A NATURAL HISTORY OF THE

BRITISH LEPIDOPTERA

A TEXT-BOOK FOR STUDENTS AND COLLECTORS

BY

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PREFACE.

In presenting the second volume of this work to my brother entomologists I can only hope that it will meet with as kindly a reception as did the preceding one. The general approval with which the first volume was received by subscribers and critics could not fail to be exceedingly gratifying to an author, and the generous recognition and appreciation of the labour involved in the collection and collation of such a large amount of previously published (but scattered) and unpublished detail has been a strong incentive to deal with the second volume on the same thorough lines, and to give to every specialist such material as is at present available on which to base his own particular branch of work.

The general trend of the criticism of the first volume largely resolved itself into a regret that more subjects were not equally fully dealt with, in other words, that the book was not larger than it was. The same criticism will apply equally well to this. We have no doubt that the synonymist will consider that the description of a larva might well be condensed into half-a-dozen lines, and the biologist will urge that the synonymy could very well be left out; the student of variation will possibly assert that the dates of appearance could be neglected, and the phenological student that the description of varieties and aberrations might occupy a much less important position in the work. Such criticisms will no doubt almost certainly be offered by the various classes of students. We suspect, too, that we shall be told that more species might have been dealt with. We can only reply that one cannot get a quart into a pint pot.

It was our intention when we commenced this volume to give an account of, at least, the Psychides, the Pterophorides, and the Lachneides. The first-named superfamily had quite recently been overhauled, and we suspected that the study of our few British species would be comparatively easy, and a fairly full account of them occupy but little space. Our earliest attempts to grapple with the subject showed not only that there was very little accurate information available about the British Psychids, but that, if we were to know more of the group, we should have to get a general grip of the whole Palæarctic Psychid fauna. The published details of the life-histories of our British species were evidently largely erroneous, wofully incomplete, and worthless for exact scientific study. Many of the species in our lists were little more than names, and these wanted clothing with life and meaning. The kind help of Lord Walsingham, Dr. Chapman, Messrs. Bacot, Durrant, and Prout was enlisted, and the life-histories of several of our British and continental species were studied in detail and the result is now before you. This part of our book includes an enormous amount of exact and minute work done by these gentlemen, and, with our own results, is largely new. To Lord Walsingham, Messrs. Durrant, Kirby, and Prout we are especially indebted for the Synonymy and much that is contained in the Distribution lists; to Mr. Bacot and Dr. Chapman for help in the description of eggs, larvæ, and pupæ. To a large number of entomologists we are also indebted for the facts from which our Locality lists, Times of Appearance, and details as to Habit and Habitat have been compiled; to others we are indebted for a generous expenditure of time in procuring material, and for the loan of interesting and important specimens. Without this help we need hardly say much of the minutiæ of this work could not possibly have been got together.

It may also be urged that it was unnecessary to enter so fully into historical detail, and that our book here (as well as in the synonymy used) shows within itself the mode of evolution of our work. We suspect that this has its advantages, and will enable students to grapple more readily with the difficulties that we had to meet as our work progressed. The study of an obscure and difficult group, such as the Psychids undoubtedly form, necessitates a clear understanding of the work already done before any advance can be made, and one is obliged to check with specimens almost every fact as one goes on, or one would find oneself admitting very different descriptions as of the same species —two, three, and even more species having frequently been described under the same name by different authors. Everything that we considered would help to make clearer the facts that had to be elucidated has been discussed, and we claim to have given lepidopterists an amount of material that will enable them to prosecute the study of this group, at least with some greater probability of success than has been possible hitherto. At the same time the true relations of the various Psychid groups had never been previously thoroughly investigated, and hence, as our studies proceeded, and the facts about the various species accumulated, generalisations became possible which could not have been formulated when the work was begun. We can only hope that our account of these interesting insects will entice many lepidopterists to study them, and one may safely prophesy that, with more workers, many new facts relating to them will soon be discovered.

What is true of the gradual development of our own views of this group as the work progressed, is equally true of our usage of the names (particularly generic names) that we have felt compelled to adopt. We assumed primarily that Heylaerts' work (*Ann. Soc. Ent. Belg.*, 1881) dealt with the nomenclature on sound lines; but we soon discovered as we went on that he had quite overlooked much of the generic nomenclature of his predecessors, and that many (indeed, most) of his new names fell before those of earlier authors. The catalogue on pp. 432-434 shows our final conclusions on this subject.

It would be unjust to the earlier students of this superfamily were we not to acknowledge our indebtedness to their pioneer work. Reaumur, Zeller, Guénée, Bruand, Speyer, Hofmann, Standfuss, and Heylaerts have been laid freely under contribution, often for quotation, sometimes for criticism, but we believe always with due acknowledgment in the first case, and we trust justly and with due cause in the second.

The work connected with the Lachneids has been comparatively straightforward. The difficulty here has been in some cases to separate the wheat from the chaff, and much material has had to be sifted and much rejected. Many authors have dealt with the group incidentally, but to Aurivillius, who had largely cleared the way as to the synonymy, and given us a right appreciation of the superfamily, our thanks are especially due. The life-histories, however, have had to be done *de* *novo*, and here again Dr. Chapman and Mr. Bacot have done yeoman service.

We have no doubt that one of the greatest objections to this volume will be the fact that it leaves off where it does. We anticipate that the Lachneids will require at least 200 more pages to complete our account of them. Many details relating to the other species still remain to be worked out, and to have included the remaining species in this volume would have delayed its publication for at least four or five months and made a book much too large for everyday use and for repeated reference. It appears advisable that we should publish what has already been done without further delay. We have no further excuse to offer for doing so.

There yet remains the pleasing duty of thanking our subscribers, without whose kind and generous help this work could not be produced. This we do most gratefully and heartily. To the names of those ladies and gentlemen published in the first volume, the following have to be added—

Atmore, Edward A., F.E.S.
Barton, W. H.
Carlyon, T. A.
Chichester, Rev. C., M.A.
Colignon, E. (for the Société Entomologique de Namur).
Flemyng, Rev. W. W.
Fletcher, T.B., R.N., F.E.S.
Freeman, Rev. R., M.A.
Green, J. F., F.Z.S., F.E.S.
Hancock, G. D.
Hewett, William
Hopson, M. F.
Lofthouse, T. A.
Montgomery, A. M.
Rea, Carleton, M.A. (2 copies).
Reid, Percy C.
Ridley, Philip W.
Sich, Alfred, F.E.S.
Varty, H. A., F.E.S.
Vaughan, J. Williams
Verrall, George H., F.E.S.
Wainwright, C. J., F.E.S.
Williams, T. Goddard

PRESS NOTICES OF VOL. I.

"Mr. Tutt's first volume of the '*Natural History of the British Lepidoptera*' is something more than its title would lead us to expect, and if other volumes should succeed it, compiled on the same lines, and with equal elaboration and attention to details, we may expect a fund of information, for collectors as well as students, such as has never before been brought together in so accessible and convenient a form. . . . The first part of the book gives ample evidence of careful thought, of unlimited industry, and of some power of analysis, yet there is much that we only partially understand, and a good deal that comes under the category of 'not proven,' but we must add that it is written in no aggressive spirit, and is pervaded rather by a tone of modesty and self-effacement worthy of the truly scientific enquirer, a quality which adds much to its merit. The second part of the book contains a vast fund of information. The conscientious care with which Mr. Tutt searches out the histories of the various species, has provided the student with a perfect compendium of all that has been written on the subject worth reading, and much knowledge possessed by himself and others hitherto unpublished. The full references and synonymy given in all cases, together with the original descriptions, leave no excuse for ignorance or error in any future work undertaken in this connection, and we have no hesitation in saying that this is the first instance in which any author has provided his readers with so complete and careful a summary of evidence to support the identification of species in any genus of the Micro-Lepidoptera. For this and for the careful redescriptions of each species (including original descriptions of two new to science) it is impossible to praise the author too highly or to express too strongly the thanks of those who study the subject which he has so amply elucidated. For many of them it would have been impossible to refer to the works quoted, scattered as they are through various libraries, private and public, at home and abroad, and, in any case, the expenses incurred in so doing would have been greater than the moderate sum necessary to provide them with more than one copy of Mr. Tutt's excellent book."—(Rt. Hon.) Lord Walsingham, in *The Entomologist's Monthly Magazine*. July, 1899.

"This is a closely-printed octavo book of 566 pages, in which the author shows himself to be, at least, a master in the arts of compilation and condensation. It is divided into two parts, the first of which, devoted to introductory matter, occupies 112 pages, and contains nine chapters. These deal with the origin of the Lepidoptera, the ovum, embryology, parthenogenesis or agamogenesis, external and internal structure of the larva, variation in the imagines, protective coloration and defensive structures of Lepidopterous larvæ, and lastly, the classification of Lepidoptera. Upon all these subjects we find a great mass of information, collected from every conceivable source, and presented in such a concise manner as to save the student a vast amount of time and trouble in searching for any particular fact. . . . The second part of the volume, containing (exclusive of index), 434 pages, deals with the superfamilies Micropterygides, Nepticulides, Cochlidides, Anthrocerides, so that on an average five-and-a-half pages are devoted to each species. . . . Each species is treated of under the following plan: first a full list of synonyms and bibliographical references, then an exact copy of the original description, this last a good idea, and an extremely useful feature of the book. Following this comes a description of the imago, then particulars as to variation, egglaying, description of eggs, habits of larva, description of larva, pupa and cocoon, method of dehiscence, food-plants, parasites, &c. Extremely full details are given as to localities, time of appearance, and distribution outside the British Isles, and the trouble expended in the preparation of this portion of the work must have been enormous. It strikes us, indeed, that there cannot surely be much omitted from this important work for the future investigator to turn his attention to, so fully does the author enter into the subject. We cordially congratulate Mr. Tutt upon the successful issue of this first volume, and trust that he will be encouraged to proceed rapidly with the succeeding parts. If to the mere collector it may appear at first sight the driest work on British Lepidoptera that has yet appeared, it must, on the other hand, prove to the serious worker an invaluable companion."—*The Annals of Scottish Natural History*. July, 1899.

"In this excellent work of 560 pages, the first twelve chapters are devoted to the origin of the Lepidoptera; the ovum or egg; the embryology of a lepidopterous larva; parthenogenesis; external and internal structure of a lepidopterous larva; variation of the imagines; protective coloration and defensive structures of larvæ; classification of the Lepidoptera, with a plate on which is given a phylogenetic tree, illustrating the development of the Lepidoptera from a hypothetical base. Part II. is devoted to the Sphingo-Micropterygid stirps—the Micropterygides, the Nepticulides, the Cochlidides, and the Anthrocerides. This first volume on the British Lepidoptera is a model in its way, and gives promise that when the entire work is completed little will be left to be desired. The subjects in the first part are dealt with very fully, and it would almost appear that every writer of importance had been culled from, yet the work is not entirely a compilation, for the author's own observations and conclusions are everywhere in evidence. The subjects of the second part are even more exhaustively treated than those in the first, which is very proper in a book of this character. Six pages and a half are devoted to the first insect dealt with, *Micropteryx calthella*, L., under the headings: Synonymy, original description, imago, sexual dimorphism, variation, comparison with other species, egg-laying, ovum, habits of larva, larva, cocoon, pupa, food-plant, habitat, time of appearance, localities and distribution. It is rather discouraging to the student of North American Micros to see how full and complete a history is given of these insects in England, while our knowledge of the species in this country stands, in comparison with what remains to be learned, like small and remote oases in the great desert. It is impossible to do justice to a work of this character in the short space that can be allowed, but no worker on the Lepidoptera should be without it."—Professor Fernald, PhD., F.E.S., *The Canadian Entomologist*. June, 1899.

"In comprehensiveness and fulness of detail on all points of interest to the biologist, the systematist, and the collector, this volume is, as regards the particular subjects treated, without a rival. The whole subject is treated with wideness and appreciativeness of view. One of the chief merits of the book is the fulness with which it sets forth the views of other authorities, and the reasons for the choice which it is necessary to make between them and the views, in many cases original, of the author. . . There are so many public libraries, institutions, &c., in England, in America, on the European continent, and elsewhere, to which the possession of this work will be so absolutely indispensable, that it may be hoped that the demand will justify the great expenditure of labour and time that has been made upon it. It should be in every reference library in the provinces professing to be of a comprehensive character."—F. Merrifield, F.E.S., in *The Entomologist*. April, 1899.

"The present volume covers a somewhat, I might almost say a quite, unoccupied field. In the opening chapters the author incorporates in a series of special essays the leading facts that have been published during the past 20 or 30 years by Dyar, Scudder, Poulton, Dixey, Speyer, Walter, Packard, Hampson, and a host of others. Many of these chapters are very full, and not only have we here a great gathering of facts from various sources, but they are treated and marshalled by the author with much philosophical insight and with the addition of new material of his own and obviously very frequently a verification by actual observation of the facts quoted from other authorities. . . . The great value of the classificatory part of the work is that it brings together in readable form a mass of information only to be got from a multitude of different sources, and the same feature marks equally the rest of the work dealing with families and species. . . . The most valuable and original division of the second portion of the work is the section on the Anthroceras. . . . This is a very full discussion of our British representatives and the allied Continental species and varieties, a subject of which Mr. Tutt has made a special study and amounts to an exhaustive monograph of the group. . . . The account of the Nepticulae is also of great value, as it incorporates much material which is referred for authority to Fletcher and Wood which there is much reason to believe would have largely escaped publication had not the author induced these authorities to assist him. . . . There can be no doubt the work marks an important step forward in the treatment of British Lepidoptera, recognising more fully than any previous treatise that a complete study of all the stages of the insects, not only structurally but physiologically, in their habits, changes, variations, distributions, &c., is now essential to further progress. The groups selected for treatment lend themselves especially to this demonstration. . . . The work is produced in a very satisfactory form. I have no doubt that its merits will secure it a reception that will induce the author to proceed with the remaining volumes."—Dr. T. A. Chapman, in *The Entomologist.* March, 1899.

"On the Lepidoptera Mr. Tutt is an acknowledged authority, and this first instalment of his vast projected work on the Lepidoptera of Great Britain must assuredly add to his reputation . . . The volume consists of near upon 600 pages of closely printed matter . . . written with great clearness, and it is perhaps unnecessary to say that a work such as this is not light reading, and is not intended for beginners or mere dilettanti, but for serious students. On all general matters Mr. Tutt summarises with admirable perspicuousness the latest and most authoritative views, supplemented by the results of his own investigations and discrimination . . . It is a mine of suggestive information for the scientific student and of ascertained facts for the field naturalist. No work upon this immense, this exhaustless subject can, of course, approach finality, but it is a real and great service to every entomologist to have brought together from innumerable sources the latest results of entomological investigation, and at the same time elaborate, well-authenticated lists, which tell him when and where each species may be looked for. This is what Mr. Tutt's present volume has done, and what renders it an indispensable addition to our entomological libraries. We very sincerely hope that the encouragement which the author has received, and which has enabled him to bring this first volume out, will be continued to him and will increase. Of the continuance of his own energy and capacity we have no doubt, but the work still lying before him, if his treatise is to be completed with the thoroughness of this first instalment, is formidable enough; and it remains for all those who are seriously interested in the science of entomology to see to it that he does not fail through lack of sympathy and help."—Selwyn Image, M.A., F.E.S., in the *Phoenix*, April 28th, 1899.

