Epilobium* as stated by many authors, but only species of the genus *Lonicera*.]

Habits and habitat.—In wood-clearings and wood-ridings, loving the flowers of rhododendrons in the large private parks of the South of England, but also occurs in meadows by hedgesides, and by railway-banks, and at Oxshott haunts the honeysuckle growing amongst the heather on the heaths. It occurs everywhere in the wood-meadows in Baden, at Andermatt it loves the mountain-meadows, and at St. Michel-de-Maurienne haunts the lower zig-zags on the way up to Valloire, whilst in the forest of Fontainebleau we found it hovering over the masses of *Echium vulgare* by the sides of the open rides, or growing by the roadsides on the outskirts of the forest. It is abundant on the hot slopes of the Esterels and is common in the corkwoods to the north of Hyères, whilst Lambillion records it as haunting the rocky ground of the Namur district. Head finds it not an easy species to breed in confinement owing to the difficulty of keeping the moths supplied with an abundance of the right kind of flowers on which they may feed; they pair both in the morning and afternoon, and seem to lay their eggs any time during the day. The imagines emerge from noon until 2 p.m. (Kimber), and fly in the sun almost the whole of the day, from early morning between 9 a.m. and 9.30 a.m. (in the Esterels), until 4 p.m., at which time they were seen feeding busily at the bugloss flowers (in Fontainebleau Forest). They dearly love certain flowers, about 150 specimens being taken whilst flying at the blossoms of rhododendrons in the New Forest in 1869, the insects appearing always to prefer the light crimson varieties to the other colours (Cox), at flowers of rhododendrons in the Bristol district (Hudd), and at Newark (Leivers), plentiful at blossoms of honeysuckle in Rhinefields, June 5th, 1891, the rhododendrons not then being out (James), common at flowers of bugle and honeysuckle in the Kent woods (Carrington), common at flowers of bugle and rhododendrons in the bright sunshine in the New Forest (Carr), at flowers of *Ajuga reptans* in the Long Meadow at Abbott's Wood (Porritt), hovering over the flowers of *Ajuga reptans* during sunshine in the damp ridings of a large wood near Wragby (Raynor), at flowers of *Ajuga reptans* in Wigmore Wood (Chaney), at flowers of *Lychnis floscuculi* and *Ajuga reptans* near Rugby (Longstaff), common on a patch of ground covered with *Lychnis floscuculi* in blossom at Kettering (Sturgess), at flowers of *Glechoma hederacea* at Thurning, and at flowers of *Lychnis floscuculi* in Tilgate Forest (Briggs), hovering over a patch of *Nepeta glechoma* in a wood near Guildford (Grover), at *Melampyrum* flowers at Hailsham (Carr), over *Stachys sylvatica* at Groombridge (Blaber), very abundant in 1893, feeding at flowers of bluebells, violets and primroses (Fowler), flying over *Lychnis* at Clonbrock (Dillon), at lilac flowers at St. Petersburg (Menshootkin), whilst 30 or more can be taken easily at rhododendron blooms from 10 a.m.-11 a.m. on a sunny morning, as well as odd ones at flowers of *Ajuga reptans* in the wood-drives near Lincoln (Musham), Krieghoff notes the imagines as attracted to flowers of *Syringa*, *Pulmonaria*, and *Ajuga* in Thuringia, and Garbowski that *Salvia officinalis* is favoured in Galicia, where, in some years, it is much more abundant than in others; Bartel notes thistles, rhododendrons, *Syringa*, *Pulmonaria*, *Echium*, *Lavandula*, *Salvia pratensis* and *Ajuga* as being the most attractive flowers, generally, on the continent ; Nolcken gives *Ajuga pyramidalis*, *Echium vulgare* and *Lychnis viscaria* for the Baltic provinces.

Time of appearance.—The moth emerges in May and June in Britain—May 15th-June 15th are good average dates for Wigmore Wood in Kent. It is, however, well out in the Esterel from early April, where it possibly produces a second brood (Tutt), and was common until May 3rd, 1899, in the corkwoods to the north of Hyères (A. H. Jones), it occurs in May, and again in July-August in the Haute-Garonne (Caradja), has a 1st brood about May 10th and a 2nd brood in July at St. Quentin (Dubus), May and again in August at Eure-et-Loir (Guénée), August 1st-3rd at St. Michel-de-Maurienne, possibly a second brood (Tutt), in May-June and August in Alsace (Peyerimhoff), June 20th at Grumazesti, July 13th at Kloster Neamtz (Caradja), at the end of May (May 24th, 1896) at Namur (Lambillion), in August at Liège (Donckier-Huart), May-June and again in August in Upper Austria (Himsl), in May and June, and more rarely again in August at Baden (Reutti), May 13th, 1902, at Brünnen (Chapman), double-brooded in the Swiss lowlands, occurring in May and end of July, but only single-brooded in the mountains (Frey), imago occasionally emerges in autumn of the same year that the larva pupates at Munich (Rössler), in June at Hraszt (Mann), common in the meadows at Andermatt up to 5000ft., middle of June, 1886 (Jones), at flowers of *Lonicera*, May 26th, 1875, at Tuors Pensch (Zeller), commencement of June at flowers of *Orobus* at Upsala (Dalman), June 28th-July 1st, 1897, at Fountainebleau (Tutt), Fritsch gives dates for Austro-Hungary from May 5th to June 9th, also April 7th at Cilli, and April 24th at Vienna. There appear to be no records of second-brooded examples in Britain, at least the following show none: June 18th, 1856, hovering round *Betonica officinalis* at Box Hill (Watney), May 17th, 1857, May 30th-June 6th, 1858, May 27th, 1860, at West Wickham (Healy), first week in June, 1857, at Fakenham Wood (Tillett), May 25th, 1858, in New Forest (Bryant), June 19th, 1858, common at Kettering (Sturgess), May 31st, 1859, at Stone Woods, Greenhithe, June 25th, 1863, at Lyndhurst, May 29th, 1865, not scarce, also May 29th, 1866, and June 16th, 1874, at Darenth, May 29th, 1866, at Blean Woods (Fenn), May 21st-23rd, 1859, at Darenth Wood (Harding), June 4th, 1859, at West Wickham Woods (Tibbs), June 14th-28th, 1860, at Balcombe (Merrifield), May 15th-21st, 1864, June 2nd-5th, 1869, at Thurning, May 25th, 1866, at Bagley Wood, June 20th, 1867, at Tilgate Forest, bred June 4th-7th, 1889, eggs laid by ♀ captured near Peterborough, June 7th, 1888, larvæ from which pupated August 19th, &c. (T. Briggs), May 23rd, 1865, at Loughton (Cole), June 9th-14th, 1866, at Coombe, near Brandon (Longstaff), June, 1866, at flowers of common bugle and cowwheat at Ipswich (Last), June 2nd, 1866, in Blean Woods (A. H. Jones), June 22nd-23rd, 1867, bred at Emsworth (Buckler), June 5th-26th, 1869, in New Forest (Capper), June 11th, 1870, at Lewes (Jenner), latter half of July, 1879, in good condition in New Forest (Graham), May 29th, 1884, at Bulmershe Park, June 3rd, 1887, at Sulham, June 1st, 1890, at Butterwood, May 29th, 1894, at Bagley Wood (Holland), bred June 2nd-13th, 1885, caught June 11th, 1887, May 24th, 1890, at Brentwood (Burrows), June 7th, 1888, June 6th, 1890, May 9th, 1896, May 4th, 1900, at Pamber Forest (Butler), June 30th, 1888, near Emsworth, May 26th, 1892, May 5th, 1894, May 22nd, 1897, June 27th, 1899, in the New Forest (Christy), extremely abundant in June, in 1888, in New Forest, a generally late and bad season for lepidoptera (Adye), July 9th, 1888, at Groombridge (Blaber), May 19th, 1890, at Wicken (Freeman), May 20th, 1890, in Brighton district (McArthur), May 31st-June 7th, 1890, at Brockenhurst in tolerable abundance (Ogden), June 5th, 1891, May 26th-June 2nd, 1894, at Rhinefields (James), June 13th, 1891, at Abbott's Wood, May 28th, 1895, near East Hoathly (Nicholson), May 26th, 1892, in a wood near Wragby (Raynor), common June 2nd-12th, 1892, in the Long Meadow at Abbott's Wood (Tugwell), June 8th, 1892, in a wood near Guildford (Grover), April 24th, 1893, at Colchester (Harwood), May 13th, 1893, in Brandon Wood, June 17th, 1899, at Moreton (Peachell), April 26th, 1893, at Abbott's Wood, a very early year all over the country for lepidoptera (Esam), May 16th, 1893, in New Forest (Sich), May 11th, 1893, at Oxshott, May 26th, 1896, June 4th, 1897, in New Forest (Kaye), May 21st-24th, 1893, in New Forest (Richardson), May 14th, 1894, June 5th-7th, 1896, at Lyndhurst (Tremayne), May 15th, 1894, in New Forest (Robson), June 8th-17th, 1894, flying at rhododendrons, June 5th-11th, 1898, at azaleas, at Rhinefields (Wells), April and May, 1895, at Rhinefields (Nash), May, 1895, near Newark (Leivers), June 1st, 1895, at Lincoln (Pearson), June 16th, 1895, in Eastcote Woods, May 23rd, 1886, in New Forest (Smith), ova found in New Forest end of July, the larvæ fullfed August 23rd, 1895, later examples fullfed September 23rd, imagines from which emerged June 5th, 1896, and following days, plentiful at Wishanger, May 28th, 1899, and after (Bingham-Newland), May 16th, 1896, common at Ringwood (Fowler), June 15th, 1897, at Seal Chart (Watts), May 25th, 1898, at Hayling Island (May), May 30th, 1898, in New Forest (Adkin), June 3rd, 1898, at Leicester (Dixon), June 29th, 1899, at Langford Moor (Carr), May, 19th-27th, 1900, in New Forest, Southampton and Isle of Wight (Moberly), at flowers of "honesty," *Lunaria biennis*, in bright sunshine at 8.50 a.m., on June 4th, 1900; at flowers of *Lychnis diurna* in bright sunshine about 4 p.m., on June 10th, 1901, at Corfe Castle (Bankes), June 2nd, 1901, at Reigate (Prideaux), June 8th-9th, 1901, in some abundance, on side of road in Worth Forest (Beadnell), June 10th, 1901, in Dorking district (Oldaker).

LOCALITIES.—The species is locally abundant as far north as Yorkshire, beyond which its range is very doubtful. Exceedingly rare (if not entirely absent) in Scotland* and Ireland, and all Scotch and Irish records want confirmation very badly. [AYRSHIRE (Duncan, see *Ent. Rec.*, xiv., p. 162).] BERKS: not scarce (Barrett), Reading (Butler), Newbury (Kimber), Bagley Wood near Oxford (T. Briggs), Bulmershe Park, Sulham, Aldermaston, Tilehurst (Holland). BUCKS; Halton (Stainton). CAMBRIDGE: rare (Barrett), Wicken (Freeman), near Cambridge (Layard). [CHESHIRE: Bidston, scarce (Brockholes).] DEVON: rather common (Barrett), Stoke (Harvie), Exeter (Stainton), Buckerell district, not abundant (Riding). DORSET: not common (Barrett), Wimborne (Fowler), Blandford (Smith), Moreton (Peachell), Bloxworth (Cambridge), Corfe Castle (Bankes), West Bournemouth (Robertson). [DUMFRIES: Castledykes (Lennon) (see *Ent. Rec.*, xiv., p. 162).] ESSEX: generally distributed in suitable localities (Harwood), Epping Forest (Donovan),

* Meyrick says (*Handbook*, &c., p. 294): "Britain to Sutherland, rather common." This is quite misleading (see *Ent. Rec.*, xiv., pp. 112, 162).

Colchester (Harwood), Brentwood (Burrows), Loughton (Cole), between Loughton and Theydon Bois (Lane). [GALWAY: Clonbrock (Dillon).] GLAMORGAN: Swansea (Robertson). GLOUCESTER: not common (Barrett), Clifton Down (Spencer), Redland (Vaughan), Wotton-under-Edge, scarce (Perkins), near Gloucester (Merrin), Bristol district, scarce (Bartlett), Painswick (Watkins). HANTS: common and generally distributed in woods (Barrett), Gosport district, not common, Stokes Wood, Purbrook Common, Grange (Pearce), railway bank at Wood Fidley (Wells), New Forest (Graham), Isle of Wight (Grant), Burghclere, abundant (Sladen), Brockenhurst (Mitchell), Ringwood (Fowler), Lyndhurst (Tremayne), Bournemouth (Bristowe), Winchester, Basingstoke (Holdaway), Pamber Forest (Butler), Wishanger (Bingham-Newland), Binstead, Southampton (Moberly), Hayling Island (May), Rhinefields (James), Ampfield, Crabbe Wood, fairly common (Fisher), Butterwood, near Odiham (Holland), Littleton Copse, near Kimpton (Rudd *teste* Stephens), Winchfield (Robertson). KENT: common and generally distributed in woods (Barrett), Darenth Wood (Harding), Sevenoaks (Farren), West Wood, Shooter's Hill (West), Chattenden (James). Seal Chart (Watts), Blean Woods (A. H. Jones), Stone Woods, Greenhithe (Fenn), Chatham district, not common—Wigmore Wood, Park Wood (Chaney). LEICESTER: Leicester (Dixon), Gumley (Matthews). LINCOLN: locally common—Skellingthorpe, Newball, Hartsholme (Carr), Lincoln (Pearson), Wragby (Raynor), Market Rasen district, moderately common (Mason). MIDDLESEX: [Westbourne Park Station (Walker, *Nat. Hist. Notes*, 1882, p. 4),] Eastcote Woods (Rhoades-Smith), Harrow district, Kingsbury (Bond), Ruislip (Melvill), Waltham Cross (?) (Bowles). NORFOLK: rare, but widely distributed—Horsford, Heydon, Drayton, Cawston, Briston, Wormejoy, Middleton (Barrett), Stratton Strawless, near Norwich (Moss), Aylsham (Freeman), Fakenham Wood, near Thetford (Tillett). NORTHAMPTON: locally common (Barrett), Kettering (Sturgess), Thurning, Castle Hanger Wood, near Peterborough (T. Briggs). NOTTS: north-east of county—Newark, common (Leivers), Langford Moor (Carr). OXFORD: Oxford (Timmins). [RENFREW: very rare, Paisley (? Scott, see *Ent. Rec.*, xiv., p. 162).] [ROXBURGH: Hawick district, rare—Goldielands (Guthrie).] SOMERSET: local—Leigh Court, scarce, Portbury Woods (Hudd). SUFFOLK: generally distributed in suitable localities (Harwood), local and somewhat rare—Stowmarket (Bree), Ipswich (Last), Newmarket (Brown), Monk Park Wood (Wratislaw), Bentley (Harwood), Aldborough (Hele), Dunwich (Harker), Sudbury, very rare (Ransom), Brandon (Walsingham), Downham (Norgate), Merton (Barrett). SURREY: common and generally distributed (Barrett), St. George's Hills, wood near Ockham Road (Carrington), Oxshott (Kaye), Herne Hill, abundant (Austen), Dorking (Oldaker), Guildford (Grover), Frimley (Bingham-Newland), Coombe Wood (Stephens), Box Hill (Watney), Haslemere (Barrett), Horsley (Warne), West Wickham (Healy), Newland's Corner, near Guildford (Griffiths), Worth Forest (Beadnell). SUSSEX: common and generally distributed in woods (Barrett), St. Leonards (Robinson), East Hoathly (H. L. Sich), Balcombe (Merrifield), Brighton district (McArthur), Hayward's Heath, Lewes, Laughton, Battle (Jenner), Hastings district, rare (Bloomfield), Long Meadow, Abbott's Wood (Porritt), Tilgate Forest (T. Briggs), near Emsworth (Christy), Lewes (Stainton), Hailsham (Carr), Groombridge (Blaber). WARWICK: locally between Knowle and Hockley Heath (Imms), Coombe, near Brandon, Rugby (Longstaff), Brandon Wood (Peachell). [WORCESTER: Worcester, common (*Subs.*, p. 184).] YORK: Selby (Hebson), near York, plentiful in 1827 (Hewitson), Bishop Wood (Porritt), Wheatley Wood, Doncaster (Corbett).

DISTRIBUTION.—Over the greater part of Europe (except the northernmost regions), Transcaucasia, northern and central Asia from Asia Minor to the Altai mountains, also in northern Africa; the most easterly point it reaches is Nikolajewsk; north Persia, Asia Minor, Greece and Mauretania appear to be its most southerly range, its most northerly points are Lapland, Kasan, and the Altai mountains. Its limit of elevation is noted as 8000 ft. AFRICA: northwest Africa—Algeria, northern Morocco (*teste* Bartel). ASIA*: generally distributed to the Altai, but in most parts not common—northwest Asia Minor—Brussa, Olympus, near Demirtasch; northeast Asia Minor—Amasia, Tokat; north

* Jordan says: "There is no *Hemaris* in Amurland, China or Japan that can be considered as a variety of, or identical with, either *H. fuciformis* or *H. tityus*. Neither of our two species goes farther east than the Kuku Nor and the Altai mountains" *(in litt.)*.