"To the superficial mind it might appear that there was already a sufficiency of works on British butterflies and moths; and yet many of those which have recently appeared treat of the subject from an enlarged standpoint, and cannot be denounced as superfluous. Among these we have met with none, not even Mr. Barrett's, which approaches the work which Mr. Tutt has undertaken, for comprehensiveness and richness of detail. The amount of matter, too, which it contains is enormous, for it is so closely printed, and small type is so freely used, that every page probably contains on an average from two to four times the amount of matter which might reasonably be expected to occupy a page of similar dimensions. The first part of the book may be regarded as introductory, and contains chapters on the origin of the Lepidoptera; the ova, embryology, and parthenogenesis; external and internal structure of larvæ; variation of imagines, protective coloration, and defensive structures of larvæ, and classification. The phylogenetic tree illustrating the last section is extremely complicated, and will be found worth study, as graphically illustrating the author's views on the relation of the various groups of Lepidoptera. It is not possible to speak of this portion of the book in detail. British and foreign authors are freely quoted, but large portions are founded on the direct observations of the author himself, or cast into a form regulated by his extensive knowledge of the subject. The second part of the volume contains the life-histories of a portion of the 'Sphingo-Micropterygid stirps,' working from the more generalized to the more specialized superfamilies, according to the system selected by the author. Only four superfamilies are discussed in the first volume—the Micropterygides, the Nepticulides, the Cochlidides, (or Eucleides), and the Anthrocerides—comprising about 100 species, giving an average of three or four pages to each species. In many cases, however, this limit is far exceeded, the notice of *Anthrocera filipendulae* alone filling twenty-five pages, under the various heads of synonymy, original description, imago, sexual dimorphism, variation (with notices of varieties from α to ξ), ovum, larva, variation of larva, cocoon, pupa, dehiscence, food-plants, parasites, habits and habitat, time of appearance, localities, and distribution. One commendable practice of the author's is to reprint the original description, whether short or long. In the case of *A. filipendulae*, a Linnean species, it happens to be barely two lines long; but in the case of some of the *Nepticulae* it runs to nearly a page. The relationships between foreign and British genera and species are likewise freely discussed. We have said enough to show the enormous compendium of information which Mr. Tutt has brought together from all sources, published and unpublished, making his book a regular cyclopædia on almost all subjects connected directly or indirectly with British Lepidoptera. We hope that the author may receive some little return for the unavoidable amount of weary drudgery (to say nothing of the time spent in really interesting work) that he must have devoted to his self-imposed task, in the grateful recognition of his labours by his fellow entomologists."—*Annals and Magazine of Natural History.* September, 1899.

BRITISH LEPIDOPTERA.

CHAPTER I.

METAMORPHOSIS IN LEPIDOPTERA.

It is impossible to deal with the pupal stage of Lepidoptera (at any rate so far as relates to the internal condition of the pupa) without first obtaining some idea of the nature of metamorphosis, the essential features of which, in insects, appear to be the separation of the periods of growth and development, and the limitation of the reproductive processes to a comparatively short time at the end of the individual existence.

Although it is not our intention to enter into a consideration of the general question of metamorphosis in insects, one or two points may claim our attention. We may look upon the embryonic life of an insect as its life within the ovum, or we may consider it as including the whole of that period of existence extending from the beginning of yelk segmentation to the acquisition of the mature form. In some insects most of these changes take place in the egg stage, in others a great many modifications take place afterwards, *i.e.*, in the larval and pupal stages. Our ordinary idea of embryonic life, being based largely on the conditions existing in placental mammalia, is slightly different from either of these. The embryonic stage may, in this sense, be defined as lasting until a stage is reached which is like that attained at maturity, except in size and capacity for reproduction.

The primitive Thysanurid insect is a hexapod and ceases embryonic life when it quits the egg, having, by this time, except in size and maturity, acquired its adult form; it moults as it increases in size, but does not change its appearance. The Orthopteran, which is also more or less a primitive form, has almost acquired its adult appearance on leaving the egg; it moults a certain number of times, and at the last moult acquires wings. By this further piece of evolution the previous stages may be termed embryonic. In this respect the young Orthopteran is as much an embryo as the lepidopterous larva.

The lepidopterous larva has been evolved from, and represents the active (quasi-adult) larva of Orthoptera, and is, in a sense, its direct descendant. Its vermiform aspect has been acquired by change from the active hexapod state (still represented by the Orthopteran nymph), and must not be considered as a persistence, after hatching, of the vermiform embryonic stage that all insects pass in the egg.

Thus, *Thysanura* is hexapod and active all through its life after hatching from the egg, moulting and increasing in size, but without any change of form. The Orthoptera are hexapod and active all through life, after hatching from the egg, moulting and increasing in size, and becoming winged at the final ecdysis. The true nature of this view of metamorphosis is well illustrated by *Meloë* and its allies, which are hexapod and active when hatched, become vermiform and more or less apod at the later moults, reassuming legs and becoming winged at the last ecdysis. The Lepidoptera hatch with ill-developed true legs and with special appendages (prolegs) for progression, increase in size, and moult during the larval stage, having the true legs developed in the pupal stage, and becoming winged and fully hexapod in the imaginal stage. It may be assumed, therefore, that the lepidopterous pupa represents the most ancestral form of the Lepidoptera, and that the scale-winged imago and the vermiform larva are both special forms evolved owing to the exigencies of environment from an ancestral active form with many of the characters now only to be observed in the pupal stage, and this notwithstanding the quiescent condition of the lepidopterous pupa. When, therefore, a larva is referred to as being embryonic, it must not in any way be considered that the stages through which it passes are a reversion to previous vermiform stages that are passed in the ovum, nor as a more or less direct continuation of these, but simply as being a series of specialised changes that have become necessary to the success of the order and that lead up finally to the assumption of the adult form.

We have already seen (vol. i., ch. iii., pp. 16-23) that the lepidopterous embryo in the egg rapidly passes through a number of remarkable changes of form, and have hinted in the succeeding chapters, that the larva, after hatching, undergoes equally great and important modifications at each ecdysis in adaptation to the different modes of life adopted by the various species; but besides these external changes in the form, structure, and general appearance of the insect, there are other equally important changes occurring simultaneously, *viz.*, a change of the internal organs, and a change in the physiological processes. It has already been hinted by Meldola, and others, that the last factor is, possibly, the most important, and that the change in external form is often only the outward manifestation of changed or modified physiological processes, and although, in general, enquiries as to development have been largely directed to the larval, pupal, and imaginal stages, it is well known (*vide*, vol. i., p. 51) that insects leave the egg in differing stages of development (even within the limits of the same family), and many distinctions observed in subsequent stages of metamorphosis may be the result of differences in embryonic development. Not that we consider, as we have already pointed out, that the larval instars are to be considered as continuous of the changes occurring in the egg, but rather that some of the larval changes may have been crowded back as it were into the egg stage. With this limitation understood, we may premise by stating that the term "metamorphosis" is applied to the changes that take place between the hatching of the larva from the egg, and the period at which the adult imaginal stage is finally reached. These changes are undoubtedly due to the varying conditions of the environment (used in its widest sense, *vide*, *Proc. South Lond. Ent. Society*, 1898, pp. 70 *et seq.*), to which many insects are subject, and to the fact that the holometabolic insects lead, during the periods of existence following the egg stage, three distinct and different lives, under quite dissimilar surroundings, amongst different enemies, and exhibiting entirely different habits. That these divergences should be accompanied by distinct modifications of the existent structures is to be expected, and thus we find that the larval organs are modified in the pupa, and the pupal organs in the imago, to such an extent that their functions are often radically different, yet there can be no doubt that the necessary change in function has brought about the evident change in structure, in other words, that modification has accompanied the different needs of the animal.

The term larva is strictly applicable to the stage following the egg only in the holometabolic orders of insects, although it is often popularly applied to the corresponding stage of the heterometabolic orders. In the older and more generalised orders the larval and pupal stages are not differentiated, and the term "nymph" is now generally used to designate in them all the stages of existence between the egg and the imago. The term is defined by Eaton as "applying to the young of insects which live an active life, quitting the egg at a tolerably advanced stage of morphological development, and having the mouth-parts formed after the same type of construction as those of the adult insect." In this sense the term is used by McLachlan, Cabot, Calvert, Sharp, Packard, &c. Other entomologists, however, still use the term larva for the early stages of the Heterometabola, and restrict the term "nymph" to the stadium preceding the imago. Brauer actually applies the term "nymph" to the holometabolous pupa.

Every insect after leaving the egg casts its skin a number of times. Each of these castings constitutes a moult or ecdysis. The number of moults varies for different species, although usually fixed for the same species, except in those cases in which it differs in the sexes. Without entering into a comparison between the gradual succession of ecdyses that the Orthopteran nymph, as representing the Heterometabola, undergoes, without any striking change of form until it reaches the imaginal condition, and the succession of larval changes undergone by the Lepidoptera, as representing the Holometabola, before the pupal stage is reached (when a most remarkable change of form occurs, equalled only by the change from the pupa to the imaginal condition) we may state that the great difference in the two series is that the Lepidoptera have interposed, between the penultimate and the final ecdyses, a completely quiescent condition, whilst the Orthoptera have no such quiescent condition, their only period of rest being confined to a short time immediately before the final form is assumed, and apparently of the same character as the rest previously indulged in at the preceding ecdyses. Not that all those insects that have a pupa present an absolutely immobile form as do the more specialised obtect lepidopterous pupæ, for those of certain Trichoptera, though quiescent at first, become active just before the final change, and many lepidopterous pupæ-incompletæ are capable of considerable movement.

The intervals between the ecdyses are called "stadia," the first "stadium" extending from the hatching period to the first moult, whilst the form and appearance of the larva at hatching is known as the first "instar," that of the larva after its first moult as the second instar, and so on.

We are now in a position to discuss the nature of the larval ecdyses. The larval skin is composed of a cellular layer or hypodermis situated on a basement membrane. The hypodermis consists of chitinogenous cells, and these excrete a substance which remains attached to the body and forms the hard outer layer of the larval skin. This layer of chitin has no vitality, it varies much in thickness and in its general character, and Krawkow considers it to be of a somewhat variable chemical composition. It is, however, composed largely of nitrogen and carbon, and hence its formation has been suggested as a means of getting rid of a great deal of the nitrogenous and carbonaceous matter from the blood.

The observations of Trouvelot on *Telea polyphemus* show that the increase of size and the rapidity of growth in some phytophagous larvæ are enormous. He states that the larva of this species weighs when hatched $\frac{1}{20}$ of a grain, in 10 days it weighs $\frac{1}{2}$ a grain, in 20 days 3 grains, in 30 days 31 grains, in 40 days 90 grains, in 50 days 207 grains, *i.e.*, it has increased to 4,140 times its original weight. During this time it will have eaten 86,000 times its primitive weight of food. Of this about one quarter of a pound becomes excrementitious matter, 207 grains are assimilated, and over 5 ounces have evaporated. Dandolo gives the weight of the larva of *Bombyx mori* on hatching as $\frac{1}{100}$ of a grain, and when fully grown as 95 grains, so that during this time the larva has increased to 9,500 times its original weight, and to do this it has eaten 60,000 times its original weight of food. Newport found that the larva of *Sphinx ligustri* increased from $\frac{1}{80}$ of a grain on hatching to nearly 125 grains (fullfed, 32 days after), an increase of 9,976 times its original weight; whilst Lyonet asserts that the larva of *Cossus ligniperda* increases between hatching and maturity 72,000 times its original weight. Newport adds that those larvæ in which the proportion of increase is the greatest, are usually those which remain longest in the pupal stage. This we very much doubt, *e.g.*, *Cossus ligniperda* exists for three years in the larval, and little more than three weeks in the pupal, stage. He asserts, too, that growth is most rapid after the last moult, and that a larva of *Sphinx ligustri* increased from 20 grains to 120 grains during its last stadium, extending over eight days. The general principle here involved we believe to be absolutely correct.

We have quoted the above at length simply to show that lepidopterous larvæ must get rid of a large amount of waste material, as the result of the vital activities, and it has been stated by Sharp and others that it is for the purpose of getting rid of certain nitrogenous waste matters that exuviation takes place. Certainly moulting increases the size of an insect, but this appears to be only a factor of secondary importance, for the integument can increase and stretch to an enormous extent even at the moulting period, and many moults are made when increase of size does not demand them, and the shedding of the skin at pupation is accompanied by a decrease of size. Chapman, however, expresses doubt as to exuviation having for its object the getting rid of effete nitrogenous matters. He considers that the larva does this in the ordinary way, *viz.*, as uric acid, urates, and allied compounds. The chitin, he says, is nitrogenous, but it is not related at all to these, and is got rid of because it is effete, just as animals shed their hairs, &c., and because it has served its purpose and is no longer useful. He adds that he "has no doubt that chitin is formed out of fresh nitrogenous material and not out of waste or effete material." The objects of moulting, he states, are: (1) Increase of size. (2) To get rid of material that is effete as a cutaneous covering, and secure a new and active one (internally as well as externally). (3) As an acquired use to obtain change of plumage, change to pupa, &c. As regards the effeteness of the cast skin of the larva, it may be well to note here that many larvæ eat their cast skins, showing that it is a loss of elaborated (not waste or effete) material, that they can ill spare, and some larvæ, *e.g.*, the Cerurids, at least in captivity, do badly, or die, if deprived of their cast skins. When the moulting takes place, not only is the exoskeleton shed but also the chitinous linings of all the internal organs which have had an ectodermal origin.

Before the larva moults it stops feeding, and usually (at least in the case of the exposed-feeding lepidopterous larvæ) spins a silken pad, into which the hooks of the prolegs are firmly fixed. At this time, the larva seems to draw upon its stored food (the fat-body) and the hypodermis secretes a fresh supply of chitin beneath the old cuticular envelope. At the same time the old cells beneath appear to become disintegrated and to produce a lubricating fluid between the new and old skins, which greatly aids in the process of exuviation; the external envelope now dries, becomes wrinkled and much contracted in length, being gradually separated from the new and very delicate one beneath. Trouvelot explicitly says that in *Telea polyphemus* the old skin "is detached by a fluid which circulates between it and the worm (larva)."