Persia—Elburz mountains, near Astrabad (Staudinger); govts. Tobolsk, Uralsk, Turgai, Turkestan, Semirjetschensk—Lepsa; Akmolinsk, Semipalatinsk—in the Altai mountains on the upper Irtish, between Ust-Kamenogorsk and Ust-Buchtarminskaja, govts. Tomsk, Jenisseisk, Irkutsk, Trans-Baikalia—Kentei mountains (*teste* Bartel), Amur district—Nikolajewsk (Graeser), Lena district—Witim, Wilui (Herz), Trebizonde (Oberthür). AUSTRO-HUNGARY: Innsbruck, Taufers valley (Weiler), Lavantthal (Höfner), Tyrol, very rare—Lienz, Meran (Hinterwaldner), Brenner district—Mitzens, Navis, Statzer Thal (Galvagni), Bucovina, local and scarce (Hormuzaki), Pressburg (Rozsay), Bohemia—Carlsbad (Nickerl), Galicia, local—Lemberg, &c. (Garbowski), Stanislawow (Werchratski), Holosko, one (Nowicki), Brünn (Schneider), Cilli, Freistadt, Vienna (Fritsch), Epiries, not rare (Husz), Hungary—Hamer, Kikulahegy (Vángel), Gölnitz (Hudák); Salzburg—Gais-Berg to 3200ft. (Nickerl), Glockner, Hraszt near Fiume (Mann), Upper Austria—Linz, Postlingberg, Schiltenberg (Himsl), Carniola—Nanos-Berg, Carinthia—Heiligenblut at 4600ft. elevation, Friesach, Lower Austria—Schneeberg, Moravia—Mährisch-Trübau, Ungarisch-Brod, Hungary, everywhere rare—Transylvania, Nagy-'Ag or Noság, Budapest, Fünfkirchen, Croatia, Dalmatia (*teste* Bartel). BELGIUM: generally distributed (Donckier), throughout the Namur district (Lambillion), Brussels, Lüttich (*teste* Bartel). BULGARIA: near Sofia (Bachmetjew). DENMARK: in most parts, but generally sparingly (Bang-Haas), Jutland, Zealand—Copenhagen (*teste* Bartel), FINLAND (Lampa). FRANCE: common (Berce), Basses-Alpes—Digne, Hautes-Pyrenees, Ille-et-Vilaine, Rennes, very common, Cancale, Pyrénées-Orientales—Vernet-les-Bains, Eure—Evreux (Oberthür), Eure-et-Loir—Châteaudun (Guénée), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne (Sand), Haute-Garonne, especially common at Bouconne, Mont Cagire, up to 4000ft. (Caradja), Hyères (Jones), The Esterel, Fontainebleau, S. Michel-de-Maurienne (Tutt), Var (Cantener), Morbihan (Griffith), Gironde—Pessac (Trimoulet), Doubs (Bruand), Aude—Le Malepeyre (Mabille), Saone-et-Loire (Constant), Seine-Inférieure, common (Viret), St. Quentin (Dubus), Deux-Sèvres (Maillard), Cherbourg district (Nicollet), Indre—Nohant, Sologne, Cher—St. Florent, Auvergne—Chaudefour, Mont Dore, Le Livran (Sand), Eure—Pont-de-l'Arche (Dupont), the Landes, Montpellier, depts. Meurthe-et-Moselle, Meuse, &c. (*teste* Bartel). Loire-Inférieure—Nantes, La Chapelle-sur-Erdre, La Haie-Fouassière (Bonjour), near Paris (Bartel). GERMANY: generally distributed (Heinemann), northwest Germany—Osterode, Neuhaldensleben near Magdeburg, Rheingau, &c. (Jordan), Rhine Palatinate (Bertram), Wurtemberg—Stuttgart (Seyffler), Giessen (Dickore), Lower Elbe district (Zimmermann), Waldeck (Speyer), Erfurt, rare (Keferstein), Zeits-on-the-Elster (Wilde), Munich (Kranz), Rudolstadt (Meurer), Hamburg, Bremen, not rare (Rehberg), Saxon Upper Lusatia, rare—Bautzen, Löbauer mts., near Seifhennersdorf, Grossschönau, Zittau, Neugersdorf, up to 2000ft. (Schütze), Dresden district, widely distributed, but only singly (Steinert), Prussia—Dantzig, Karalene, &c. (Grentzenberg), Rastenburg (Klups), Silesia, rare, principally in mountains (Assmann), Mittelwalde, between Kohlfurt and Siegersdorf (*teste* Bartel), Upper Lusatia—not rare in the southern highlands of the Zittau district (Moeschler), Nassau (Rössler), Alsace—Vendenheim, Vogesen, Lutterbach, Hardt, near Mulhausen (Peyerimhoff), Wernigerode (Fischer), Pomerania—Stettin (Hering), Brunswick, rare—Helmstedt (Heinemann), Hanover (Glitz), Eutin (Dahl), Berlin district, not common (Pfützner), Hildesheim (Grote), Chemnitz (Pabst), Frankfort-on-Oder (Bartel), Mecklenburg, not common—Neustrelitz, Schwerin, Wismar (Schmidt), Burgsteinfurt, Crefeld, Umgebung, Elberfeld, Barmen, Rheinland, Cassel (*teste* Bartel), Halle-a.-S. Peissnitz, Seeleben, Bündorf (Stange), Leipzig, somewhat rare, Osterland (*teste* Bartel), Thuringia, rare in plains, common on the mountains Laucha, Erfurt, Arnstadt, Gotha, Tettelstedt and Waltershausen, common (Knapp), Bavaria—Kissingen, Bamberg, Ratisbon, rare, Grosshessellohe, Pullach, near Munich, Augsburg, in most years common, Kempten (*teste* Bartel), Baden—Constance district, near Freiburg, Lahr, Carlsruhe, rare (Reutti), Bingen, Frankfort-on-Main, Wiesbaden, Taunus, Oberhessen, Bavarian Palatinate (*teste* Bartel). GREECE: Veluchi mts., very rare (*teste* Bartel). ITALY: throughout, except Sardinia and Corsica, not common (Çurò), Modena (Fiori), Roman Campagna—Monte Rotondo near Rome, throughout Tuscany, Florence, Monte Stenario (Calberla), Sicily—Palermo (Mann), Lombardy, Piedmont, in the plains and valleys, Liguria, in the mountains (*teste* Bartel). NETHERLANDS: in most provinces, not common (Snellen), Ginneken, Strybeek, Breda (Heylaerts). PORTUGAL (*teste* Bartel). ROUMANIA: Tultscha in the Dobrudscha (Mann), Grumazesti, one, Kloster Neamtz, one, Azuga (Caradja), Comanesti (Leon). RUSSIA: Baltic provinces—Lechts, Kokenhusen, Sessau, Riga, Kemmern (Nolcken), Estland, Livonia—Dorpat, Neu-Kasseritz, near Werro (*teste* Bartel), Moscow govt. (Albrecht), southwest Caspian district—Talysch (Radda), Volga district — Kasan, Orenburg province, not rare (Eversmann), Transcaucasia — Tiflis, Kodjori, Börjom, Bakouriana, Kasoumkent (Romanoff), St. Petersburg (Erschoff), Russian Lapland, Finland, govts. Archangelsk, Oblonez—on Lake Ladoga, Kurland, govts. Pskow, Mogilew—Gorki, Volhynia, Kiev, Poland — Kamenez-Podolskii, Bessarabia, Cherson, Poltawa — Lubny, Orel, Kaluga, Tambow, Simbirsk, Ufa, Baschkiria dist., govts. Samara—Sergijewsk, Saratov, Astrachan (*teste* Bartel). SCANDINAVIA: not rare (Aurivillius), Lapland —Upsala (Dalman), Götheborg (Wallengren), southeast Norway, absent in southwest (Siebke), Gothland, rare, Scania (Zetterstedt), Hunneberg (Lampa), Christiania, East Gothland, here and there, Vermland, Lappmark (*teste* Bartel). SPAIN: Teruel (Zapater), Galicia (Macho-Velado), Barcelona (Cuní y Martorell), Catalonia (Martorell y Peña). SWITZERLAND: up to 4000ft.—Bergün, etc., Zürich, fairly abundant (Frey), Weissenburg (Huguenin), Grisons (Killias), Tuors Pensch (Zeller), Andermatt to 5000ft. (Jones), Bechburg (Riggenbach-Stehlin), Brünnen (Chapman), Canton St. Gallen, up to the mountain-region (Täschler), Canton Glarus (Heer), Schaffhausen, by no means rare (Trapp), Winterthür district (Biedemann), Bremgarten (Boll), Aargau, in the valleys and on the Jura nowhere rare, on the Born and Engelberg, Oftringen, Aarburg, Lenzburg, Vevey, Villeneuve, Martigny (Wullschlegel), Berne, Gadmen, only in the valleys (Rätzer), Schüpfen, not rare (Rothenbach), Neuenstadt (Couleru), Geneva (Museum coll.), Einsiedeln—Sattelberg (Paul).

HEMARIS TITYUS, Linné.

SYNONYMY.—Species: *Tityus*, Linn., "Sys. Nat.," xth ed., p. 493 (1758); Auriv., "Sv. Vet. Ac. Hand.," xix., p. 170 (1882); Kirby, "Cat.," p. 626 (1892); "Ent.," xxix., p. 40 (1896); "Handbook," &c., iv., p. 5 (1897). *Fuciformis*, ? Poda, "Ins. Mus. Græc.," p. 12, pl. ii., fig. 6 (1761); Scop., "Ent. Carn.," p. 188 (1763); Müll., "Faun. Frid.," p. 37 (1764); "Zool. Dan. Prod.," p. 187 (1776); Hfn., "Berl. Mag.," ii., pp. 184, 194 (1766); Linn., "Sys. Nat.," xiith ed., p. 803, var. β (1767); [Schiff.,] "Schmett. Wien.," pp. 44, 306 (1775); Ill., n. Ausg., p. 22 (1801); Lasp., "Ill. Mag.," ii., p. 37 (1803); Ochs., "Die Schmett.," ii., p. 185 (1808); iv., pp. 41, 42 (1816); Oken, "Lehrb. Zool.," i., p. 749 (1815); Stphs., "Ill. Haust.," i., p. 134 (1828); "Cat. Br. Ins.," ii., p. 34 (1829); Bdv., "Eur. Lep. Ind. Meth.," p. 32 (1829); "Icon. Chen.," pl. x., figs. 3—4 (*circ.* 1840); "Hist. Nat. Sphing.," p. 365 (1875); Dup., "Hist. Nat.," supp. ii., p. 164 (1835); "Cat. Méth.," p. 43 (1844); Wood, "Ind. Ent.," p. 22 (1839); Evers., "Faun. Volg.-Ural.," p. 105 (1844); H.-Sch., "Sys. Bearb.," ii., p. 83 (1846); Heydrch., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Speyer, "Geog. Verb. Schmett.," i., p. 313 (1858); ii., p. 280 (1862); Staud., "Cat.," ed. i., p. 17 (1861); ed. 2., p. 38 (1871); Snell., "De Vlind.," p. 90 (1867); Berce, "Faun. Franç.," ii., p. 32 (1868); Nolck., "Lep. Fn. Estl.," i., p. 91 (1868); Zell., "Stett. Ent. Zeit.," xxx., p. 387 (1869); Mill., "Cat. Lép. Alp.-Mar.," p. 120 (1872); Bang-Haas, "Nat. Tids.," (3), ix., p. 401 (1874); Praun, "Erg.," pl. i., fig. 12 *a—b* (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 42 (1874); Curò, "Bull. Soc. Ent. It.," vii., p. 114 (1875); Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 520 (1876); Frey, "Lep. Schweiz," p. 59 (1880); Lampa, "Ent. Tids.," vi., p. 27 (1885); Minà-Pal., "Nat. Sic.," vii., p. 135 (1888); Tutt, "Brit. Moths," p. 37 (1896); Bart., "Palæark. Gross-Schmett.," ii., p. 234 (1900). *Musca*, Retz., "Spec. Ins.," p. 33 (1783). *Bombyliformis*, Esp., "Eur. Schmett.," ii., p. 180, pl. xxiii., fig. 2 (1779); Bork., "Sys. Besch.," ii., pp. 55, 134, 176 (1789); Fb., "Ent. Syst.," iii., pt. 1, p. 382 (1793); F. J. A. D., "Bork. Rhein. Mag.," p. 314 (1793); Hb., "Eur. Schmett.," pl. ix., fig. 56 (1796); text p. 93 (*circ.* 1805); "Larv. Lep.," ii., Sph. iii., Legit. A. a., fig. 1 *a* (*circ.* 1800); "Verz.," p. 131 (*circ.* 1822); Panz., "Faun. Ins. Germ.," pt. 69, no. 24 (1798); Schrank, "Faun. Boica," ii., 1, p. 231 (1801); Haw., "Lep. Brit.," 1, p. 68 (1803); Latr., "Hist. Nat.," xiv., p. 134 (1805); Dalm., "Vet. Ak. Hand.," xxxvii., p. 216 (1816); Godt., "Hist. Nat.," iii., p. 61, pl. xix., fig. 5 (1821); Curt., "Brit. Ent.," fo. 40 (1824); Frr., "Beit.," ii., p. 26, fig. 56 (1829); Meig., "Eur. Schmett.," ii., p. 125 (1830); Dunc., "Brit. Moths," p. 170 (1836); Zett., "Ins. Lapp.," p. 917 (1840); Humph. and Westd., "Brit. Moths," i., p. 26 (1841); Dbldy., "List Br. Lep.," p. 3 (1847); Stphs., "List Br. An. Br Mus.," p. 29 (1850); Sta., "Man.," i., p. 99 (1859); Humph., "Gen. Br. Moths," p. 12, pl. iii., fig. 7 (1860);

Wallgrn., "Skand. Het.," i., p. 56 (1863); Newm., "Brit. Moths," p. 12 (1869); Buckl., "Larvæ," ii., p. 122, pl. xxvi., fig. 4 (1887); Poulton, "Trans. Ent. Soc. Lond.," p. 283 (1889); Auriv., "Nord. Fjär.," p. 47 (1889); Barr., "Lep. Brit.," ii., p. 73 (1893); Meyr., "Handbook," p. 293 (1895); Lucas, "Brit Hawk Moths," p. 147 (1896): Cann., "Riv. Ital.," xxi., p. 15 (1901). *Bombyciformis*, Leach, "Edinb. Encyl.," p. 131 (1815); Sam., "Ent. Comp.," p. 244 (1819). *Fusciformis*, Bdv., "Gen. et Ind. Meth.," p. 45 (1840). *Scabiosae*, Zell., "Stett. Ent. Zeit.," xxx., p. 387 (1869); Staud., "Cat.," 3rd ed., p. 105 (1901). *Knautiae*, Zell., "Stett. Ent. Zeit.," xxx., p. 387 (1869).

ORIGINAL DESCRIPTION*.—*Sphinx tityus*, abdomine barbato, cingulo nigro. M. L. U. Habitat in calidis regionibus. Alarum margo niger est (Linné, *Sys. Nat.*, xth ed., p. 493, no. 24). [In the xiith ed., p. 803, Linné treats it as a var. β of *fuciformis*, repeating the preceding description.]

IMAGO†.—38mm.—45mm. Anterior wings with the costa and a basal patch extending along inner margin beyond its centre blackish, scaled with ochreous-brown, the central area more or less transparent, with blackish nervures; a narrow, dull, blackish-brown, hind-marginal band, broader at apex, very narrow at anal angle. Posterior wings transparent, with blackish nervures, inner margin blackish, scaled with yellow-ochreous, a very narrow (linear), blackish-brown, hind-marginal border. Thorax brown with long yellow silky hairs, paler at sides. Abdomen blackish-brown, thickly covered with yellow hairs, more golden-coloured behind the two narrow black median bands, a pale yellow hair-tuft on either side behind the black bands; the apex terminating in two black tufts separated by yellow hairs.

VARIATION.—There appears to be very little variation in the species, since Jordan asserts that the so-called Amurland *brunneobasalis*, Staud., referred to by various authors as a local race of this species, is identical with *manderina*, a local race of *Hemaris radians*, and has no connection with *H. tityus*. Caradja reports, in his *Macrolepidopteren Rumaniens* the capture of an interesting aberration with exceptionally broad black border to both fore- and hindwings. Bartel adds that the specimens from the Thian-Schan are also broader bordered than the European. The single ♀ specimen recorded from Sicily is said to be very large (wing expanse 48mm.), and to have the underside of the abdomen, the femora and tarsi deep black.

EGGLAYING.—The eggs are laid on the underside of a leaf of *Scabiosa succisa* (Jeffery). Sladen reports (*Ent.*, xxi., p. 14) that he once observed a ♀ at Burghclere, as he thought, laying its eggs whilst on the wing, but that he failed to find any eggs. Bartel states that the oval green eggs are attached to the underside of leaves of scabious (*Knautia arvensis*), but only one or at the most two eggs are laid on one plant. The ♀s, he asserts, are easily induced to oviposit in confinement.

OVUM.—Almost spherical in shape, but with a distinct depression on the upper surface of the egg. It is of a bright apple-green

* The original description of *bombyliformis* reads as follows: "*Sphinx bombyliformis*, abdomine barbato coccineo, alis hyalinis luteo variis; posticis margine albis. Habitat in Europa" (Linné, *Sys. Nat.*, xth ed., p. 493, no. 27). In the xiith ed., p. 801, Linné sinks this as var. β of *Theretra porcellus*.

† When freshly emerged, the wings are thinly covered with silvery-grey scales, having a purplish iridescence. These are all shaken off at the first movement (*teste* Barrett).

colour, the shell covered with a minute, irregular, polygonal reticulation. When near hatching, the colour becomes yellowish, and afterwards the embryo is distinctly visible through the now transparent egg-shell, the black bifid hairs being particularly conspicuous, and exhibiting, as it were, a loose reticulation. The micropylar area, placed at one end of the egg, is only noticeable from the much more distinct reticulation over that area. The eggs are laid singly on the underside of scabious leaves. [The eggs received from Mr. Wolfe on July 6th, description made under a two-thirds lens on July 7th.] Nearly round, with a slight depression on the top; green in colour; the body of the embryo is seen through the egg-shell to be covered with hairs (Jeffery).

Habtis of larva.—The larva hides under the leaves of its foodplants and is best obtained during the day by carefully turning over the radical leaves of the plants on which the larvæ are feeding. According to the season they may be obtained at any time between May and August, late June and July being, however, the usual time. To find the larvæ, look for leaves of the blue scabious with holes bitten in them; many leaves with holes will, of course, not yield larvæ, whilst at other times plant after plant will give a bright green larva with red markings on the sides, on the underside of one of its leaves (Wratislaw). We have collected the following dates on which larvæ have been observed—July 16th, 1864, at Cambridge (Grinstead), end of May, 1865, at Penllergare (Llewelyn), July 17th-21st, 1866, from Epping, fullfed (Buckler), in August, 1886, at Renfrew (Dalglish), 22 larvæ, May 27th, 1893, in New Forest, one already fullgrown, two others in the last instar, and others of various sizes (Richardson), June 10th-21st, 1894, and June 25th, 1896, in the New Forest, but on August 10th, 1895, in Argyllshire (Christy), early June (1st-9th) in 1893, but on July 10th in 1891, in the New Forest (Robinson), fullfed August 8th-15th, 1899, around Evolena in the Val d'Herens (Tutt). Bartel says that when the sun is shining, the larva remains concealed in the earth; but before the 3rd moult, one finds the larva sometimes sitting exposed on the leaves (mostly on the underside), on the stems, or under the flowers of the foodplant, but that these exposed larvæ are mostly stung. Thus a great number of young larvæ of this species, which Bartel found on the Jungfernheid, near Berlin, sitting exposed on leaves, stems, and under the flowers by day, were without exception infested with small ichneumon larvæ, which destroyed the larvæ before they had even reached middle growth, whilst he states that, in dull weather or at dusk, one also finds larvæ singly resting quite exposed on the foodplant. Yet he notes that, in breeding the larvæ in confinement, they must be quite exposed to the sun, and that the food should also come from sunny places; but even then poor plants are the more acceptable, because succulent plants, or those which are placed in water, inevitably cause diarrhœa. It is especially partial to dry meadows, and, according to Rössler, is sometimes observed in great numbers on hayricks. It is difficult to breed; yet the young larvæ are said to thrive excellently when fed with scabious or snowberry. Some days before pupating, the larva becomes entirely dirty brown-red.