Newport describes the moulting of the larva of *Sphinx ligustri*, stating that, after several powerful efforts of the larva, the old skin cracks along the middle of the dorsal surface of the mesothoracic segment, and by repeated efforts the fissure is extended into the prothorax and mesothorax. The larva then gradually presses itself through the opening, withdrawing first its head and thoracic legs, and subsequently the remainder of its body, slipping off the skin from behind like the finger of a glove. This process, after the skin has been once ruptured, seldom lasts more than a few minutes. When first changed, the larva is exceedingly delicate, and its head, which does not increase in size until it again moults, is very large in proportion to the rest of the body. Chapman states that in the larval moults (larva to larva) of *Sphinx ligustri*, the head remains in one piece and rarely remains attached to the rest of the skin. It contains the mouth-parts of the new head and fluid. This is probably licked up by the larva at the moult. The old head often falls off, but if not, the larva rubs it against its foothold, or side, until it does so. Sometimes, in captivity, owing to weakness of the larva, &c., it does not rub it off, and it remains on. If it does so until the new head hardens, and one then removes it, one finds that it has restricted and deformed the new mouth-parts, especially the jaws, so that the larva cannot feed. In a larval moult, the skin usually remains attached by the prolegs, and the larva, as it were, creeps out of it. At the pupal moult, the larval skin slowly passes backwards, collecting in a heap at the anal segment.

Trouvelot describes (*American Naturalist*, i., pp. 37-38) the exuviation of *Telea polyphemus*, and states that "the larva ceases to eat for a day before moulting, spins some silk on the undersurface of a leaf, secures the hooks of its hind-legs therein, and remains motionless. After a time, through the transparent skin of the neck, a second head can be seen, larger than the first, belonging to the larva within. A little before the actual moult takes place, the larva holds its body erect, grasping the leaf with the two pairs of hind-legs only, the skin being wrinkled and detached from the body by a fluid which circulates between it and the worm; two longitudinal bands are seen on each side, produced by a portion of the lining of the spiracles which, at this moment, have been partly detached; meanwhile the contractions are very energetic, and, by them, the skin is pulled off and pushed towards the posterior part. The skin thus becomes so distended that it soon tears just under the neck and then from the head. When this is accomplished the most difficult operation is over, and the process of moulting goes on very rapidly. By repeated contractions the skin is folded towards the tail, like a glove when taken off, and the lining of the spiracles comes out in long white filaments. When about one-half of the body has appeared, the head-shell still remains like a cap, enclosing the jaws; then the larva removes it by rubbing it on a leaf. The larva finally crawls out of the skin which remains attached to the silken pad made for the purpose. Once out of its old skin, the larva feels with its head the aperture of every spiracle as well as the tail, probably for the purpose of removing any fragment of skin which may have remained in these delicate organs. Not only is the outer skin cast off but also the lining of the air-tubes and intestines, together with all the masticatory organs and other appendages of the head."

The mode of ecdysis of *Lyonetia clerckella* appears to be somewhat similar to that of the Nepticulids (*vide*, vol. i., p. 174), for Healy remarks that on the skin splitting at the head, the larva gradually eats its way forward, and as it feeds with the underside of its body facing the upper surface of its food, the dark horny thoracic legs, as they successively make their appearance out of the old skin, become very conspicuous. The head of the larva is then very pale brown and has a dark brown spot on each side. At length, after feeding for ten hours, the larva entirely escapes from its old skin and remains motionless for some time. The same observer describes (*Ent. Mo. Mag.*, i., p. 19) the moulting of *Eriocrania unimaculella* as not occupying five minutes. He says that he observed the old skin to split on the front of the prothorax, when the larva pressed its head against the side of its mine, and then, by curving its body and violently jerking itself up and down, drew its body out of the old skin. . . . The head was thrown off in front and not permitted to recede down the body as the old skin had done. The body was then quite white and spotless, but the dorsal vessel slowly assumed a pale reddish tinge, the tip of the mouth gradually became reddish-brown, whilst down the centre of its head, two parallel pale brown lines appeared; the head then became brown, and shortly afterwards a dark triangular patch appeared on each side thereof. The larva now resumed its feeding, the dorsal vessel (? alimentary canal) became green, which gave a greenish tint to the whole of the body.

We have already stated that all those organs that have an ectodermal origin (see, vol. i., p. 19) throw off their outer covering at each moult as exuviæ. Thus the integument, hairs, and setæ are accompanied by the eye-facets, the lining of the mouth, pharynx, mandibles and the lining of the tracheal tubes, whilst Newport adds that "the lining of the large intestines is detached with the skin of the posterior part of the body," and that "the lining of the portion of the alimentary canal which extends from the termination of the œsophagus to the insertion of the so-called biliary vessels, is also detached and becomes completely disintegrated." Packard notes that in the larva of *Datana*, the tracheæ at the time of ecdysis undergo a complete histolysis, and arise *de novo* from hypodermal cells, the so-called spiral threads originating from elongated peritracheal nuclei. This, he adds, is "also undoubtedly the case with the salivary ducts, which are strengthened and rendered elastic by tænidia like those of the tracheæ. As the urinary tubes are diverticula of the proctodæum, itself an ectodermal invagination, they may also, though not lined with a chitinous intima, be renewed. With little doubt the intimæ of the ducts of poison, spinning, and most, if not all the other, glands, though certainly the dermal glands, are exuviated."

Howgate noticed (under the microscope), whilst observing a small immature transparent Geometrid larva, peculiar internal movements, "each segment, commencing at the head, becoming elongated within the outer skin, whilst the next ones remained in their former state. Each segment in its turn behaved in this manner until the last was reached, when the motion was reversed and proceeded towards the head, when it was again reversed. . . . The whole proceeding appeared as if the larva was gliding within itself, segment after segment, the outer skin remaining as if held by the other segments, whilst the particular one in motion freed itself within. After remaining motionless for a short interval, the skin near the head swelled and burst open at the back. . . . Presently the head of the new caterpillar came out, pushing forward the old one. . . . After a short struggle the new true legs appear, pushing off and treading under foot the old ones, then, by a violent wriggling movement, the abdominal legs are extricated. After this all is clear, and the larva, quite exhausted, coils itself up and literally pants for breath" (*Naturalist*, 1885, p. 366).

Chapman notes that when the larva of *Charaxes jasius* moults, the head of the larva retreats from the effete head to the prothoracic segment, leaving only the mouth parts within the old head. He says that this is easily observed in many species of larvæ, but it struck him as being curious in this species because the four horns or spines of the new head were not directed backwards but laterally, two to either side, under the skin of the prothoracic segment. The same observer writes (*Ent. Record*, ix., pp. 217-218): "In many Noctuid (and other) larvæ with transparent heads, it is easily seen at the period of moult, that the old head is not entirely filled by the new head, but that the old head is largely occupied by fluid which bathes the new skin beneath the old one. At this stage, the head has really moulted, being chiefly within the prothorax. This fluid contains some chitinous matter in solution, and the dampness of the newly-changed larva dries up into a superficial layer of chitinous material. . . . At the larval moults of *C. jasius* (as with many other species) the head is cast entire, but at the pupal moult it splits up. At a larval moult the larva eats the cast skin, except the head, but it does not appear to specially eat up the leaf with the silken carpet on which it has rested, as our *Cerurae* invariably do when possible."

Miss Golding-Bird stated (*Entom.*, ix., p. 270) that, in the young larva of *Stauropus fagi*, the process of moulting lasted about half an hour, that the legs "did not all get free till the skin had been pushed back to the 6th segment (? 2nd abdominal), and that then even the flattened tail made its way out with comparative ease." Birchall also notes (*Ent. Mo. Mag.*, xiii., p. 232) that there was not the difficulty in a larva of *Stauropus fagi* changing its skin that he "had expected from its singular form and varying diameter." The three pairs of legs, he says, "were drawn out from the old shells precisely after the manner of a crab or lobster, but with much greater ease, owing to the small amount of contraction at the joints, a few seconds only being needed for the operation. The new legs on emergence are semi-transparent and apparently soft, and are at once folded up against the fore-part of the larva, which then rests for a few minutes, for the purpose of allowing the newly-developed legs to acquire colour and hardness by exposure to the air; in about five minutes they are unfolded, and the work of extricating the body proceeds; the swollen terminal segments offer no difficulty, the old skin seeming to possess great elasticity."

Buckler considers the last larval moult of *Stauropus fagi* to be a very exhausting operation and describes (*Ent. Mo. Mag.*, xvii., p. 18), at length, an ecdysis that apparently commenced on September 3rd, 1879, when the larva was noticed as already having a double-headed appearance, from the real head being mostly within the skin of the prothorax. It was grasping a twig with the four pairs of ventral prolegs, and all the front segments were stretched, arching backwards over the erected broad segments of the tail, thus forming a more or less circular position. At long intervals the fore-part of the body was gently raised up and down a little, sometimes varied with a kind of convulsive heave, and once, after many hours' stillness, the anterior legs were extended laterally to their utmost stretch, quite rigid for a couple of minutes, and were then gradually refolded. Quite late at night the anal segments hung down a little, but were soon erected again. Next morning, and throughout the day, the first pair of ventral prolegs and the second pair partly, sometimes wholly, were withdrawn from the twig, the hold of the larva being sustained then by the third and fourth pairs, which brought the head down lower than before on one side or other of the tail; as night drew on all the anterior legs were outspread to the utmost. In early morn of September 5th it was in the same position as on the previous night, though about noon the head was even still lower, and with the fore-part of the body turned away a little on one side from the tail, and in the course of the afternoon suddenly changed over to the opposite side; thus, with slight variation of detail, for the remainder of the day and evening continued this wonderful exhibition of power and endurance. At 10.35 p.m. the larva seemed to be getting restless, and continued to swing itself partly round on the twig, still in the same circular posture, and in a minute or two swung back again, and then commenced, gently at first, writhing backwards and downwards, soon with increasing energy; the anterior legs, having lately been folded together, now began to alternately relax outwards and contract again inwards close to the body, in what soon became a regular recurring rhythmic movement, in unison with the heavings of the breast, until within 25 minutes of the event expected, when suddenly most violent writhings and rapid twistings ensued for the space of two or three minutes, and then the slower measured movements were resumed; the skin enveloping the head became glistening, and throbbed in parts with a slight inflation, in accord with the general heaving action of the larva; presently a series of very violent struggles occurred with the anterior legs extended laterally; these efforts proved effectual, for then, at 11.35 p.m., the expected moment came, when the skin suddenly burst all round the throat, as it seemed then to be, close to the old headpiece. Immeditely there appeared a transverse yawning rent, exposing the whitish head and tender glistening bases of the short first pair of legs, held back at the moment by their sheathings of old skin, which drew quickly from off them, when they fell forward in their natural position; the same measured heaving to-and-fro movement continued with incessant energy as the old skin (rapidly blackening) drew back and next exposed the basal joints of the second or longest pair of legs, whose long femora were soon uncovered, yet, before their tibiæ were freed, the third pair of legs, being a little shorter and of unequal lengths, were drawn out from their sheathing and slipped forwards, first one, the shorter of the two, then the other; next were liberated the tibiæ and tarsi of the long second pair, all playing immediately after in unison with the whole body, which, now unbending, sustained its hold of the twig by one ventral proleg only of the fourth or hindmost pair, and while the old skin glided back by degrees, the other ventral legs were, in turn, stepping out as it were of their old stockings; at this time the long crustacean-like legs began impatiently to play about and push at the old headpiece as cleverly as arms and hands, to weaken the attachment and free the mouthparts, and, from them, the old helmet fell away just as the second pair of ventral prolegs was uncovered. Meanwhile the hinder segments of the body had become drawn out straight and narrowly cylindrical, though tapering, the caudal filaments drawn close together, forming apparently but one projecting point, which now, with the hinder portions of the body, became elevated almost perpendicularly as the foreparts with the head and anterior legs were lowered, whilst the larva was evidently feeling for the adjacent leaf (which had been cut away); the third pair of ventral prolegs were next uncovered, and then one of the fourth pair . . . followed by the only supporting proleg, the shrivelling skin then drew off the 11th (? 7th abdominal) segment . . . For two minutes the larva remained perfectly still, and then turned partly round and vigorously thrust and pushed with its mouth and arm-like legs at the old collapsed skin on the 12th (? 8th abdominal) segment which soon became freed, excepting the caudal filaments hidden within the retreating skin. The larva now lay at full length, with hinder segments slightly turned aside, all the ventral prolegs sprawling, the anterior (true) legs being extended forward, motionless, for 14 minutes; it then vibrated the front legs a little and, slowly turning its head round, threw out the longest pair of arm-like legs beyond the head, one bent partly over the other . . . and rested for four minutes more; it then shook the tail segments, which still remained comparatively narrow, when, suddenly the exuviæ fell away disclosing the two perfect filaments. Thus, at 12.20 a.m., was this moult completed, having, from the rupture of the skin to the final riddance, occupied one hour and a quarter."

Stainton noticed on September 16th, 1886, a batch of larvæ of *Phalera bucephala* already laid up for their last moult. On the 17th a silken carpet had been spun, and they rested quite immovably through the 18th, 19th, and 20th (when, however, one example was noticed throwing its head from side to side). The first moult took place on September 21st soon after noon, and all the batch but one or two individuals had moulted by the morning of the 22nd, but none fed until the afternoon of that day. Stainton notes, concerning the actual moult, that "the gradual retirement of the old skin towards the anus seemed to be almost a self-acting motion, to which the larva contributed but little till the time came for extricating the anal extremity from the old skin." He says that "the old heads were completely detached from the other part of the skin, and fell down separately as the moulting progressed."

As we have already hinted, the formation of the new skin beneath the old one is due to the secretion of the structureless chitinous layer by the cells of the hypodermis, by the process of histogenesis. Packard says that "these cells at this time are very active, and the formation of the new layer of chitin arrests the supply of nourishment to the old skin, so that it dries, hardens, and, with the aid of the fluid thrown out at this time, separates from the new chitinous layer secreted by the hypodermis."

That this fluid exists between the two layers is evident. We have seen the new hairs of *Arctia caia* and *Apatela aceris* quite moist when first set free from the old skin. Chapman says that "the fluid is related to that which hardens into the dense pupal case, and also hardens in a less degree the skin of the larva." He supposes that "it must contain some chitin in a soluble form, for if a newly-cast larval skin be taken, there is no difficulty in extending the shrivelled mass to its full length and dimensions, but, if a short time elapses, this chitin hardens and the skin cannot be extended after soaking in water, alcohol, ammonia, or any other solvent experimented with."

There is no doubt that the growth of the setæ and hairs on the new cuticle likewise serves to loosen the overlying skin which has to be exuviated.

It would appear that there is no essential difference between the exuviation of the last larval skin that sets free the pupa and those preceding it. Gonin states that during pupation the outside of the pupa, especially the parts of the head and throax, is coated with a viscid liquid "secreted by special thoracic glands." Subsequently it was determined that the fluid was not secreted by these special cells found on the thoracic segments, but was distributed all over the surface, and Bugnion considered it to be a secretion of the whole surface of the hypodermis when the cells were still soft and not yet hardened by contact with the air.