Larva*.—*First instar* (newly-hatched): The newly-hatched larva is covered with small black tubercles bearing forked black hairs; the caudal horn placed far forward on the 8th abdominal segment, and rather resembling a bristle surmounted with two black hairs (Jeffery); the hairs on the head and scutellum long, stiff, and dark in colour, their bifid character being merely suggested by a notch at the tip; on the other hand, the body hairs are similar to those of the newly-hatched larva of *H. fuciformis*, only black instead of pale-coloured; the caudal horn is covered with minute bristles, but no basal mammillæ are apparent (Bacot). *Second instar:* After the first moult the caudal horn is more characteristic, but still terminated by several forked black bristles (Jeffery). *Last instar:* Length 1·625 inches when retracted and sulky, 2 inches when crawling, over ·25 inches thick, thickest about 4th abdominal; tapers a little to head, the prothorax and head being comparatively small; tapers from about 6th abdominal to anus; caudal horn pink, and starting from it is a darker dorsal, and on either side a subdorsal, line; just below the latter is a paler stripe, which is about halfway from dorsum to spiracles; there is also a series of oblique lateral stripes, these are a little obscure, but may be described as a darker shade passing from the subdorsal line, starting at the middle of a segment, downwards and backwards so as to include the spiracle of the following segment and reaching the posterior border of the segment, whilst it is edged above and below with paler; these paler areas might be described as the oblique stripes, as they are very marked below the spiracles, and, in fact, alternate with the others, but rather expand upwards, so as to be more than stripes (a specimen was seen with some pink in these stripes); the stripes pass through each abdominal spiracle, a paler line or stripe also passes from the caudal horn to behind the last spiracle; the spiracles themselves are oval, the upper and lower portions are pure white, cut off by perfectly straight lines from a central square portion, which is a bright yellowish-brown; the spiracle is bounded by a black line especially marked against the white. The head is of the same colour as the body, but in the dark larva with a substitution of greenish; it has very numerous fine hair-points; ends of jaws black, labrum, labial palpi and antennæ brown; jaws curiously angulated, each with 4 teeth; central ocellus very minute, the lowest of the 5 in arc also very small; antennæ green-tinted, brownish, and two-jointed. The body-surface is covered with minute hairs arising in little white dots; transversely there are about 15 of these from dorsum to spiracle, longitudinally each subsegment carries them irregularly, so that they cannot be counted in rows, but they are often in pairs or singly, so that each subsegment carries two or three rather than one row; there are 8 subsegments to the abdominal segments of which the 1st and 3rd are rather the largest, the prothorax, however, has only three, 1 large and 2 small, the mesothorax 2 large and 2 small, and the metathorax 5 subsegments; the true legs are pink; the pale stripe below the spiracle marks a lateral flange, very conspicuous in some

* Good descriptions of the early stadia of the larva of this species are still a desideratum.

movements, obliterated in others; two further wrinkles intervene between this and prolegs, which have a fringe of rather larger hairs 12—15 in number; about 20 hooks to prolegs which retract very completely; hooks alternately longer and shorter, the hair-points on horn are rather larger and more numerous than elsewhere, and the white bases have on upper and under surface of horn, brown rings; anal and clasper plates much as rest of surface except fringe of hairs at lower border of clasper plates [Chapman, August 14th, 1899. Two larvæ from Evolena. One specimen apparently fullgrown is green, another in last skin is pale purplish and had same colour in previous instar]. *Adult larva* (preserved specimens): Head rounded, inclining to be tall, vertical measurement greater than horizontal; caudal horn stout, short and pointed; body rather plump and stout compared with larva of *Sesia stellatarum*, and very stout compared with that of *Hemaris fuciformis*. The three examined vary in tint; one is whitish-green, the second slightly darker, the third very dark olive-green with purple oblique slashes in which are the spiracles sloping from head to anus. The purple subdorsal line of this last example increases on each segment to a triangular or pyramidal blotch tapering from front to back; a dark mediodorsal line is present in all the examples, as also is the subdorsal in some shade or other, and faint traces of the oblique markings; the abdominal subsegments are clearly marked by 8 ridges of mammillary points. There is no differentiation in appearance between the thoracic and abdominal segments, as in Sphingids and Manducids, nor does one find the marked tendency to taper from the abdominal segments to the head that is so strongly marked in the Eumorphid larvæ and, to a slighter extent, in that of *Sesia stellatarum*, nor is there any tendency to form one large subsegment by the union of the first three subsegments as in the Eumorphids. On the whole, the general form of the larva is more suggestive of the Amorphids in shape than of any other Sphingid larva that I have examined (Bacot). The larva when fullgrown is 40mm.—50mm. long. It is bluish-green, lighter coloured in the incisions, with a longitudinal white line on each side of the dorsum, in which stands, on each segment, a brown-red spot. The two lines unite on the almost straight, rough, browned horn, which is only slightly curved and runs to a fine point. Spiracles white, granulated with reddish and with red-brown margin; sometimes without this. Thoracic legs reddish. The centre of the venter is occupied by a broad brown-red longitudinal stripe, which runs from the first pair of legs to the anal claspers, and also colours the inner side of the ventral prolegs with red. The head is dark green, and like the rest of the body of the larva, rough shagreen (Bartel).

Variation of larva.—The larva of *H. tityus* is rather variable both as to the tint of the ground-colour and as to the quantity and intensity of red markings present. In colour the larvæ not only vary through different shades of green but rare forms are buff or even pale purplish in tint, not only in the last, but also in the preceding, instar. Such an one Chapman found at Evolena in the Val d'Herens, before its last moult, the colour being maintained throughout the last instar until fullgrown. Buckler gives figures of two forms of the fullgrown larvæ (*Larvae*, &c., ii., pl. xxvi., figs. 4, 4*a*) showing considerable difference in the quantity of the red markings. One green one that we found at Evolena was marked with distinct red longitudinal lines.

COMPARISON OF LARVÆ OF HEMARIS TITYUS, H. FUCIFORMIS AND SESIA STELLATARUM.—The larva of *Sesia stellatarum* has a strong white stripe where the subdorsal pale band is in *H. tityus*, edged with distinct black above; the caudal horn of *S. stellatarum* has a brown point and a black ring below; there is also a bright yellow flange line, edged with dark above; the spiracles are black, with yellow spots within margin, at top and bottom; the number of subsegments is the same in the larvæ of both species, and each subsegment carries a single row of largish white spots, bearing minute hairs, in *S. stellatarum* 8 from spiracle to centre of dorsum; the legs brown (Chapman). Lucas gives the following comparative table of the larvæ of *Sesia stellatarum*, *Hemaris fuciformis* and *H. tityus*:

I. Spiracles not in a red patch.
  i. Ground-colour green or brown, white subdorsal line, and yellow subspiracular one .. .. .. *S. stellatarum.*
II. Spiracles in red patch, ventral surface red.
  ii. Ground-colour pale green; dorsal line showing at division of segments, indistinct subdorsal line, spiracles in small reddish spots .. .. *H. fuciformis.*
  iii. Ground-colour rather full green; fairly distinct subdorsal yellowish line, often having a row of red spots above it; spiracles set in elongated red spots *H. tityus.*

COCOON.—The larva forms, on the surface of the earth, under moss, a very simple, wide-meshed cocoon (Bartel). Constructs a slight loose cocoon, among rubbish in some sheltered nook on, or just under, the surface of the ground (Barrett). Moeschler states that he used to obtain the pupæ in numbers, with a "straw hoe" in the spring in Upper Lusatia.

PUPA.—Length 1·2ins. long, head to the 4th abdominal segment 0·65ins., 0·29ins. wide at the mesothorax, narrowing slightly to the 4th abdominal, a little more to the 6th, and the terminal segments conical ending in a point. Colour, deep brown or black, incisions paler; the surface minutely wrinkled and apparently hairless, but with numerous minute hairs on clypeus and abdominal dorsum, and even on thorax. The maxillæ (proboscis) are very broad basally (a common Sphingid, apart from Amorphid, character), or rather, perhaps, the cheeks extend far downwards on either side and the maxillæ thus form a square patch at their base, one angle extending upwards (between cheeks) to the labrum, two angles outwards (giving the apparent breadth) as though they would like to reach the antenna above the first legs, and a lower angle, which is produced into the extended maxillæ, reaching end of wings. No trace of the 3rd legs. Antennæ reach to $\frac{3}{4}$ the length of the wings, the 2nd legs to slightly beyond them, the 1st legs decidedly shorter, about $\frac{2}{3}$ rds. At either side of the maxillary base is a conical projection, terminating in a fine point. These seem to be at site of mandibles; labrum not well marked above and between these. The cremaster is a large and elaborate structure, and takes a very secure hold in the silk of cocoon. Seen laterally, it is thin and pen-like, but dorsally or ventrally (still pen-like) it continues the regular conical outline of the terminal segments to a point; its length (dorsally measured) is nearly $\frac{1}{10}$ inch. The actual point, however, carries two spines directed laterally, almost anchor-like, basally it is smooth and has a number of short stiff brown bristles, beyond it is rough and wrinkled, and dorsally and along its lateral edges carries numerous fine hooks, these stand stiffly outwards, and, with an abrupt bend backwards, terminate in a sharp point; 10 or 11 may be counted in profile along the margin (Chapman).

Variation in the pupal period.—The pupal stage in Britain, northern Germany, and the districts inhabited by the species at a higher latitude than these countries, lasts from July-August to May-June. In central France and southern Germany a certain number of pupæ give their imagines in August, so that the pupal period for these lasts only some 4—6 weeks, from late June to late July and early August, and for the descendants of these moths from October to May-June.

Foodplants.—*Scabiosa succisa* (Doubleday), *Knautia arvensis*, *Lychnis dioica* (Paux), *L. sylvestris* (Donckier), *Symphoricarpus lineocarpa* (Lambillion).