There is considerable variation in the number of moults that lepidopterous larvæ undergo, and even in the number of moults in the same species, the difference sometimes being sexual, *e.g.*, *Notolophus antiqua*, in which the female larva undergoes a moult more than that of the male. Boisduval was one of the first authors who drew attention to the variable number of moults that some lepidopterous larvæ appeared to undergo. He writes :—"Le nombre des mues varie peu dans une même espèce, et peut-être même dans l'état sauvage est-il toujours constant ? Mais chez quelques chenilles velues que l'on élève en captivité, il peut-être augmenté ou diminué par une nourriture plus ou moins abondante." Edwards has discussed at length that the larvæ of butterflies with a summer and a spring brood vary in their moulting, the hybernating winter larvæ moulting once more than the summer larvæ. He points out that "there seems to be a necessity with the hybernators of getting rid of the rigid skin in which the larva has passed the winter, at least in certain species —*Apatura*, *Limenitis*, &c. He adds that "in these cases, very little food is taken between the moult which precedes hybernation and the one which follows it. The skin shrinks, and has to be cast before the awakened larva can grow. Those species (observed) whose larvæ moulted five times in the winter brood, required but four moults during the summer. The larva is, in lethargy, actually smaller than before the next previous moult." Dyar says (*Psyche*, iii., p, 161) that the Arctiid larvæ have a great capacity for spinning out their life-histories by interpolated stages ; he thinks it is because so many of them hybernate, and only a single brood extends through the season. The early spring moult, before any feeding takes place, after hybernation, is indulged in by the Anthrocerids, and must apparently be done in order to get rid of the effete excretory matter that the skin represents. Chapman considers that "Arctiids are typical hybernators. Many of them have to half-hybernate, having warmth enough to keep them awake, but not enough food for growth, but their tissues, at least the chitinous ones of the cutis, and also, probably, and perhaps especially, of the alimentary canal, become old and effete, and require the rejuvenescence acquired by a moult. Other smooth-skinned hybernators have similar capabilities." Packard considers that, "as a rule, the greatest number of moults occurs in holometabolic insects with the longest lives, and that an excessive number of ecdyses may at times be due to some physical cause, such as lack of food combined with low temperature." He says that, "in the winged insects, especially Lepidoptera, the number of moults is dependent on climate; insects of wide distribution, growing faster in warmer climates, consequently shed their skins oftener, *e.g.*, the same species may moult once oftener in the Southern, than in the Northern, States, as in the case of *Callosamia promethea* which in West Virginia is double-brooded." Weniger, by rearing the larvæ of *Antheraea mylitta* and *Eacles imperialis*, which when reared under normal conditions have six stadia, found that when reared in a warm moist atmosphere of about 25°C., they have but five stadia, *i.e.*, they moulted but four times. In the hot and moist climate of Ceylon, also *A. mylitta* has but five stadia (*Psyche*, v., p. 28).

Exact information as to the number of stadia through which individual species pass is much desiderated. Dyar notes that *Phyrrarctia isabella* moults ten times, *Ecpantheria scribonia*, *Scepsis*, and *Apatelodes* eight times, and *Seirarctia echo* seven times. Buckler notes that *Nola centonalis* moults nine times, the other species of the genus but six. Packard gives *Callosamia promethea* as moulting three times. The male larvæ of *Notolophus* (*Orgyia*) *leucostigma* were found by Riley to moult three times, the female larvæ four times, whilst Dyar notes that in *N. gulosa* the male larvæ moult three or four times, the female larvæ always four, and that whilst male *N. antiqua* larvæ have six stadia the female has seven. This latter observation is surprising in the face of our experience in Britain (*vide*, post.).

With regard to the variable number of moults in *Notolophus antiqua*, Chapman notes (*Ent. Mo. Mag.*, xxiii, p. 224) that he has observed—3-moulter males, 4-moulter males and females, and 5-moulter females. Bearing on this he makes the following important observations: "The larvæ that moult three times always produce male moths, those that moult five times females, those that moult four times produce both." "There is also another circumstance that is usually associated with this fact, *i.e.*, that the male emerges from the pupa a few days before the female. Now, if we consider only the 4-moulters, consisting of both males and females, this is not so, but if we associate them in this order—(1) 3-moulter males, 4-moulter females, (2) 4-moulter males, 5-moulter females, we find that the usual rule of the males emerging first is observed. This also shows more distinctly that another rule obtains in *N. antiqua*. It is one that obtains among bees, and would, I think, be found in other insects if observation on the point were made. It is this, that the male, though feeding as larva a shorter time (being a smaller insect), remains a longer time in the pupal state than the female, apparently requiring a longer time to undergo its full development. It would thus appear that in *N. antiqua* the female moults once more than the male, a circumstance that I have not seen noticed as occurring in any other species, and that further the moults may vary by one." Riley, as early as 1868, had called attention to the fact that the male larva of the American *Notolophus leucostigma* underwent one moult less than the female larva, the numbers given (*loc. cit.*, p. 274) by him being three for ♂ and four for ♀. He further states that "there is a very general tendency in individuals to vary from the normal number of moults in the species," and adds that "whenever there is much discrepancy in the size of the sexes, the smaller (usually the male) undergoes a less number of moults, and that the variation in the number of larval moults (except where, as in these cases, it is sexual, and presumably predetermined in the egg) is dependent on food-supply rather than hybernation." He thinks that "it may be stated as a very general rule that moulting is correlated with rate of growth and nutrition, those species which have a short larval existence, generously nourished, exuviating least."

Chapman records (*Ent. Mo. Mag.*, xxxii., pp. 54-57) how, on one occasion, he practically starved some larvæ of *Triphaena comes* that had reached their last instar, by giving them a diet of *Arbutus unedo*. After putting them back on dock, all but two died, but these undertook an extra (post-ultimate) moult and then died. In a second experiment, the larvæ were fed up until they had reached the last instar, and then, by a diminished food supply, they were kept almost at a standstill for five or six weeks, when they were placed on an abundant diet. In due course, several changed normally into pupæ, others came to grief, whilst a third section made an attempt to moult again; two actually succeeded in doing so, others did so partially, whilst the remainder died. Those that moulted or did so partially exhibited peculiar characteristics, such as—the loss of the hooks of the prolegs, a structural change in the true legs, an alteration of the maxillæ, the development of a short haustellum, and the two normal palpal processes much lengthened. The antennæ were the organs most altered, the basal joint large and bladder-like, whilst the remainder was from 1mm.-3mm. or more in length, in one considerably longer, folded together, as the pupal antenna is, within the larval head. Before moulting it became brown and transversely ribbed, just like the pupal antenna, but had a soft white terminal joint with a terminal bristle. . . . The eyes were more or less altered. In nearly all, the six eye-spots could be observed, but the two upper were usually smaller or disappearing. They had amongst them yellow, raised, clearly defined patches, whilst in several of the larvæ, a crescentic slightly raised mark lay between the eye-spots and the base of the antenna. This was clearly the crescentic mark of the glazed eye, both from its form and its position; the latter not at first recognisable, until it was remembered that the face becomes bent forwards in the pupa and the antenna thrown backwards. . . . The larvæ, though possessing normal jaws, did not attempt to eat . . . and exhibited to a great extent in the characters indicated, some development towards the pupal stage. Chapman considers that the condition of the glazed eye shows clearly that the crescent is an appendage to the eye, and not a part of the eye itself, since it is distinctly separate from the larval eyes just as in the pupa, and it is outside the area which often shows indication of the hexagons of the imaginal eye, and beneath which that commences its development. The observer suggests whether the diminished nutrition was, in this experiment, not commenced before a certain amount of change towards the pupal stage had occurred, and that this could not be undone. He thinks that had the diminution of nutrition been begun earlier (*i.e.*, before these changes had sufficiently advanced to be of importance) it is quite possible that the further larval instar would have been of an entirely larval character.

The normal number of moults in the Acronyctids (taken as a whole) is five, although a number of species do, occasionally, reach the last (sixth) instar in four moults, by omitting the fifth, and when, as in *Pharetra rumicis*, that instar has a special distinctive marking, or coloration, or arrangement of hairs, these larvæ never exhibit that particular phase. In *P. rumicis* this is by no means uncommon, most broods presenting some examples of it; it has also been noted in *Pharetra menyanthidis*, *P. auricoma*, *Acronicta leporina*, and *Apatela aceris*, and no doubt it occurs, if more rarely, in all the other British species. This variation has no relation to sex, and Chapman found that it did not represent an attempt of the larva to press forward so as to become double-brooded, although *P. rumicis* (next to *P. auricoma*) most frequently produces autumnal specimens that probably represent a double brood, nor did he observe any difference in size in the full grown larvæ or imagines. It seems to be a spontaneous variation, the meaning and use of which have yet to be discovered. *Jocheaera alni* alone, of the British species, has four moults as the normal number, but, in rare instances, it moults five times like the others, and when it does so, the larva, in the extra penultimate instar, differs from any of those preceding it, and shows a transition between the juvenile and adult plumage, suggesting that formerly the adult plumage was attained by a gradual development, and that the present abrupt transition occurs by the suppression of the now lost intermediate stages. A not infrequent form of plumage exhibited in the extra instar is like the present fourth instar with certain adult characters superadded. Chapman notes another form of plumage correlated with the extra skin (only observed in one specimen) more like the adult than the juvenile form, but with some juvenile characteristics. The same observer also remarks (*Ent. Record*, ii., p. 127) that from his observations it would appear in this (and other) species that "a larva temporarily belated by want of food or other circumstances, may die of atrophy, or may display extra vigour, have an extra moult, and finally be a larger specimen than if the normal course had been pursued." He further notes that, in *J. alni*, the extra-moulter larvæ produce moths of both sexes, and further that the variation is not hereditary, as ova obtained from these extra-moulters in 1888 did not produce a single example in 1889. Chapman concludes that no detailed remarks that he could make, would "add to the evidence that these two forms of larva, with an extra stadium, afford, *viz.*, that *J. alni* was once a five-moulter like the other species of the genus, and that intermediate forms between the present fourth and fifth instar plumages, at one time existed, some features of which are preserved by these atavistic variations," and he observes that "it is also interesting to note that in the latter (rarer) form, at any rate, some features of other species of the genus are presented, which are quite absent in normal *J. alni*." *Hyboma strigosa* is usually a four-moulter larva, but Chapman notices, out of a brood of some two dozen larvæ, four five-moulter larvæ. The five-moulters in the fifth instar do not assume the ordinary adult plumage, the plumage of the extra moult not differing much from that of the fourth instar.

The same observer has also noted (*Ent. Record*, iv., pp. 265 *et seq.*) in *Arctia caia*, not only variations in the number of moults, but that variation, both in plumage and habits, may be associated with the variation in moulting. This species normally hybernates in the fifth instar, and moults thrice (sometimes twice and occasionally four times) after hybernation. However many instars the larva may pass, nine, eight, seven, or six, the adult plumage is usually reached only in the last two instars. In every brood a certain percentage (about five per cent.) feed up rapidly in the fourth instar, become larger in this, than is the normal larva in the fifth, instar, and at the fifth moult, these pass into the *caia* (adult) plumage. These larvæ generally become full-grown in the sixth stadium, whilst others do so in the seventh, and emerge as moths in from eleven to thirteen weeks from the date of the eggs being laid, these are called the "Forwards." The great mass of larvæ, however, are of the "Normal" type, have eight instars, moulting four times before hybernation and three times after, and produce moths within a few days of twelve months of the eggs being laid. Others progress slowly and get in extra moults (one or two) before obtaining adult plumage. These are called "Laggards." A series of pedigree experiments on "Forwards" and "Normals" (*Ent. Record*, iv., pp. 288 *et seq.*), and "Laggards" (*loc. cit.*, v., pp. 33 *et seq.*), are detailed, by which it appears that the elimination of a peculiar "Forward" race is dependent on temperature, and that a certain percentage of every brood has a tendency to develop into "Forwards" under ordinary conditions. The experiments show that selection of, and breeding from, "Forwards," does not tend to develop a purely "Forward" race, whereas, a portion of a brood, bred at 80° F., yielded 75 per cent. "Forwards," the other portion of the same brood bred at 60°-65° F., yielding only 5 per cent., and whilst the latter took three months to complete their cycle of metamorphoses, the former had completed them in two months. These "Forwards," *i.e.*, individuals which feed up, and emerge in autumn are occasionally met with in nature, but must be considered as very rare. Further observations (*loc. cit.*) showed that much further variation was noticeable, many examples not reaching the hybernating stage (and plumage) until they had moulted five or even six times, *i.e.*, had reached the sixth or seventh instar. These would then after a short hybernation subdivide, one part maturing rapidly and assuming the adult plumage, the other part tending towards the "Laggard" type and maturing much more slowly.

As to the correlation between the rapidity of moulting and the plumage assumed, Chapman writes:—"In all cases the Laggards fed more slowly and made less growth at each moult than the Normals, so that a Laggard would be only in its third instar when a Normal was already prepared to hybernate in its fifth instar; the former also would, in its fifth instar, be no further advanced as regards size and plumage than a Normal in its third or fourth instar (*vide*, *Ent. Record*, v., pl. ii., figs. 1, 2, 3). In one case a Laggard did not reach its last instar until after thirteen moults. Others would pass on to the adult plumage and progress more rapidly after reaching a certain stage . . . Individuals would begin hybernation at very uncertain stages, some in "*Spilosoma*" (normal for fourth instar), some in "*fuliginosa*" (normal for fifth instar), others in "*caia*" (normal for sixth instar) plumage. It also happened that some aberrant Normals in the later broods prepared to hybernate in distinctly adult "*caia*" plumage. The following tabulation of the principal and most distinct forms is interesting:—

FORWARDS.—1. Passes from 4th (*Spilosoma*) to 5th (*caia*) plumage, omitting *fuliginosa* plumage, feeds up rapidly, and does not hybernate.
- *a.* Adult in 6th instar.
- *b.* Adult in 7th instar.

NORMALS. — 2. *Fuliginosa* plumage in 5th instar in which it hybernates; *caia* plumage in 6th instar.
- *a.* Adult in 7th instar.
- *b.* Adult in 8th instar.

3. Larger form, with more profound hybernation.
4. Assumes *fuliginosa* plumage in 6th instar after hybernation, adult in 8th and 9th instars.
5. Assumes *fuliginosa* plumage and hybernates in 6th instar.

LAGGARDS.—6. Feeds slowly, never assumes distinct *fuliginosa* plumage; reaches *caia* plumage in 8th and 9th instars.
7. Many variations, in which hybernation takes place in 6th, 7th, 8th, or 9th instar, and either in *fuliginosa* or *caia* plumage.

Chapman then notes that he has several times taken Laggards at large, *i.e.*, larvæ apparently in the plumage of the third or fourth instar found in September and October, and that have fed on slowly without going into "*fuliginosa*" plumage or attempting to hybernate. It is certain, therefore, that though, in England, the great mass of *A. caia* larvæ are what are here called Normals, *i.e.*, the form which is especially well clothed in the fifth instar in which the larvæ hybernate, nevertheless both Forward and Laggard forms do occur not uncommonly, and probably many of the various intermediate forms, some of which are above described.

The fact that, out of a single brood treated identically, some should require but six stadia, and others fourteen, to reach maturity, and this, as a simple matter of variation and not of disease, is remarkable. One is tempted at once to ask what is the use to the species of this variation, and Chapman suggests that since the Forwards are decidedly favoured, if not caused, by a high temperature, it appears that if, in a warm and early season, only the Normal form existed, these would be ready to hybernate at midsummer, and would probably largely perish in consequence, whilst the larvæ from a second brood of Forward moths would in such a season, reach the hybernating stage at a fairly favourable date. In an early English summer the Forwards themselves, or their progeny, would no doubt perish, hence possibly the rarity of wild Forwards in England. It is obvious that the large hybernating form (No. 3 *ante*), with its larger store of nutriment and denser clothing, appears to be specially adapted to carry the species through a long and severe winter. The Laggards, on the other hand, appear to be particularly suitable to a mild winter, in which hybernation is impossible, though a little feeding could be done, but no real progress made. These different forms obviously exist commingled in our English race of *A. caia*, the Normals largely predominating, but ready to give way to the Forwards under the influence of a high temperature. Chapman's conclusions from his experiments on *Arctia caia* are stated as follows:—"(1) The larva of *A. caia* possesses three types, each with subsidiary varieties. (2) Each of these types, and, indeed, each subsidiary variety, is characterised by a series of moults, a succession of plumage, and habits as to hybernation, in which it differs from the others. (3) *A. caia*, as we meet with it, may be regarded as a mongrel race, consisting of these three types, closely mixed and intercrossed, but capable of separation by appropriate breeding and selection, or more probably of two races, one with hybernating larvæ and a single brood annually, the other of an alternating summer and winter form. (4) Though these two races may conceivably, under certain climatic conditions, have existed as separate and pure races (and may do so now in some parts of the world), yet the hybernating form is most largely represented, at present, in England, with a small intermixture of the digoneutic form, which persists, as it enables the species to be continued in exceptional seasons that would be destructive to the dominant monogeneutic type."

The changes that almost all larvæ undergo at each stadium are such that they often give important clues to the phylogeny of the species. No doubt, in the case of many (? all) species, the modification observed at each successive instar, bears a fixed relationship to the habits of the larva during that instar, and it is noticeable that larvæ that hide by day, or obtain their meed of protection by their similarity to their immediate surroundings, *e.g.*, larvæ of Noctuids, Geometrids, or those that are internal feeders, vary least in their superficial appearance at each instar. Generally speaking, those larvæ that are most modified in appearance at the various moults, lead a more or less exposed life, and their changes (correlated with their habits) are so fixed that the plumage is often sufficient to discover the instar already reached by an individual larva. Chapman has given (*ante*, pp. 12 *et seq.*) some remarkable details bearing on this point with regard to *Notolophus antiqua*, *Jocheaera alni*, *Arctia caia*, &c. It often happens that the larvæ of two species are quite unlike when adult and yet present great similarity in their earlier stages. It has also been observed that one or more of the early larval stages of a species may sometimes closely resemble the adult stage of another. Such similarities as these have been frequently noticed, and, as the resemblances clearly point to a common origin, whilst the differences tend to show the point at which divergence has arisen, the phylogenetic significance of such markings may prove of the utmost importance. Interesting deductions in this direction have been made by Poulton and others on the phylogeny of certain Saturniid and Sphingid moths.

Scudder applies the term "hypermetamorphosis" to the changes observable in the external character of the larva and the variable nature of the segmental appendages, at each larval exuviation. He notes that the mature larvæ of Satyrids have a rough skin due to a vast number of minute tubercles, each bearing a single hair and scarcely visible to the naked eye. The skin of the young larva, however, instead of being thus supplied, bears only a small number of club-shaped bristles, arranged in the characteristic longitudinal series of tubercles. In *Nymphalidi* the newly hatched larvæ bear regular stellate warts, whilst, in the mature larvæ, some of the segments are provided with fleshy tubercles, in place of the warts, and some of the segments themselves are grotesquely and peculiarly hunched. In *Anosia archippus* the young larva is ornamented only with black bristles placed on the ordinary trapezoidal tubercles, whilst the adult possesses, in their stead, long thread-like fleshy flexible tentacles at each extremity of the body. In Vanessids the young larvæ have long tapering hairs arranged in ordinary form, whilst these are replaced in the adult larva by conspicuous branching spines. In the Heliconiids, the newly-hatched larvæ have large tubercular papillæ, each bearing a long slender clubbed hair, but after the first change of skin the head is armed with a pair of stout thorny spines nearly as long as itself, whilst the large papillæ are replaced by tall tapering spines bearing little needle-like papillæ, the differences being intensified at every subsequent ecdysis.

Clifford and Moncreaff both give three as the normal number of moults in *Smerinthus ocellatus* and *S. populi*. Moncreaff further observes that, when moulting, the old cap (or head) of the larva is first thrown off and that the skin then breaks up between each segment and along the spiracles. He further states that three-fourths of the young larvæ of these species perish in their first moult, not being able to rid themselves of the old head-covering. Bacot states that the larva of *S. ocellatus* has four moults (not three). Miss Golding-Bird also notes that the "mask," or old head, is first moulted and falls from the larva of *Stauropus fagi* before the further moulting has seriously commenced.

Many green tree-feeding larvæ that pupate in the ground, and have an intermediate period of wandering on the ground, are well-known to assume various colour changes between the time that they leave the food-plant and that at which they undergo pupation. This phenomenon is well illustrated by the larvæ of many of our common Sphingids and Notodonts. Among the American species, Dyar notes *Eudeilinea herminiata* which, normally green, becomes bright red, *Heterogenea shurtleffii* which loses all its pigment and becomes transparent, *Polygrammate hebraicum* which, normally green, assumes a complicated pattern of lines and spots, &c. This colour-change is undoubtedly useful protectively, but its physiological nature is not at all well understood, although it is no doubt associated with the separation of the larval epidermis and the growth of the pupal cuticle, and may be due to the breaking up of the cells of the former, the change of colour being simply a result of the active physiological processes in progress at this time.

It has been noted that, when the true legs of certain lepidopterous larvæ have become lost by injury, they have been reproduced at successive moults but usually in diminished size. Réaumur, Graber, Newport, Künckel and others have experimented on larvæ, the first-named stating that, having cut off more than half of the three thoracic legs of a larva on one side, they were, in the pupa, shorter than the three corresponding ones on the other side. Newport also cut off one of the larval legs, and the imago appeared with an atrophied foot. Gonin states that he repeated a similar experiment to that of Réaumur on a somewhat younger caterpillar, and the chrysalis again showed three maimed limbs. He also states that the true leg of the larva corresponds only with the tarsus of the imago, or, in other words, we surmise, contains only the imaginal disc that forms the tarsus of the imago. The removal of the leg of the caterpillar, therefore, only removes that portion of the internal structures that will develop later into the tarsus, the femur and tibia remaining intact. Birchall notes (*Ent. Mo. Mag.*, xiii., p. 232) that a larva of *S. fagi* that he observed had "lost the whole of one of the second pair of legs except the coxa, also nearly the whole of the caudal horn on the same side . . . at none of the three subsequent changes of skin which took place was there any renewal of the missing members, or increase in the length of the stumps." Experiments of ablation cannot be considered conclusive on account of the regeneration of parts. To us it appears certain that the correct explanation is—that the imaginal leg buds out of the larval one, and finds a lodgment for some of its elements in the thorax at the base of the leg.

We have already observed that the final larval ecdysis, by which the pupal stage is assumed, differs but little in its essence from the preceding ecdyses, in fact, the phenomena attending post-embryonic metamorphosis may be really considered as an extension of embryonic life, the change in the external appearance being really but the outward manifestations of vital histogenetic changes within, but whilst the histogenetic changes are gradual, the external changes in form are more or less abrupt. Uusually, however, the larva adopts some special means for its protection during this period, and spins a cocoon, makes an underground chamber, or suspends itself in a position where its resemblance to its surroundings will aid in its protection, before changing into the pupal form. Nor is the change to a pupa really so sudden as it appears, for the larva, for some days (variable in number) before its actual change, passes through a quiescent period, in which the pupal organs are more or less perfected, and even before the quiescent period is reached, the larva has usually been for some little time restless, and has ceased to take food, whilst its dry hard excrement appears to be almost exclusively formed of fragments of the intestinal epithelium (Packard), and are often stained red by the secretions of the urinary tubes (Gonin). With regard to the fæcal deposits at this period, Chapman notes that when the larva of *Pharetra* (*Arsilonche*) *venosa* is ready to spin up, it voids some damp frass very unlike the dry material of a feeding larva, shrinks very much in bulk, diminishing in length from 45mm. to 33mm., whilst the colours lose all definition and brightness. *P. auricoma* has a somewhat similar habit of shrinking in size and voiding moist frass before spinning. Chapman thinks this is really a somewhat universal habit, though varying much in degree, the large silkworms, *Antheraea yamamai*, *Samia cecropia*, &c., voiding some actual fluid when preparing to spin.

The same observer notes that it appears to be a common occurrence for many Lepidoptera to inflate the intestinal canal with air when about to moult. The larva of *S. cecropia*, just before spinning its cocoon, discharges, with the last contents of the intestinal canal, from 30-50 minims of clear fluid, which soon becomes brown, and various other Bombycids do the same. Nevertheless the larva does not diminish in bulk, the intestinal tube remaining inflated with air. This, he says, is "easily tested by scratching the tubercles of the larva, when a hollow sound results, hardly any sound being produced by so treating a feeding larva." He has further determined by dissection that it is air that is in the intestine.

The larva is much shortened and thickened during the quiescent period preceding pupation, the thoracic segments often appear to be much contracted longitudinally and bulged (due probably in part to the contracting of the thoracic muscles), and if, at different periods during this stage, the larva be hardened in alcohol, and the larval skin taken off, the semipupa, pronymph or propupa (of different authors) will be found in different stages of development. With regard to this change in shape it may be mentioned that the mesothorax of the pupa is much its largest segment, for the development of the great muscles used in flying; the wings and legs attached thereto also occupy considerable space just before pupation. Consequently the thoracic segments are, at this period, much bulged, the larval skin often distended apparently to its utmost limit, whilst the appearance of contraction is due to the tenseness of the incisions and the comparative shortness of the ventral skin. We may further note that, in a larval moult, the skin usually remains fixed to a silken pad, whilst the larva creeps out of it. In the pupal moult there is no such assistance, and this swelling of the thoracic segment is also, no doubt, mechanically useful in the rupturing of the larval skin, without too much vermicular effort, although the swelling itself is probably aided by some slight vermicular efforts during the resting period. Chapman also notes that before the larval skin is moulted in *Sphinx ligustri*, 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 1st spiracle was already brownish, as well as the flanges on the 5th, 6th and 7th abdominal segments.

Newport describes the mode of moulting the final larval skin (of *Aglais urticae*) as follows: "The skin bursts along the dorsal part of the mesothorax, and is extended along the pro- and metathorax, while the coverings of the head separate into three pieces. The insect then exerts itself to the utmost to extend the fissure along the segments of the abdomen, and, in the meantime, pressing its body through the opening, gradually withdraws its antennæ and legs, while the skin, by successive contortions of the abdomen, is slipped backwards, and forced towards the extremity of the body, just as a person would slip off his glove or his stocking. The efforts of the insect to get entirely rid of it are then very great; it twirls itself in every direction in order to burst the skin, and, when it has exerted itself in this manner for some time, twirls itself swiftly, first in one direction, then in the opposite, until at last the skin is broken through and falls to the ground, or is forced to some distance from it. The new pupa then hangs for a few seconds at rest, but its change is not yet complete. The legs and antennæ which, when withdrawn from the old skin, were disposed along the undersurface of the body, are yet separate, and do not adhere together as they do a short time afterwards. The wings are also separate and very small. In a few seconds, the pupa makes several slow, but powerful, respiratory efforts, during which the abdominal segments become more contracted along their undersurface, and the wings are much enlarged and extended along the lateral inferior surface of the body, while a very transparent fluid, which facilitated the slipping off of the skin, is now diffused among the limbs and, when the pupa becomes quiet, dries, and unites the whole into one compact covering."

One of the best detailed descriptions of the final larval ecdysis and assumption of the pupal form that we know is that of Chapman. He says (*Ent. Record*, ix., pp. 218-219) of *Charaxes jasius*: "The pad of silk to which the larva suspends itself is made in a few hours; the actual pad is made by the larva withdrawing its head from the surface, and so making a free loop of silk, longer than is necessary to reach to the point at the surface to which it returns, and the repetition of this process gradually forms the pad. It is always so placed that the larva shall swing clear of all surrounding objects, and the latter is never suspended, as are many Vanessid larvæ, so that the pupa can touch a vertical surface. It has a certain amount of surrounding spinning, usually, apparently, with no other object than as standing room for the larva whilst spinning the pad, but, in one instance, when the suspension was beneath a leaf, certainly tending to prevent the leaf falling off by spinning the petiole to the twig. The larva must fall to the suspended position immediately, as I never saw one with its claspers in position on the pad and still holding by the ventral prolegs, a position held for many hours by most Vanessid larvæ I have noticed. As soon as suspended, the larva curls itself up into a ring, with the mouth to the undersurface of the 8th abdominal segment, and maintains this position for two or three days.

"When the larva is ready to change, the coloured anal appendages are visible through the larval skin. The first actual steps towards the moult are very slight and slow in progress; a certain amount of movement is visible by depression or contraction of segments, somewhat rythmically, and apparently, as all these movements are, vermicular, *i.e.*, passing from segment to segment. During several hours, however, the results are slight, just as the movements have been.

They consist, so far as can be seen, in the development of a few white lines under the first and second, and dorsally on the terminal, abdominal segments, as well as a few in front of the second segment. These indicate places where slight folds have occurred in the effete skin, and probably indicate that the operations of the past few hours have been more important than appears, by making the larval skin everywhere free from the pupal skin beneath, breaking down any remaining cellular attachments, and leaving nothing between the old and new skin but a little fluid. By this time, the head of the larva is bent so as to be opposite the 6th abdominal segment, and not quite touching it, so that only a little straightening has taken place. More active (apparently) movements now occur, strictly vermicular in character, commencing at the anal segment which contracts, and passing forward from segment to segment. After five or ten minutes the larva is L-shaped, *i.e.*, the thoracic segments are now horizontal, and the head far removed from the front of the abdominal segments. It is now obvious that the meso- and metathorax are enlarged, a change that has already progressed during the first stage; the first thoracic is small throughout. Additional slight folds of effete skin occur across the dorsum of the abdominal segments. The third stage, if not of greater activity, at least of very much more rapid progress, is entered upon. The skin of the abdominal dorsum slides backwards, and accumulates at the anal extremity, ventrally, and the suspensory processes of the pupa, which are very large and conspicuous in this species, are easily seen through the delicate skin to hook into a fold of the skin of the last segment, or rather into the fold formed by the incision with the next segment, and the skin of the ventral surface accumulates in front of this. It is also tolerably evident, though the folds of larval skin are now thick enough to rather obscure it, that the cremastral process is thrown backwards at each vermicular movement, acting from the suspensory processes as centres of rotation, so as to push the successive folds of dorsal skin, as formed, between it and the suspensory processes. The succession, or rather concurrence, of events is now very rapid; one notes the white points formed at the spiracles by the dragging out of tracheal linings, quickly extending into a continuous line, and one notes especially such a lining drawn out between the meso- and metathoracic segments, where the imago has, but the larva has not, a spiracle. Suddenly one sees that the larval skin is ruptured down the centre of the thorax, and soon that the head is split in half, with the clypeus in a separate piece, which follows the mouth-parts. Quickly the skin passes towards the tail. The cremaster has pushed all the dorsal skin below it and appears through the dorsal slit, and, at the second push through, it seizes the pad of silk, whilst the movements of the pupa then push the larval skin off the suspensory processes, and, all weight being taken off it, and receiving some upward thrusts, the crochets of the anal prolegs are also loosened from the pad of silk and the skin is free and falls. This pupa, chiefly perhaps from its large size, but also from the colouring of the suspensory processes, renders the part the latter play in the casting of the larval skin very easy to observe. . . . The casting of a tracheal lining from the second thoracic spiracle at pupation, I do not remember to have observed before, but inferred that such occurred, since I had seen it many years ago in numerous larval moultings—*Antheraea yamamai*,

&c., and had also demonstrated the existence of this spiracle in the imagines."