Habits and habitat.—Ridings and open glades in woods, rough fields and open meadows, near woods, rough overgrown ground in marshes and fens, bogs, and low-lying hollows appear to be the favourite haunts of this species in Britain, although gardens in some districts are by no means neglected. It also affects damp openings in woods in Herefordshire, but occurs on the open hillsides at Dunoon (Chapman); the hills around Digne (Tutt), the swampy meadows at Brunnen (A. J. Jones), and the mountain slopes above Evolena (Tutt), suggest a variation of habitat on the Continent that would betoken a wide choice. The imagines are largely attracted to flowers; they favour those of *Salvia officinalis* in the Haute-Garonne (Caradja), *Ajuga reptans* in the Namur district (Lambillion), *Cardamine pratensis* in Nassau (Rössler), *Lychnis viscaria* in Lapland (Zetterstedt), flowers of *Salvia pratensis* and honeysuckle in the dept. du Nord (Paux), whilst Zeller says it comes generally to the meadow flowers at Bergün. In Ireland, it is recorded as flying over *Lychnis* at Clonbrock (Dillon), at scabious flowers at Enniskillen (Partridge), at bugle flowers at Portlaw (Flemyng), over flowers of stock at Poyntzpass (Johnson), flying at flowers of *Menyanthes trifoliata* in bogs near Athenry at the beginning of June (Lawless), &c. In Scotland, it is recorded between Bunawe and Oban on May 26th, 1859, when many newly-emerged imagines were seen at flowers of *Lotus corniculatus*, over which, during bright sunshine, they delighted to hover, occasionally inserting their trunks to sip the nectar while on the wing (*Ent. Wk. Int.*, vi., p. 182); at the blossom of purple lilac at Temple, in Midlothian (Evans), plentiful at rhododendron blossom, most abundant from 3.30 p.m. to 6 p.m., at Corsemalzie (Gordon), sparingly over the moist ground in the low-lying part of Glen Lochay, the imagines hovering over *Pedicularis* flowers (Morton), &c. In Wales, it is recorded as common in meadows near Swansea in early May, 1893, flying to the flowers of *Ajuga* and *Pedicularis* (Holland); over flowers of *Orobus tuberosus* at Newtown (Tetley), &c. Nash records two specimens *in cop.* taken on the wing at Stubby Copse, and Merrifield has captured imagines about 3 p.m. flying at ragged robin flowers in an oak wood at Holmbush. The moth, however, appears to dearly love the hot sun, and Raynor notes it as hovering over the flowers of *Ajuga reptans* in the sunny ridings of a large wood near Wragby; abundant at flowers of lousewort (*Pedicularis sylvatica*) at Burghclere (Sladen), at flowers of the same plant in Ashdown Forest (Nicholson), also at Wan Fell (Britten), and in the Bristol district, in damp meadows (Hudd), at flowers of red rattle in a rough field surrounded by woods (Hellins), more common than usual in 1893, feeding at flowers of bluebells at Ringwood (Fowler); at flowers on the railway bank at Wood Fidley, in the New Forest (Wells), also at flowers on the railway bank near Wreay (Thwaytes), and in gardens at Folkestone (Knaggs). Flies earlier in the season in the Lincoln district than *H. fuciformis*, and is partial to the barely-opened blooms of *Ajuga reptans* in the drives of woods (Musham), at thistle flowers at Oxton (Wilkinson). Some 20—30 examples netted over flowers of *Pedicularis palustris* near Glendalough. In making this record Carrington notes that it is best to always strike down while the moth hovers over the flower, and then to lift the bottom of the net, when the insect will flutter upwards. Kane says that it appears to be rather fickle in its habits, disappearing suddenly from its usual habitat without apparent cause, also that it is easily taken when feeding at the flowers of bugle or marsh-rattle, but that, on very hot days, its activity on the wing is prodigious, as it scarcely pauses to taste the flowers and flies as rapidly as *M. stellatarum*. Carpenter observes (*Proc. Sth. Lond. Ent. Soc.*, 1894, p. 52) that the moth has the habit, when on the wing, of getting well into the bushes and undergrowth, a proceeding that no doubt soon helps to rid it of its surface-scales. Frohawk exhibited at the meeting of the South London Entomological Society, on August 10th, 1893, a specimen of *H. tityus* and a species of humble-bee, *Bombus agrorum*, which the moth mimics, both captured in company at rhododendron flowers in the New Forest. Curtis says that the imagines are remarkably swift on the wing and make a humming noise similar to that made by a humble-bee. Bartel observes that the moths in flight look conspicuously similar to the humble-bee, which is flying about at the same time, so that it needs a practised eye to distinguish them. Its flight is, however, more rapid than that of the humble-bee; the moth circles in larger curves, shooting off like a dart to a considerable distance. It is to be met with especially in luxuriant wood-meadows and places where there are plenty of flowers, flying in sunshine to the flowers of many plants.

Time of appearance.—From the middle of May to the middle of June is the usual time of appearance of this species in the British Islands—May, June, and July in Connemara (Lawless)—but there is no record of even a partial second-brood, unless this Connemara reference be one; on the continent, however, double-broods or partial double-broods are not infrequent, in southern Europe apparently the rule, whilst in northern Africa, at Tangier, Meade-Waldo records imagines in fair numbers at the end of January, 1900 (*Ent.*, xxxiv., p. 206), suggesting continuous-broodedness.

In May-June and August (August 26th) in Roumania (Caradja), in June-July at Tultscha (Mann), at Schiltenberg (Himsl), double-brooded, the 1st brood about May 10th, the 2nd brood in July at S. Quentin (Dubus), also two broods in Alsace (Peyerimhoff), April and June-July in the Haute-Garonne (Caradja), in early April at Digne (Tutt); early May in Waldeck, in 1844 on the wing by April 30th (Speyer), at the beginning of June at Brunnen (Jones), May and June at Eure-et-Loir (Guénée), May 24th, 1896, at Namur (Lambillion), May 25th, 1875, at Bergün (Zeller), June 12th, 1870, at Königswinter (Jordan), June 29th at Hoel Renebo, and early July, 1898, at Hoel Trondhjem, in Norway (Bingham-Newland), June 24th at Pichtendahl (Nolcken). Fritsch gives dates from April 23rd to June 6th, extending over a long series of years in Austro-Hungary, also a few at the end of July at Salzburg, 2000ft. above the sea-level. Dates for the British Islands are—June 11th, 1848, June 25th, 1851, at Holmbush (Merrifield), May 27th-31st, 1856, at Dunoon (Chapman), June 1st, 1857, some 30 imagines at Langwith Common, but imagines at York in July, 1860, a very backward season (Anderson), May 28th, 1858, in New Forest (Bryant), June 1st-4th, 1858, June 6th, 1859, at Worcester (Edmunds), about 100 in the few days preceding June 14th, 1858, in fields where scabious abounds at Himbleton (Smith), June 1st-21st, 1858, at Greenock (Somerville), June 7th-21st, 1858, at Newnham (Bingham), May 27th-June 5th, 1859, near Loch Nell, between Bunawe and Oban (*Ent. Wk. Int.*, vi., p. 182), June 16th, 1859, on Wimbledon Common, May 23rd-28th, 1866, at Bagley Wood, June 2nd-15th, 1891, at Leatherhead (T. Briggs), June 21st-24th, 1868, at Howth, fine series June 19th, 1869, at Howth (Carrington). Birchall notes it (*Ent.*, v., p. 81) as abundant in the autumn of 1869 at Connemara, imagines being on the wing in May, a few worn specimens in June, and freshly emerged examples in July (Lawless *teste* Birchall), May 29th, 1869, at Winlaton Mill (Hedworth), June 5th-26th, 1869, at New Forest (Capper), beginning of June, 1871, near Athenry (Lawless), June 12th, 1871, at Inverurie (Garrow), June 21st, 1874, on Sandburn Common (Dutton), April 19th, 1863, not scarce at Balcombe, May 17th, 1875, at Ramnor in the New Forest (Fenn), May 27th, 1885, May 26th-28th, 1892, in a wood near Wragby (Raynor), June 16th, 1885, at Cork (Sandford), June 3rd, 1887, May 12th, 1893, at Sulham, June 1st, 1890, at Butterwood, never abnndant, throughout May, 1893, in the Swansea district very abundant (Holland), May 20th, 1890, in Brighton district (McArthur), May 31st-June 7th, 1890, on wing at Brockenhurst (Ogden), May 28th-June, 1891 and 1892, near East Hoathly (Nicholson), June 5th, 1891, at red rattle in Stubby Copse, May 26th-June 2nd, 1894, in New Copse (James), May 27th, 1892, in the Belfast Hills (Watts), May 26th, 1892, May 5th-21st, 1894, May 22nd, 1897, in the New Forest (Christy), June 18th, 1892, at Guildford, (Grover), May 1st, 1893, at Aberdeen, flying wildly (Horne), May 11th, 1893, at Oxshott, May 26th, 1896, at scabious in New Forest (Kaye), May 21st-24th, 1893, in bad condition in New Forest (Richardson), May 4th, 1893, at Monaghan (Kane), May 21st-24th, 1893, in New Forest

(Frohawk), May 12th, 1894, on railway banks at Stubby Copse, May 23rd-24th, 1896, in New Forest (Smith), May 15th, 1894, in New Forest (Robson), June 8th-17th, 1894, flying at Rhinefields, June 5th-11th, 1898, on railway bank at Brockenhurst (Wells), May 25th, 1895, at Ferness on the Findhorn (Thomson), June 11th, 1891, June 2nd, 1895, May 25th, 1896, June 5th, 1897, in Wyre Forest (Rea), first half of June, 1895, at Glen Lochay (Morton), May 20th, 1896, at Temple (Greeve), May 23rd, 1896, at Temple (Evans), May 25th, 1896, at Pamber Forest (Butler), June 9th, 1894, at Galway, earliest dates of capture May 25th, 1896, May 25th, 1898, latest date June 26th, 1898, at Galway and Enniskillen (Allen), May 25th, 1896, at Lincoln (Pearson), last week in May, 1896, at Lyndhurst (Bowles), June 27th, 1896, June 30th, July 5th, 1897, at Aylsham (Freeman), May 15th, 1897, common at Ringwood (Fowler), May 22nd, 24th and 25th, 1897, flying freely in the sunshine at Reading (J. Clarke), May 22nd-30th, 1897, June 3rd-5th, 1898, at Newtown (Tetley), June 5th-7th, 1897, at Rhinefields (Tremayne), June 12th, 1897, near Old Dromore, June, 1900, at Lough Erne (Bingham-Newland), June 10th-22nd, 1897, June 16th-19th, 1898, at Wan Fell (Britten), May 30th, 1898, in New Forest (Adkin), June 11th, 1898, common on the railway bank near Brockenhurst (Wells), June 15th at White Loch in a meadow, June 23rd, 1898, at Loch Eldrig, June 8th-16th, 1899, at Corsemalzie (Gordon), June 28th, 1898, at Orton, July 17th, 1900, on railway banks near Wreay (Thwaytes), June 9th, 1899, at Poyntzpass (Johnson), June 21st, 1899, at Hayton Moss (Routledge), May 22nd-June, 1900, in New Forest (Moberly), June 4th, 1900, at Wan Fell (F. H. Day), June 4th, 1900, at Salkeld (Wilkinson), June 22nd, 1901, in garden at Redhill (Beadnell).

LOCALITIES.—Abundant in many Irish localities but uncertain in appearance (Kane). Distributed throughout the greater part of Scotland, England and Wales. ABERDEEN: local, but common where it occurs (Horne), scarce, Old Aberdeen Links, Scotston Moor, Monymusk (Reid), Toms' Forest near Inverurie (Tait), Banchory (Traill). ANTRIM: Belfast district, Colin Glen, Crawfordsburn Glen (Bristow), on hills about Belfast (Watts). ARGYLL: Tayvallich (Stewart), Dunoon (Chapman), Inverary (Lucas), Isle of Jura (Evans), Loch Riddon (Christy), near Loch Nell, between Oban and Bunawe (*Ent. Wk. Int.* vi., p. 182), Oban, common (Somerville). ARMAGH: Poyntzpass (Johnson). AYRSHIRE (Duncan). BERKS: Sulham, Reading (Holland), Bagley Woods near Oxford (T. Briggs), Enborne near Newbury (Leach). BUCKS: Halton (Stainton). CAMBRIDGE: Cambridge (Waters), Horningsea Fen, Wood Ditton, Devil's Ditch (Jenyns), Wicken, Chippenham (Tutt), Burwell, Bottisham (Gaze). CARNARVON: Tan-y-Bwlch (Blagg). CHESHIRE: Bidston (Gregson). CORK: Skibbereen (Wolfe), Cork (Sandford), Mallow (Stawell), near Old Dromore (Bingham-Newland), Ummera Woods near Timoleague, Glandore and Courtmacsherry (Donovan). CUMBERLAND: probably commoner than is suspected (Day), plentiful on west coast (Mawson), common (Armstrong, *Ent. W. Int.*, vol. vii., p. 29), Carlisle (Morris), Orton (Dobie), Hayton Moss, Headsnook (Routledge), Durdar (Atkinson), Salkeld, Wan Fell, near Lazonby (Wilkinson), Lake district (Stainton), Grasmere district (Massey), Wreay (Thwaytes). DEVON: Woodbury, not rare (Kane), Barnstaple (Mathew), Exeter (Stainton). DONEGAL: Inishowen (Hart). DUBLIN: Howth (Carrington), Blackrock (Greer), Dublin (Bristow). DURHAM: Durham (Wood), Winlaton Mill (Hedworth). DUMBARTON: Garelochhead (Somerville). DORSET: Blandford (Stainton). DOWN: Belfast Hills (Watts). ESSEX: generally distributed (Harwood), Epping(Stainton). FERMANAGH: Enniskillen (Allen), Lough Erne (Bingham-Newland). GALWAY: Clonbrock, Merlin Park, (Kane), Galway (Allen), Athenry, Connemara—Great Killery (Lawless), Ardrahan (Nugent)., GLAMORGAN: Penllergare (Llewelyn), Swansea district, common (Holland), Penarth (Birkenhead). GLOUCESTER: near

Almondsbury, rare (Hill), Newnham (Bingham), Lydney (Higgs), Gloucester, (Marsden), near Easton (Barton), Bristol district, scarce (Hudd), Timberlands, rather common (Rea), Clutterbuck (Tetley), Stonehouse (Nash). HANTS: Ringwood, common (Fowler), Rhinefields (Wells), Burghclere (Sladen), New Forest (Capper). Gosport district, Stokes Wood (Larcom), Brockenhurst (Ogden), Pamber Forest (Butler), Winchester, Basingstoke (Holdaway), Lyndhurst (Bowles), Butterwood near Odiham (Holland), Stubby Copse (Nash), Wood Fidley (Wells), Winchfield (Robertson). HEREFORD: in damp openings in woods in Hereford district (Chapman), Leominster (Hutchinson). HUNTS (Humphreys and Westwood). KENT: Sandwich, common (Harding), Ashford (Jeffery), Sevenoaks (Farren), Folkestone (Knaggs), KERRY: Killarney (Salvage), near Kenmare, very abundant (Vernon). LANARK: nr. Glasgow (C. G. Barrett). LANCASHIRE: Manchester (Stainton), North Lancs—Silverdale mosses, rare (Murray), east side of Windermere, near Newby bridge (Massey), Ribbleton Moor, near Preston formerly (Hodgkinson). LEICESTER: Earl Shilton (Bouskell). LIMERICK: Cratloe wood, near Limerick (Neale). LINCOLN: Newball, rare (Carr), near Wragby (Raynor), Lincoln (Pearson). MERIONETH: Barmouth (Arkle). MONAGHAN: Drumreaske, abundant (Kane). MONMOUTH: Wye Valley (Vaughan). MONTGOMERY: Newtown (Tetley). MORAY: Duffus (Moore). MIDDLESEX: Kingsbury (Bond). MIDLOTHIAN: Temple (Evans). NAIRN: Ferness, on the Findhorn (Thomson). NORFOLK: Stratton Strawless near Norwich (Moss), Aylsham (Freeman), Woodbastwick, not common, Hersford, Cawston (Barrett). NORTHUMBERLAND: Shull (Backhouse), Twizell (Selby), Flass (Wailes). OXFORD: Oxford (Stainton). PERTH: not uncommon—Forth, Earn, Gowrie, Perth and Rannoch districts, Moncrieffe, Dalcrue, Durdie (F. B. White), Glen Lochay (Morton). RENFREW: very rare—near Glasgow (Dalglish), Greenock (Somerville), Paisley (Dunsmore). ROXBURGH: Caverton district (Elliott), Hawick district — Goldielands, rare (Guthrie). ROSCOMMON: Mote Park (Kane), Hollybrook (Ffolliott). SHROPSHIRE: Wyre Forest (Rea). SLIGO: Sligo (Russ), Markree, Lough Gill (Kane). SOMERSET: Bratton St. Maur (Macmillan). STAFFORD: not uncommon in North Staffs, Craddock's Moss (Daltry), Market Drayton district, very sparingly—Betton (Woodforde). STIRLING: Forth district (White). SUFFOLK: local and rare—Stowmarket, Raydon (Bloomfield), Assington, rare (Ransom), Tuddenham (Wratislaw). SURREY: Haslemere (Barrett), Redhill (Beadnell), Coombe Wood (Humphreys and Westwood), Wimbledon Common, Leatherhead (T. Briggs), Dorking district (Oldaker), Guildford (Grover), Oxshott (Kaye). SUSSEX: Brighton district (McArthur), Chichester (Lucas), East Hoathly, Ashdown Forest (Nicholson), Balcombe (Fenn), Lewes, Abbott's Wood, Battle, Guestling (Jenner), Hastings district (Bloomfield), Holmbush (Merrifield). SUTHERLAND: Kerrera (Salvage). TYRONE: Favour Royal, Altadiawan (Kane). WARWICK: Coombe Wood, nr. Coventry (Kenrick), Wyre Forest (Abbott), between Knowle and Hockley Heath (Imms). WATERFORD: Curraghmore (Wyse), Portlaw, (Flemyng). WESTMEATH: Cromlyn, scarce (Battersby). WESTMORLAND: Kendal district (Moss), Witherslack-under-Whitbarrow, Grasmere (Massey). WICKLOW: between Round Wood and Seven Churches, near Glendalough (Carrington), Killynauly wood (Bristow). WIGTOWN: Wigtown, White Loch, Loch Eldrig, Corsemalzie (Gordon). WILTS: Salisbury (Gummer). WORCESTER: common—Himbleton (Smith), Worcester (Edmunds), Cowleigh Park, Trench Wood (Edwards), Broadheath (*teste* Rea). YORK: York, Langwith Common, near York (Anderson), Huddersfield, formerly (Varley), Sheffield (Doncaster), Sandburn (Walker).

DISTRIBUTION.—Over the greater part of the Palæarctic region (except the polar area) including Mauretania. It reaches Lapland in the north, Kuku-Nor and the Altai in the east, and north Persia, Sicily and Mauretania in the south. It reaches occasionally to a height of 9500ft. (Bartel). AFRICA: Algeria—Lambessa (*teste* Bartel), Tangier (Meade-Waldo.) ASIA *: north-eastern Asia Minor—Amasia, Tokat; north-western Asia Minor—Brussa, Olympus; Bithynia, Pontus, Armenia, north Persia—Elburz mts., Astrabad, Fergana (south) and govts. Tobolsk, Uralsk and Turgai, Turkestan, Pamir—Bach Alai, Olguine Loug mts. to 9500ft. (Staudinger), Kouldja, fairly common

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* According to Staudinger and Bartel this species occurs in Amurland, &c., but Jordan states that no *Hemaris* which can be considered a variety of, or specifically identical with, *tityus* occurs in Amurland, China or Japan. The so-called var. *brunneobasalis* is, he says, the same as *manderina* which is specifically identical with *H. radians*.