The action of the suspensory processes (in suspended pupæ) at the time of moulting was demonstrated (*Nature*, vol. xvi., pp. 502-503) by Osborne, who also discovered that the final connection between the old larval skin and the pupa of *Aglais urticae*, at the critical moment that the latter has to insert the cremastral hooks into the pad of silk already prepared for it, was "a membrane extending from the lining of the old larval skin to the anterior horns of the two lateral ridges bounding the anal area of the chrysalis." He found this in *Pieris brassicae* and *Euchloë cardamines*, as well as in *Aglais urticae*, and by cutting the girt or loop by which pupating larvæ of the two first-named are supported during this period, he changed many pupating larvæ from *Succincti* into *Suspensi*, and found that a third or fourth of the *Pieris* were able to attach themselves by the cremastral hooks to the silk in the manner of true *Suspensi*. He observed that the method by which this was done, in the thus artificially-suspended Pierids, is essentially the same as in *Aglais urticae* "except that the rapid and assured precision with which the Vanessid chrysalis thrusts up its cremaster and lays hold upon the silk, is replaced, in the Pierids, by long and laborious efforts as if the tail were just a little too short to reach the silk." He further noticed that, in the Anthocarid, not one individual, of which the girt had been previously cut, fell whilst pupating, but that, in all (seven), the pupal cremaster was retained in the pocket of the old larval skin, so that suspension was directly from the latter. Six other larvæ, that had not been interfered with, became *Suspensi* of themselves, attaching themselves exactly as those in which the girt had been cut, *viz.*, by the cremaster being still retained within the exuviæ of the old skin.

Osborne considered that the suspension of *Euchloë* was due to the membrane (described above as being present in *A. urticae*) persisting unbroken, and states that he has "tested its strength to sustain the weight of the chrysalis." He adds that "the final writhings of the insect are not to get rid of the old larval skin, but to rupture this membrane after the chrysalis has made good its tail attachment to the silk." We have observed pupæ of *Pieris rapae*, *Aporia crataegi* and *Gonepteryx rhamni* suspended in a similar manner. Further details as to this membrane and its action are given (*Ent. Mo. Mag.*, xv., pp. 105-106) by Osborne, and he suggests that the membrane is a persistent and specialised portion of the general subcutaneous connective tissue, persistent, in part, for want of a *point d'appui* from which to act upon it before the tail of the chrysalis is fixed, &c. He further notes that, in another experiment on pupating larvæ of *Pieris brassicae*, no less than 200 pupæ succeeded in fixing themselves by the cremaster as *Suspensi*, whilst 150 fell down, having failed to reach the silk with their hooks. This, he considers, was probably due to some difference in the relative length of the cremaster and membrane. Chapman, commenting on this "Osborne membrane," says (*loc. cit.*, p. 136) that "the last abdominal segment consists of two portions (strictly two segments), the segment proper and the anal tubercle, the latter forming the hook-covered tubercle by which suspension takes place, and the segment proper being reduced on its ventral aspect, in the pupa, to a narrow line presenting two distinct, small, rounded tubercles. In the specimens prepared by Dr. Osborne, these tubercles are distinctly hitched into a fold of the larval skin, and must thereby give increased security to the suspension of the pupa. In Dr. Osborne's specimens a triangular ligament is shown by the reflection of the skin backwards, the triangle having its apex at these tubercles, and consisting of the double fold of the skin, the anterior portion being thrown back over the truly suspensory portion." Edwards confirms (*Canadian Entomologist*, vol. ix., pp. 224 *et seq.*) the presence of the "Osborne membrane" in *Polygonia* (*Grapta*) *interrogationis* and *Anosia archippus*, describing it, in the former, as "a narrow, white membrane or ligament, about one-tenth of an inch long, one end of which is pointed and fastened to the inner side of the larval skin near the extremity thereof, and the other forked and fastened to the ends of two curved, slightly raised, longitudinal ridges, which are to be found on the ventral side of the last segment. These ends are at the anterior edge of the segment." He adds that "in *A. archippus* the ligament is much larger and stronger than in *Polygonia*, and is broad, black, and deeply-forked where it is attached to the segment. In this species, instead of low ridges, there are two rows of shiny black processes, three in each row, and the outer pair are knobbed and a little pointed anteriorly. On these outer knobs the ligament is fastened." Edwards further notes that he does "not believe that the chrysalis of *Polygonia* ever seizes the loosened skin *for a support*," the support that such a hold could furnish not being essential, for "the skin can be raised with forceps entirely from the abdominal segments on the ventral side, so as to discover the distended membrane," or the skin "may be cut off just below the membrane at the instant the effort for freeing the tail begins." In these last cases "the chrysalides are seen to be connected with the skin by the membrane only, and the membrane is the only lever by which the chrysalis climbs to the skin. There cannot possibly be any other support." This brief summary Edwards follows up by an excellent detailed description of the mode of pupation in *Polygonia interrogationis* and *Anosia archippus*, much too long, however, even to summarise here. One point, however, raised by Edwards, should be noticed. He says: "The last act of pupation is beyond my comprehension, *viz.*, the rising of the chrysalis with no external aid, save that which comes from the ligament." This is probably effected in two ways, *viz.*, by the flexibility of the terminal segment, and by the growth of the cremaster which occurs at this period.

Later observations on pupating *Aglais urticae* are detailed (*Ent. Mo. Mag.*, xvi., pp. 55-58) by Osborne. He notes the "Osborne ligament" as being formed by the coalescing of the two folds of the transparent inner coat of the larval skin. He says that "this inner coat is elastic, very distensible, and of a semiplastic consistence, and readily runs into the ligamentary form under the influence of tension alone. In *A. urticae* the two crescentic whitish ridges embracing the anal area terminate anteriorly in horns, which project over the segments immediately in front. These horns have, on the inner side, a black knob, terminating a black line which runs along the under inner side of each ridge, and separated from the rest of the horn (the outer whitish knob) by what seems a small groove. It is to these black knobs alone that the ligament is finally attached, and when the tension is great and prolonged the corners of the ligament are pouched out by them into hooks or shallow pockets. But the adhesion of the pupa to the ligament is not a merely mechanical one (as if it were only slung by the insertion of these projecting knobs in the pouches of the ligament), for the old skin, when only held by the ligament, may be drawn towards the head of the chrysalis, and still the adhesion is good. It is a curious circumstance that this adhesion only takes place at pupation, and even towards the end of it, and if the skin is drawn down earlier it will peel off without any attachment to the horns, which will not, perhaps, have been yet fully developed. What the exact nature of this attachment is I am unable to say. The examination of this region in earlier stages seems to yield the result that the black knob is the earlier developed, and to hint at the hypothesis that the subsequent growth of the white knob may include or nip in a portion of the lining coat of the larval skin in such a way that it is afterwards held fast. . . . I have, however, seen the ligament, after being drawn out, at first cover the external white knobs and form a deflexed fold on each side, and, then, suddenly slip off these white knobs with the disappearance of the deflexed folds or their absorption into the main body of the ligament which is still held fast and strained in the grooves between the knobs."

Chapman was the first observer to point out (*Ent. Mo. Mag.*, xv., p. 78) that capillary attraction and atmospheric pressure, acting on the damp surfaces of the inside of the larval skin and the outside of the pupa whilst in contact, must have considerable influence on the adherence exhibited between the two surfaces during the time that the larval skin is being shed. Riley recognises this, in what he calls "the natural adhesiveness of the moist, mucous, and membranous corium," as a factor in the final exuviation of the larval skin and attachment of the pupa, and characterises the other structures involved as: (1) The "tracheal ligament," or the shed tracheæ from the last pair of spiracles. (2) The "rectal ligament," or shed intestinal canal. (3) The "Osborne," or retaining membrane (membrana retinens), which is but a stretched part of the membranous corium that accumulates around the rectum and the anal prolegs, and that is intimately connected with the rectal ligament. These three are essentially connected with the larva and are cast off with its skin. The other structures involved, but connected with the pupa, are: (1) The "cremaster," which is the homologue of the anal plate of the larva, and surmounted at its apex, and sometimes along the ventral ridges, by the "cremastral hook-pad," thickly studded with minute but stout hooks. (2) The "sustainers" (sustentores), two projections which homologise with the soles (plantæ) of the anal prolegs, and which take on various forms, but are always directed forward so as easily to catch hold of the retaining membrane. (3) The "sustentor ridges," usually connected with the sustainers, embracing them on the outside and extending backwards to the inside of the ventral cremastral ridges. These sustentor ridges are homologous with the limb of the anal prolegs, and the exposed edge with the posterior border of the said limb. (4) The "rectal piece," consisting of a piece more or less well-marked, and elevated especially around the closed rectum. Riley asserts that it is principally by the leverage obtained by the hooking of the sustainers in the retaining membrane, which acts as a swinging fulcrum, that the pupa is prevented from falling after the cremaster is withdrawn from the larval skin, and that it is also principally by this same process that it is enabled to reach the silk with the cremastral hook-pad. He adds, however, that "the rectal ligament plays a most important part, and in some species a more important part than the membrane itself." Osborne criticises (*Ent. Mo. Mag.*, xvi., p. 150) Riley's view at length, so far as relates to the influence of the rectal ligament, and, it must be owned, with considerable success. He writes:—"In the chrysalis of *Aglais urticae*, the last three or four abdominal segments are wedge-shaped, the thin ends of the wedges lying together on the venter near the knobs to which the ligament is attached. The terminal or anal surface of the last segment has, lying on it, the ridges which terminate in these knobs and the cremaster (with the hooks), making an obtuse angle with the ridges, and forming, with them, a sort of bent lever (viewed sideways, not unlike the open jaws of a serpent, having on its nose the hooks for attachment to the silk). The extension and contraction of the abdominal segments, then, cause the cremaster to move through the arc of a circle, whose centre is at the point of suspension of the chrysalis from the ligament, which ligament itself is highly elastic. With this mechanism it is not difficult to conceive how the tail of the chrysalis may work its way out of the shrivelled larval skin, stretching the elastic ligament as far as necessary, and then be thrust up around that shrunk-up packet of old skin so as to reach the silk."

Chapman makes (*Ent. Record*, x., pp. 185 *et seq.*) further important notes on the moulting of *Sphinx ligustri*, *Smerinthus ocellatus*, and *Phalera bucephala*. As an example of the pupation of an ordinary underground, cocoon-making larva, that of the last-named species is interesting. The larva pupates at from six to ten days after going down, and when the pupa within has so far freed itself as to occupy only the ten front segments of the larval skin, the latter splits down each side, just above the ventral prolegs, a short slit in each segment, but usually continued over at least two segments; immediately after, the skin splits in the normal dorsal situation, followed by the division of the larval head into the two lateral and clypeal portions, whilst a tracheal tube is drawn out of the meso-metathoracic (as well as the pro-mesothoracic) incision. The first spiracle is so deeply placed between the pro- and mesothorax at the earliest moment that it is uncovered by the receding skin, as to be seen with difficulty. The margins of this spiracle at the surface are not apparently tinted or hardened, the coloured portions of the newly formed pupa, besides minute hair-points, being the anal spines and the dorsal margins of the incision between the 9th and 10th abdominal segments, which have curiously opposed dentated borders, whilst there is also a trace of colour at the sites of the ventral prolegs. The wing- and appendage-cases are very short, and take about twenty minutes to pass from the margin of the 3rd abdominal segment to their permanent position at the margin of the 4th, but it takes some hours for the solid portion of the pupa (head to 4th abdominal segment) to grow from one-third of the total length to three-fifths of that of the mature pupa, and this occurs, not only by its own increase in length, but by the shrinking of the last six abdominal segments, the total length of the pupa being remarkably constant throughout all these changes.

In another specimen of *P. bucephala*, Chapman observed that, three minutes after the vermicular movement of the larva was first noticed, the tracheæ were seen being drawn out of the 7th and 8th abdominal segments. After five minutes, the skin split above the prolegs between the 5th and 6th abdominal segments, but was still unmoved on the 4th abdominal, *i.e.*, the last six segments of the pupa occupied the 5th and 6th abdominal segments of the larva. After eight minutes, the skin split between the 4th and 5th abdominal segments above the prolegs, and, after ten minutes, between the 3rd and 4th abdominals, *i.e.*, in the incision, but longitudinal in line above the prolegs. After eleven minutes, it split between the 2nd and 3rd abdominals, the skin on the 2nd, at this time, hardly moved down at all, the 6th abdominal segment (larval) having reached the end of the pupa. After thirteen minutes a split was observed between the 1st and 2nd abdominals. After sixteen minutes, the trachea was drawn from the 1st abdominal spiracle, whilst the skin of the 4th abdominal segment (larva) reached the end of the pupa; the skin split dorsally down the three thoracic segments, whilst the lateral split continued through the metathorax and first three abdominal segments, the head also splitting, and a small lateral slit appeared on the meso- and metathorax. After twenty minutes, the position of the first spiracle was exposed, but it was already deeply buried between the segments and hidden; the lining of the alimentary canal was drawn out between the maxillæ. After 24 minutes, the larval head had reached the wing extremities, the antennæ clear of the head although the ends still stood up free, the times of the opening and closing of the spiracular valves about equal. After 29 minutes the pupa freed itself from the larval skin, some fluid was visible on the last uncovered segments, whilst the spiracles were closing rapidly (those on the 2nd, 6th, and 7th abdominals already closed). After 32 minutes the wings extended so as to reach the end of the 3rd abdominal segment, the movement of the fourth spiracle barely visible. The maxillæ presented both a downward extension (proboscis) and a lateral one, the latter having two lines across it, as though representing two joints of the maxillary palpus.

Chapman notes that as soon as the larval skin of *Charaxes jasius* has been cast, the pupa is still of considerable length and comparatively narrow, and the wings and appendages are short, only reaching to the middle of the 3rd abdominal segment, whilst all the abdominal segments are rounded with deep incisions. Vermicular movement continues, with the result of gradually bringing the pupa into its short squat form with very dwindled terminal segments. During this process the wings and appendages nearly double in length, and the vermicular movements seem to cause this result by a process of forcing the fluids from the diminishing to the increasing parts. During this stage Chapman first noticed certain remarkable phenomena connected with the spiracles (abdominal), which, at the commencement of this period, are "wide oval depressions, with apparently the spiracle proper of a brownish colour at the bottom. During the process of hardening they become narrower, till they are, in the mature pupa, very narrow lines, with questionably any actual lumen." Within a minute or two of the skin being cast, Chapman noticed a movement that, he says, could not be better described than by saying that these spiracles "winked" at him. The brown-coloured portion was now at the bottom of the oval slit, not much wider at the surface than below, but just within the outer opening there descended from above, and hid the brown base, a pale green diaphragm, exactly like an eyelid, and then rose again. It occurred once every three seconds, the opening being now the shortest part of the sequence, and lasting half a second. This continued till the spiracular openings became too narrow to see the movements distinctly. As the observation was made on the naturally suspended pupa, the descent of the diaphragm was from the posterior margin of the spiracle, the final narrow slit being parallel with the lines of incision, or nearly so. Chapman thinks that these were valvular arrangements, associated with the pumping process necessary to the expansion of the appendages. At the same time, he suggests that the movements might be merely a development occurring for the occlusion, more or less complete, of the spiracles during the pupal state. Further observations were made by him as to the details of this striking phenomenon on other newly-formed pupæ—*Sphinx ligustri*, *Phalera bucephala*, &c., and published *Ent. Record*, &c., x., pp. 185 *et seq.* In *Sphinx ligustri*, the abdominal spiracles were at first widely open, and the winking movement of a membranous fold from the posterior wall of the trachea a short distance within was easily seen. There are no dark chitinous parts in connection with these valves in this species. The movements continued as long as observation could be made, although the period of closure became longer and longer. The movements of the valves were synchronous with the vermicular movements, but not with the pulsations of the dorsal vessel. During actual moulting the valves were quite closed. In *Phalera bucephala*, the abdominal spiracles (on segments 2-7) are wide oval openings immediately on moulting, and it is easy to look into the spiracular trachea as far as it joins the longitudinal trunk and gives off a bunch of branches. At a depth from the outer opening, equal to about its widest diameter, is a narrowing or second opening, marked by a narrow semilunar brown chitinous piece running across the anterior surface of the tube, with its free end just standing out into the lumen of the tube. Opposite this, posteriorly, one sees nothing at first, but, at intervals, a thin fold from the posterior surface passes forwards and meets this chitinous margin, closing the tube. At first the closing lasts only a second, and it remains open for five or six seconds, but gradually the intervals become more equal, and before the observation ceases the period of closure is rather the longer. The observation ceases because, in about ten minutes, the anterior and posterior lips of the external opening, or spiracle proper, become by gradual approximation, very close together, so close that, knowing what is going on, one can still see that it is continuing, but still so little, that, without that knowledge, little or nothing could be made of it, and, in from fifteen to twenty minutes, even this amount of view is shut out, and the outer spiracle is quite closed. In another 24 hours or so, this sinks into the bottom of a depression, such that, except in a very good light, one cannot see it at all, and might fancy the spiracle was simply a wide patent opening.

We have already shown, in our account of the moulting of *Phalera bucephala*, that it takes a considerable time for the various pupal organs and structures to assume their proper proportions after having got rid of the larval exuviæ. Chapman has worked out, in considerable detail, the differences existing between the proportion of the various parts in newly-formed and matured pupæ, *e.g.*, a pupa of *Sphinx ligustri* measured, immediately on moulting, 1·87in. in length, made up of (1) ·63in. from anterior extremity to end of wings. (2) 1·24in. to posterior extremity. After two hours the relative lengths had become (1) 1·1in. and (2) ·78in., so that the changes represented (1) ·63 : 1·1 and (2) 1·24 : ·78. The alteration in the proportion of parts that occurs within 40 minutes of the moult of *P. bucephala* is certainly remarkable. The length of the pupa in sixteenths of an inch is, immediately the moult has taken place, 17. Dividing the length into three parts: (1) From anterior extremity to end of wings. (2) Thence to hind margin of 6th abdominal segment. (3) Thence to anal extremity, the comparative measurements at intervals of ten minutes were:—

1.—At moult .. .. 7 : 6 : 4 | 3.—After 20 minutes 8 : 5 : 4
2.—After 10 minutes $7\frac{1}{2}$: $5\frac{1}{2}$: 4 | 4.—After 30 minutes $8\frac{1}{2}$: $4\frac{1}{2}$: 4
5.—After 40 minutes .. .. 9 : 4 : 4

This is caused partly by the growth of the wings and appendages, till they reach the hind margin of abdominal segment four, and partly by shrinkage of segments five and six. Chapman considers that this is due to a great extent to fluid presssure from the contracting portions of the insect, produced probably by muscular action, combined with the ingestion of air. As bearing on this point, he further suggests that the activity of the valves of the spiracles has something to do with the regulation of fluid pressure in connection with the redistribution of plasma and expansion of appendages, then so actively taking place.

Not only is the proportion of parts altered in the early stage of pupal existence, but their shape is considerably modified. Thus Chapman notes the newly-formed pupa of *Sphinx ligustri* as having the segments all very marked and rounded, with deep incisions, the terminal full and blunt, not tapering as in the adult pupa, the 5th and 6th abdominal segments being especially large and globular. The head stands out and somewhat apart, as it does permanently in many Tineid pupæ. The proboscis-case forms a square projection ·1 inch in length and width, but bent down somewhat already, markedly bifid, and the two lateral halves easily separated. This case assumed its permanent shape and length of nearly ·28 inches in about an hour." Edwards notes (*Canadian Entomologist*, ix., p. 229) that, when the larval skin of *Polygonia interrogationis* is first thrown off, the chrysalis hangs limp and distended like a long cone, with no prominences except the mesonotum. Presently, he says, the segments "shorten and become broader, the ends of the wing-cases creep nearer the tail, the tuberculated points on the abdomen swell out, the head-case pushes up, with its palpi-cases, and, in the course of half-an-hour, the final and characteristic shape is assumed. The change, in these respects, is nothing like so striking in *Polygonia* as in *Limenitis*, where the chrysalis is greatly hunched and displays a prodigious mesonotum. In this case, also, the chrysalis is at first limp and shapeless, but reaches its proper form in the same way, the segments contracting and the processes growing and maturing as one looks at them." Osborne notes that, at the moment of exclusion, the anterior horn of the chrysalis of *Euchloë cardamines* is a minute (ventrally), incurved process, and it may almost be seen growing till in an hour or two it has attained the completed size when it is equal in length to the posterior horn.

Many incidental phenomena connected with the pupal moult have been observed. One of the most curious was described (*Trans. Ent. Soc. Lond.*, 1887, p. 302) by Poulton and further elaborated (*Ent. Record*, x., p. 116) by Chapman. It consists of the development of black pigment over the wing areas in the larva of *Scoliopteryx libatrix* as soon as it commences to spin its cocoon and some time before it actually moults. These two black patches are very conspicuous on the green larva, the colour being entirely in the superficial layer of the larval skin and moulted with the latter. The pupa itself is sooty-black and this blackness is due to the presence of a special pigment, and it would appear that this larval pigment is similar to that of the pupa, and is connected with it in some way. Chapman points out that the material for this pigment is present in the superficial layer of the chitinous covering of the pupa at moulting, whilst it is still green and soft, and that the pigment is formed from it by some chemical change on exposure to air and light, probably by oxidation. This material, he considers, is probably formed from some constituents of the epidermic cells that break down to liberate the effete superficial layer from the dermis beneath, most of which is probably at once absorbed by the new layer of epidermal cells forming on the surface of the dermis. He then explains the formation of the black larval wing-patches as follows:—"During the larval life the wing lies in an invaginated pocket of the dermis, but at the date of the change to pupa it does not do so, but lies immediately beneath the effete skin that is about to be thrown off, and, therefore, one of the changes that occur at the end of larval life, is the disappearance of the double fold of dermis, between the epidermis and the wing. When the outer layer of this frees itself from the epidermis, it no doubt does so by the same process as that which develops pigmentary material elsewhere, but here the dermis below has itself also to disappear, so that this material is not at once appropriated by the proper new cells beneath, and there is a certain excess of it, so to speak, free. This then permeates the effete cuticle, reaches the surface, and undergoes the oxidation, or other process, that converts it into pigment. There is no other portion of the larva where pigmentary material might thus be set free, but, in this situation, it is difficult to see how it could be avoided without a different physiological process having been evolved for this little area. If we knew the precise time at which the wing became disencapsuled, we could better judge as to the probability of this being the correct hypothesis. It would also throw light on the subject to know if other instances of the same coloration of the larva were confined to cases in which the pupa has pigmental colouring, and that it does not occur where the ordinary chitinous brown only is the pupal colouring." One would be interested to learn whether the blackness of the "Osborne membrane" of *Anosia archippus*, mentioned by Edwards (*Canadian Entomologist*, ix., p. 231), has been developed in a similar manner.

It sometimes happens before the last larval skin is exuviated that one can see, through the transparent skin of certain larvæ, some portions of the pupa which have already assumed a brown chitinous colour, and, in many pupæ, immediately after the moult, there are portions already brownish, whilst the greater part of the pupa is green and soft. Chapman writes (*Ent. Record*, x., pp. 117-118) of this as follows: "In *Scoliopteryx libatrix*, before the moult, a slight ruddy tint is observable over the prothorax, and a pink spot appears on the mesothorax, just behind the first spiracle. During, and just after, the moult, the colouring of the prothorax is seen to affect precisely that part of it that is exposed in the pupa, whilst a slight tinting exists over both the meso- and metathorax. The pink spot is seen to be the posterior lip of the thoracic spiracle, as usually seen and described in the pupa. In the pupa of *Phalera bucephala*, the portions coloured at the moult are only the anal spines, and the adjacent margins of the last two abdominal segments, where they are sculptured. In *Sphinx ligustri*, the mesothoracic margin, at first spiracle, is already coloured brownish at the moult, as well also as the flanges along the sides of the 5th, 6th, and 7th abdominal segments. It seems to be very usual for the posterior margins of the first spiracle to be already slightly matured. In *S. ocellatus*, the lips of the prothoracic spiracle, the posterior margin of the 7th abdominal segment, the pale bands on the dorsum of the metathorax, and the 2nd and 3rd abdominal segments, as well as many of the small cutaneous pits, become brownish at the time the larval skin is moulted. I think, in these, and in other, instances, two points appear, the first is that no portion of the pupa can be allowed to harden and colour before the moult, that has to undergo any expansion or contraction during the alteration in form that occurs just after the moult. The second is the special case of the thoracic spiracle. What we call the thoracic spiracle in the pupa, is not the spiracle itself, which has the same structure, or nearly so, as the other spiracles, and is buried deeply in the fold between the pro- and mesothorax, and communicates with the surface by a narrow slit, but is the opening on the surface and is between the two segments close to the antenna. The margin of one or of both segments, here, is very often, indeed usually, specially wrinkled, striated, or otherwise characteristically and beautifully elaborated. It is very important, therefore, that these margins should, on the moult to pupa, fall exactly into their right places, and as this would often be apt to fail, if they were as soft as the rest of the pupa, we can understand why they are so usually (? always) coloured and hardened to some degree before the moult takes place." By having already some hardened chitin for the margin and lips of the tube, the due opposition of the surfaces is assured. As bearing on Chapman's view as to the parts which thus appear to become prematurely coloured (hard and chitinous), being already matured and potentially functional, we may note an observation made by Edwards as to the rapid formation and hardening of the knobs to which the "Osborne membrane" is adherent, in certain Nymphalid pupæ in process of formation, at the critical point of fastening the cremastral hooks into the silken pad. This reads: "It is useless, I think, to search for this membrane until the latter end of the suspending period of *Anosia archippus*. One thing is certain, it is not till late in that stage that these knobs do show themselves, but they are then soft and white, becoming hard (chitinous) just when they are needed."

Owing to the exceedingly different habits and surroundings of the quiescent pupa compared with those of the mandibulate larva, great changes occur when the pupal state is assumed. In many lepidopterous pupæ the mandibles are entirely wanting, whilst the 1st maxillæ are highly developed and specialised, the head is entirely modified in shape, the antennæ and legs, rudimentary in the larva, are well developed, whilst the wings become external organs, and conspicuous on each side of the mesothorax; the simple ocelli of the larva are replaced by the large compound eye, whilst the prolegs disappear from the abdominal segments and the genital organs become externally visible; the pupal cremaster is developed from the suranal plate of the larva, and so on. However great the external changes may be, those of the internal organs are equally modified, and these changes are usually more particularly evident in the digestive and nervous systems. The pupal form is, in these particulars, much nearer to the imago than to the larva, and the pupal digestive organs are much more nearly approximated to the imaginal, although the "reservoir" of the imago is not indicated in the pupa. The head, genital organs, and urinary vessels are nearly the same. The imaginal discs of the wings and legs are to be seen when the larva is in the quiescent stage, whilst Gonin finds in *Pieris* that the ventral discs of the three thoracic segments are each represented by several distinct folds attached to the femoro-tibial bud and to the tarsal joints. The imaginal discs may serve, in the case of the Lepidoptera, either for the formation of new organs or for the growth and transformation of organs already existing. The imaginal discs of the wings do not participate in the larval moults, and their surface only forms a cuticle towards the end of the last larval stage and becomes pronounced with the assumption of the pupal form. At this stage, the network of fine tracheæ of the wing-bud is drawn out with the internal cuticle of the large tracheæ (the permanent tracheæ appear at the time of the third larval moult as large rectilinear trunks, but are not filled with air until the time of pupation). There are from eight to ten of these tracheæ in each wing, and they give rise in the pupa to a new system of fine tracheæ (tracheoles) which replaces that of the larva (Gonin).

The development of the pupal legs, antennæ, wings, maxillæ, maxillary and labial palpi, takes place principally during the final larval stage, and their growth becomes especially rapid in the quiescent period preceding pupation. The pupal organs are, more or less, however, only one stage of the series that leads to the final development of the imaginal structures, and hence, although external organs, their development is continuous within the pupal shell, and they may thus be best considered when dealing with the internal structure of the lepidopterous pupa.

Gonin has set himself to explain why the antennæ, maxillæ, legs, and wings occupy the position they do in the lepidopterous pupa. He states that "when pupation is normal, the integument splits open on the back of the thorax and the larval skin is drawn from before backwards, and that, owing to the feeble adherence which the chitinous secretion gives it, it draws along with it the underlying organs. The legs, antennæ, and two halves of the maxillæ, retained by their ends in a small chitinous case, can only disengage themselves from it when, in elongating, they have acquired a sufficient tension. The curves are thus straightened out and the folds unbend. The chitinous mask of the head, in withdrawing with the larval skin, follows the ventral line; the tongue and labial palpi free themselves from its median part; the antennæ disengage themselves from the two lateral scales. Between these different appendages a space is left on the surface of the head for the eyes and on the thorax for the legs. These are not completely extended on account of the lack of freedom of the femora-tibial articulation; the femur preserves its direction from behind forwards; and the knee, in the first two pairs, remains at the same height. The wings overlie then and cover the underside of the two basal abdominal segments. Their surfaces, in becoming united, increase much in size." Gonin further states that the positions which the organs assume are determined in advance, and that the structure of the hypodermis is specially modified in all the parts which remain external. He also notes that if, during transformation, the chitinous mask (larval head) be separated from the integument beneath, the antennæ and tongue will not be fully extended. The position taken up by the organs is due to the fact that, as the larval skin moves back, it preserves sufficient adherence to the organs beneath to draw them after it in the direction of the abdomen.