(Alphéraky), Thian-Schan, to 4500ft.; provinces Akmolinsk, Semipalatinsk—Upper Irtish between Ust-Kamenogorsk and Ust-Buchtarminskaja, Saisan; Semirjetschensk—Lepsa; govts. Tomsk, Jenisseisk, Irkutsk (*teste* Bartel), Pokrofka (Graeser *teste* Staudinger). Austro-Hungary: Campiglio (Chapman), Brenner dist.—Mitzens, Navis, Statzer Thal (Galvagni), Innsbruck, Taufers Valley (Weiler), Lavantthal (Höfner), Tyrol, not rare—Trient, Botzen (Hinterwaldner), Upper Austria—Pöstlingberg, Schiltenberg, rare (Himsl), Bukovina, local and rare (Hormuzaki), Bohemia — Prague, rare (Nickerl), Stanislawow (Werchratschi), Galicia, near Holosko, Lemberg (Nowicki), Brünn (Schneider), Raibl and Preth dist.—Fletsch (Zeller), Bregenz, Gresten, Iglau, Kaschau, Linz, Rosenau (Fritsch), Hungary — Kocsocz (Vángel), Epiries (Husz), Glockner, Fiume (Mann), Carinthia, Salzburg (Nickerl), Upper Styria — St. Lambrecht (Kodermann), Lower Austria — Schneeberg to 5000ft., Vienna, Bohemia — Carlsbad, Moravia — Mährisch - Trübau, Transylvania, Budapest, Hevesen, Fünfkirchen, Croatia (*teste* Bartel). Belgium: widely distributed (Donckier), Marchovelette (Wautier), Namur, Dinant, Liège, Charleroi, &c. (Lambillion). Corsica: Bastia (Curò). Denmark: widely distributed, sometimes fairly abundant (Bang-Haas). France: throughout (Berce), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne, common everywhere—Nohant, Sologne, S. Florent, Guèret, Mont Dore (Sand), Basses-Alpes — Digne (Tutt), Eure-et-Loir (Guénée), Puy-de-Dôme (Guillemot), Var (Cantener), Morbihan (Griffith), Gironde—Pessac, Bouliac (Trimoulet), Doubs—Besançon, &c. (Bruand), Loire-Inférieure—Nantes, La Chapelle-sur-Erdre (Bonjour), Saone-et-Loire (Constant), Seine-Inférieure, not common—Rouen, &c. (Viret), St. Quentin (Dubus), Deux-Sèvres (Maillard), Hautes-Pyrenees (Leschnault-du-Villard), Dept du Nord, rather rare (Paux), the Landes, Haute-Garonne—near St Jean, Revel, Bouconne, Arguénos, Monte Cagire, &c. (Caradja), Hyères, not rare, Savoy, in the plains and valleys, Meurthe-et-Moselle, Meuse (*teste* Bartel), Vernet-les-Bains, Bondy, near Paris, Rennes (Oberthür), Eure, not rare—Pont-de-l'Arche, &c., Seine-et-Oise—near Venières (Dupont). Finland: south and south-east (Lampa). Germany: throughout, but rarer than *H. fuciformis* (Heinemann), north-east Germany, generally distributed (Jordan), Silesia, nearly throughout—Glogau (Assmann), Rhine Palatinate (Bertram), Wurtemberg—Stuttgart (Seyffler), Giessen (Dickore), Chemnitz (Pabst), Lower Elbe district — Elbufer, Steinbeck (Zimmermann), Waldeck (Speyer), Erfurt, rare (Keferstein), Halle-a.-S.—near Schkeuditz, rare (Stange), Munich (Kranz), Rudolstadt, not rare (Meurer), Mecklenburg, distributed (Schmidt), Bremen, not rare (Rehberg), Saxon Upper Lusatia, distributed and locally not rare (Schütze), Dresden—Gehege, Neu-Ostra, Priessnitzgrund, near Meissen, Spitzgrund, Weinböhla, Auer (Steinert), Thuringia, distributed but not common — Siebleben, Gotha (Krieghoff); Prussia, rather common — Dantzig, Willenberg, &c. (Grentzenberg), Rastenburg (Klups), Upper Lusatia, distributed —Lömischau, Rachlau (Moeschler); Nassau (Rössler); Pomerania—Stettin, Stepenitz (Hering), Gollnow (*teste* Bartel), Wernigerode (Fischer), Brunswick—Helmstedt, rare (Heinemann), Hanover (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), Königswinter (Jordan), Hildesheim, rare (Grote), Berlin district somewhat rare (Pfützner), Burgsteinfurt, Crefeld, Umgebung, Mündelheimer, Damm, Elberfeld—Ellerforst, not rare, Hilden, very rare, Ahrthal, Leipzig, Kissingen, Ratisbon, Augsburg — between Stätzling and Wulfertshausen, Kempten, Frankfort-on-Main, Wiesbaden, Oberhessen (*teste* Bartel), Alsace —Vogesen, Lutterbach, Mülhausen (Peyerimhoff), Baden, sometimes common—Constance, Carlsruhe, Turmberg, Rüppurr, Mannheim (Reutti). Italy: distributed on mainland, not common (Curò), Modena (Fiori), Roman Campagna—Monte Rotondo, near Rome, Tuscany — Leghorn, Florence, Monte Falterona, &c. (Calberla), Lombardy, Piedmont, in the plains and valleys, Liguria in the mountains (*teste* Bartel), Sicily — Pullagutta valley, near St. Martino, near Palermo (Mann). Netherlands: local, Gelderland, Amsterdam (Snellen), Breda, Ginneken, Stryeek, not rare (Heylaerts). Portugal (*teste* Bartel). Roumania: Grumazesti, Azuga, Kloster Neamtz (Caradja), Tultscha in the Dobrudscha (Mann). Russia: Baltic Provinces—Esthonia, near Koik, Wolmar, Berghof, Frauenburg, Pichtendahl (Nolcken), govts. Archangel, Oblonez on Lake Ladoga (*teste* Bartel), St. Petersburg (Erschoff), Kurland, Livonia—Dorpat, govts. Pskow, Mogilew—Gorki, Volhynia, govt. Kiev, Poland —Kamenez-Podolskii, Bessarabia, govts. Cherson, Jekaterinoslaw, Poltawa, Charkow, Orel, Kaluga, Tambow (*teste* Bartel), Moscow govt. (Albrecht), Lower Volga district, not rare, the Steppe district of Kasan, Simbirsk, Ufa, Orenburg (Eversmann), Samara—Sergijewsk, Saratov, Astrachan, Tawritschesk, Stawropol, North Caucasus (*teste* Bartel), Transcaucasia — the northern shores of lakes Goktschai and Sewanga. Kasikoparan, rare; Istissou, Karabagh, Talisch (Romanoff), south-west Caspian dist. — Lenkoran (Radde). SCANDINAVIA: not rare in south, found as far north as Helsingland (Aurivillius), Stockholm, Upsala, Götheburg, &c., not rare (Wallengren), distributed throughout southern Norway (Siebke), Lapland, more rare than *fuciformis*—Wermeland, Gothland, East Gothland, Scania (Zetterstedt), Saeterstoen (Chapman), Hoel Trondhjem, Hoel Renebo (Bingham-Newland), Lappmark (*teste* Bartel). SPAIN: Andalusia—Granada (Rambur), Barcelona district (Cuní y Martorell), Catalonia (Martorell y Peña), Bilbao, rare (Seebold). SWITZERLAND: This species goes higher up the mountains than *H. fuciformis*—Zermatt, &c. (Frey), St. Gallen, by no means rare (Täschler), Grisons (Killias), Glarus, to the mountain-region (Heer), Schaffhausen (Trapp), Zürich, especially on the rising ground on the right shore of the lake, not rare (R. Zeller), Bremgarten, often (Boll), Bechburg, rare (Riggenbach-Stehlin), the warm slopes of the Aargau, and the Solothurn Jura, nowhere rare, Lenzburg, Oftringen, Aarau, Küttigen, Bözberg, Schwarzenegg, Lungern, Villeneuve, Vevey, Martigny (Wullschlegel), Berne (Meisner), Gadmen, in the valley and on the Alps to 5300 feet elevation (Rätzer), Neuenstadt, rare (Couleru), Geneva (Mus. coll.), between Leuk and Leukerbad (Jäggi), Einsiedeln—Sattelberg (Paul), Weissenburg (Huguenin), Evolena, Villar (Tutt), Tuors Pensch, Bergün, not numerous (Zeller), Geussbach (Jordan), Brünnen (Jones), Zurichberg (Dietrich), Fusio (Chapman).

ERRATA.

p. 226, second column, between lines 46 and 47, insert: "ab. *minor*, Tutt," and "ab. *rufolinea*, Tutt."

p. 226, last line, for "*apicola*" read "*franconica*." Kirby (*Cat.*, p. 832) makes *luteus* a *Lachneis*, and Staudinger (*Cat.*, 3rd ed., p. 119) makes it a var. of *Malacosoma franconica*. In *Brit. Lep.*, ii., p. 498, we have followed Kirby, but in iii., p. 226, we have followed Staudinger. A recent letter from M. Oberthür makes it clear that both are wrong. He writes (*in litt.*): "*Luteus* is a distinct species, intermediate between *M. castrensis* and *M. franconica*; it is nearer the former than the latter. The ♀ *luteus* looks like var. *taraxacoides*, but is darker (*lutea* nec *citrina*); the ♂ *M. luteus* differs from *M. castrensis* ♂ and *M. franconica* ♂, I believe it to be a distinct species and not a variety." I only regret that I had not this note before completing my list in *Brit. Lep.*, vol. iii., p. 226 (Tutt, *Ent. Rec.*, xiv., p. 111).

p. 227, line 65, for "*Metanastria*" read "*Amurilla*, Auriv." See Aurivillius, *Ent. Tids.*, xxii., p. 251.

p. 228, first column, line 14, delete "*femorata*, Mén."

p. 228, first column, between lines 56 and 57, insert: "ab. *obsoleta-extrema*, Tutt."

p. 261, line 22, for "Frisch notices (*Soc. Ent.*, xi., pp. 19, 148)" read "Frosch notices (*Soc. Ent.*, ix., no. 19, pp. 148, 149)."

p. 342, first column, line 5, for "*Bombyx*, Hb." read "*Bombyx*, Linn."

p. 342, second column, between lines 20 and 21, insert: "var. *galeropa*, Püng."

p. 342, second column, line 50, for "*Attacus*" read "*Philosamia*."

p. 368, line 24, for "*Elpenor*" read "*Celerio*."

p. 380, line 45, for "*vespertiloides*" read "*vespertilioides*."

p. 421, line 38, insert "WESTMORLAND: Clibburn (Hope)."

p. 438, line 39, for "on little raised bosses" read "as little raised bosses."

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