Chapman observes that at the larval-pupal moult, the head of the larva of *Sphinx ligustri* splits, and remains attached to the skin by its labial margin. The effete larval head is packed tightly with the new pupal mouth-parts and antennæ (chiefly the latter), coiled and folded up. At the moult, as the head slides down the venter, it pays out the antennæ, maxillæ, &c., and seems to deposit them in their places, just as the skin of the legs seems to place the legs in position. This, however, is only a true picture to some extent, and there is something vastly stronger in the appendages reaching their true position than a mere submission to being laid down in this way, and, in investigating mouth-parts, &c., and separating them to learn their true connections in freshly moulted pupæ, one finds that they go back to their places rapidly. Dropping the pupa into weak spirit will often prevent the appendages falling into their right places, as it distorts them and prevents the chitinous fluid hardening rapidly. Each appendage (leg, wing, antenna, &c.) then appears as a mere watery bag, and looks as if it would take any form at will. The contents are very fluid, and, on puncture, flow out and leave the part (or the whole pupa) flaccid, but it has an envelope of definite form, which it persistently takes when undisturbed and distended by its fluid contents, and this form is such as to place each appendage exactly in its correct position.

The not infrequent instance of an imago with a larval head, may be due to the head at the pupal moult retaining its larval habit of not breaking up as it should do at this moult, and so maintaining its place, packed with the antennæ, &c. Should it succeed in emerging as an imago the larval head will remain. This, however, often prevents the emergence of the imago altogether. The first note on the presence of a larval head on an imago is said to be that by Müller, in *Der Naturforscher*, for 1781. In the *Ent. Mo. Mag.*, vii., p. 227, are records of such examples of *Pyrameis atalanta*, *Nymphalis populi*, *Gastropacha quercifolia*, and *Bombyx mori*. We have already recorded (vol. i., p. 428) instances of Anthrocerid imagines retaining the larval head, and Poujade records (*Bull. Soc. Ent. France*, 5 ser., ii., p. lxxxiii) a pupa of *Pieris rapae* with the head-parts covered by the head-case of the larva.

Lovett succeeded (*Ent.*, xiv., p. 176), by placing a pupa of *Arctia caia* in alcohol, just before it had freed itself from the larval epidermis, in observing that the pupa at this stage has the head, eyes, antennæ, legs and wings perfectly free, and the anal orifice quite conspicuous.

The limbs had a fleshy, structureless appearance. The wings exhibited numerous vessels ramifying over the whole surface.

Further details of metamorphosis are necessarily included in the consideration of the external morphology and internal structure of the lepidopterous pupa in the succeeding chapters. We may now briefly summarise the chief general principles that appear to us to be connected with the nature and use of metamorphosis in insects.

1. The Synaptera or apterous insects have no metamorphosis, the winged insects only undergoing the changes already described. This would suggest that metamorphosis *per se* was not inherited from the primitive ancestor of all insects.

2. The earliest and most primitive orders of insects pass through a slight metamorphosis only, but, as the adults of certain orders became more specially adapted to get their food whilst in the air and in a manner totally different from that by which they obtained it during their larval existence, the metamorphosis became more complete.

3. The advantage accruing from metamorphosis in such orders as Lepidoptera, Hymenoptera, Diptera, and Coleoptera is evident from the vast number of species that have been developed and are now in existence.

4. The fossil remains of insects suggest that in the Palæozoic period, ametabolous and heterometabolous insects alone were in existence. The holometabolous insects are much newer, and are much richer in the number of species than the older forms.

5. The great abundance of species in these orders shows that metamorphosis is a great advantage to insects in the struggle for existence. The period of exuviation is, in all Arthropods, a very critical one, and they are at that time more than usually helpless before the attacks of their enemies. The holometabolous insects, by their power of storing up surplus food (fat-body) in the larval stage, which they can use at leisure for their further development in the pupal stage, by their power of hiding within cocoons, &c., and by their being without the necessity of seeking food during this critical period, are able to undergo the necessary changes in their organisation, with a minimum of exposure and risk.

Briefly then, we may consider metamorphosis to be an adaptive habit which certain insects have adopted in their struggle for existence against those enemies by which they are everywhere surrounded, and against those animals that compete against them for food. The habit of flying, by which they are able to escape from numberless enemies that have not this power, was probably one of the first factors that led to their ultimate success. The additional ability to store up food in the early active (larval) stages of their existence, so as to allow them to adopt a hiding habit and quiescent external form at the most critical period of life, must, however, have been the proximate cause of that success which has culminated in their being numerically the most successful types of terrestrial life in existence, the number of species being almost incredible.

CHAPTER II.

INCIDENTAL PHENOMENA RELATING TO METAMORPHOSIS IN LEPIDOPTERA.

A large number of interesting details, though bearing on the phenomena of metamorphosis, are so far unconnected with the main subject as to be better dealt with, perhaps, in a short separate chapter. The following paragraphs, therefore, are on points that have occurred to us whilst writing the preceding chapter, or that have been suggested by notes made whilst preparing the subject-matter of the following chapters.

Bearing closely on the matter of imaginal development is the subject of pupæ passing more than the normal time in the pupal stage. There is but little doubt that, in our latitude, pupæ do not normally pass more than one winter in this state. We may classify pupæ that do go over the winter as: (1) Those that mature in the autumn, the fully-developed imago really hybernating within the pupal shell, *e.g.*, the Tæniocampids, *Panolis piniperda* and *Valeria oleagina*. (2) Those that undergo apparently but little development until shortly before the time for the emergence of the imago, then mature rapidly, the imagines emerging without further delay. We doubt much whether any of the first section go over the winter a second year, but our knowledge of the condition in which many pupæ go over the winter is *nil*. One of the most persistent of all pupæ for over-wintering for a number of years is *Eriogaster lanestris*, which has records for seven years (Speyer), five years (Tutt), &c., and then emerging successfully, whilst other pupæ belonging to the same batches have emerged at the end of one, two, or three years, and so on. Of the Acronyctids, Chapman says that *Cuspidia megacephala* is the most accomplished of all the species in passing more than one winter as a pupa, though it is run rather closely by *Acronicta leporina*. More than half a brood usually goes over to the second year, and, in 1891, of three pupæ left of larvæ of 1887, two emerged quite satisfactorily, ordinary, full-sized specimens, whilst the third, alive and well, passed the fifth winter as a pupa. Of *Eupithecia togata* which pupated in 1888, most emerged in 1889, but several in April, 1890; *Saturnia pavonia* from Rannoch, *Eupithecia venosata*, *Emmelesia albulata*, and *Heydenia auromaculata* from Shetland, pupæ received in 1888, chiefly emerged in 1890 (Tutt), *Petasia nubeculosa*, three, four, and five winters (Chapman), *Sphinx ligustri*, pupated 1887, emerged 1889 (Baxter), *Asphalia ridens*, pupated 1888, emerged 1890 (Hodges), *Smerinthus tiliae*, pupated 1887, emerged 1889, *Notodonta dromedarius*, *Lophopteryx camelina*, *Eupithecia pygmaeata*, *E. linariata*, pupated 1888, emerged 1890 (Fenn), *Cucullia verbasci*, two years (Bayne), *Notodonta trepida*, two years (Kimber), *Triaena tridens*, two years (King), *Phalera bucephala*, two years (Daws), *Papilio machaon*, two years (Mitchell), *Nyssia zonaria*, two years (Rowland-Brown). The record of *Catocala nupta* pupating in October, 1893, and emerging in August, 1894 (*Ent. Record*, vi., p. 33) is very peculiar. Morris notes (*Can. Entom.*, viii., p. 198) the emergence of *Samia cynthia* after three years as pupa. Edwards also notes (*loc. cit.*, xxiv., p. 52) pupæ of *Anthocharis sara*, *A. cethura*, *A. genutia*, *A. ausonoides*, *Papilio rutulus*, and *P. daunus*, as passing two years in the pupal stage before the emergence of the imago. Mera notes that of a batch of *Dianthoecia capsincola* (eggs laid in May, 1887), about one-half emerged in the August of the same year, the remainder not appearing until the following May. Carpenter notes that of a large number of *Cymatophora ridens* that pupated in 1888, most emerged in 1889, none in 1890, but one in April, 1891. Adkin writes (*Ent. Record*, ii., p. 90) that in 1884 he fed up larvæ from 25 ova of *Endromis versicolor*, which pupated in due course, the imagines appearing as follows: April 19th, 1885, one male; April 20th-25th, 1885, 8 ♀; April 3rd-20th, 1886, 12 males only. Another lot fed up in 1888 produced—March 30th, 1889, one male; April 4th, 1889, one male; March 22nd-April 4th, 1890, five females; and April 16th, 1890, one male. Fenn notes an occasion on which *E. versicolor* passed five years in the pupal stage. *Saturnia pavonia*, in the Orkney Isles, pupated in July, 1866, four imagines emerged between May 23rd-June 16th, 1867, all females, whilst three appeared in April, 1868, all males (Trail). Hellins states that more than half the pupæ of *Eupithecia expallidata* that one gets pass two years in the pupal state. Fletcher notes the appearance of six moths of *Endopisa nigricana* from a large batch (larvæ collected end of July, 1872) on August 19th-22nd, although kept in a fireless room, most, however, emerged during June and July, 1873, although one did not emerge until June 1st, 1874, all being kept under the same conditions. From *Emmelesia unifasciata* larvæ collected in 1871, imagines emerged in 1872, 1873, and 1874 (Jones). Pupæ of *Cerura vinula* formed in 1862 produced imagines in June, 1864 (Horn). *Cucullia scrophulariae* larvæ collected 1894, several imagines emerged March, 1895, two or three in 1896, none in 1897 or 1898, seven between April 29th-May 8th, 1899, having been in the pupal stage five years (Tutt).

There must be several elements that result in the causation of the retarded emergence of the lepidopterous imago, or, perhaps, it would be generally more correct to say, of the retarded development of the lepidopterous imago. Some species, especially those that are strictly northern, *e.g.*, *Petasia nubeculosa*, appear normally to extend the pupal stage, apparently without injury, over a period of three, four, or five winters, and then to emerge satisfactorily. Other species widely distributed over our Islands—*Eupithecia venosata*, *E. togata*, *Emmelesia albulata*, *Endromis versicolor*, *Saturnia pavonia*, &c., occasionally pass a second winter as pupæ even when derived from a southern source, but do so frequently even when northern pupæ are brought south, in fact, such pupæ are more prone to delay their development when brought south, than when reared in their own latitude under normal conditions. In such instances as these, the delay appears to arise rather from an excess than a defect of temperature and Chapman notes that "this appeared to be especially demonstrated" when, some years ago, he attempted to force the pupæ of several species early in the winter. Not one of the pupæ, he says, "would be forced, they resisted the high temperature in the winter, throughout the spring, when their proper season for emergence arrived, and went over the next summer and winter. These pupæ included some *Dianthoeciae*, which are rather prone to taking a second winter, some Geometrids, and some *Cucullia verbasci*, which does not often take a second winter. It is as though these pupæ felt that the proper season for emergence had arrived or past, before they had made a move, and they must therefore wait till next season." There can be no doubt that many pupæ require a minimum time to more or less perfect certain organs before the rapid histogenesis resulting in the final imaginal development is possible, and that this final histogenesis is impossible until a certain condition of the tissues (or of the histolytic products) has been reached, and that this can only be reached under certain external conditions of environment of which a high temperature may not be one. Having reached this stage a gentle forcing, judiciously increased after a time, generally produces successful results. Thus many Sphingid pupæ that will rarely respond to a forcing treatment when applied in the very early stages of the pupa, will generally mature rapidly under the same treatment if applied some two or three months afterwards.

There must be, however, a great deal in the individual constitution, for, of pupæ from the same batch of ova, identically treated throughout their whole existence, some will come out at the normal time whilst others will last on as pupæ for another year, and then, will only emerge at the proper season for the insect to take on the imaginal form, thus Baxter notes "fourteen *Sphinx ligustri* pupated in 1887, eight emerged in June, 1888, and six in June, 1889; all fourteen were subjected during the first year to the same conditions of heat, dampness, &c." We ourselves note a long series of *Emmelesia albulata* that emerged in April, 1890, a large number of specimens having emerged in April, 1889, from the same lot of pupæ received from Shetland in the autumn of 1888. Bayne notes that, of a brood of *Cucullia verbasci* that pupated in 1888, part emerged at the usual time in 1889, the remainder on May 3rd, 1890. Miss Kimber records the pupation of nineteen *Notodonta trepida* in 1888, in January, 1889, they were put in a forcing-house (in one of the hottest parts of a hothouse), some came out in May 1889, the other pupæ went over, the heat in summer was intense, but in March and April, 1890, five fine imagines emerged.

Even, in a state of nature, the influence of temperature on overwintering pupæ is apparently very variable and uncertain. In 1893, we had a remarkably hot and early spring and summer with the result that Lepidoptera that hybernated normally in the egg stage had hatched, and those that hybernated in the larval stage had pupated, whilst imagines from both appeared, long before their usual time, many getting in an abnormal second brood in August and September. Of overwintering butterfly pupæ the temperature appears to have affected some, whilst others (of the same species) were quite unaffected. Thus in early June, 1893, we note the possession of living winter pupæ of *Pieris brassicae* and *P. rapae*, and also pupæ from eggs laid in April; at the same time we had overwintering pupæ of *Euchloë cardamines*, and eggs, larvæ, and pupæ of the year, &c. It is difficult to find an explanation of this varying effect on different pupæ of the same species.

There are species that are almost regularly double-brooded in this country, and the fact that double-broods are more particularly noticeable in hot summers, such as 1893, makes it certain that temperature is an important factor in their development, but the fact that partial double broods are common almost every year, *i.e.*, that from a single batch of eggs laid in spring or early summer, a part of the larvæ will feed up rapidly and emerge in late summer or autumn, and produce eggs, larvæ, or pupæ to over-winter in due course, whilst the remainder linger on as over-wintering larvæ or pupæ (according to the species) although treated exactly similarly, suggests that there is some hereditary difference in the individuals themselves, as, indeed, has already been shown in *Arctia caia* (*ante*, p. 16). Of species, the bulk of which are single-brooded, but which produce a partial double-brood on occasion, a very fair share of our lepidopterous fauna might be enumerated—*Papilio machaon*, *Leucophasia sinapis* (always double-brooded in south Europe), *Brenthis euphrosyne*, *B. selene*, *Dryas paphia*, *Nisoniades tages*, &c., will at once occur to every lepidopterist. *Clos-*

tera anachoreta and *Notolophus gonostigma* will produce partial third broods occasionally, as also will *Spilosoma fuliginosa* (Bazett), *Tephrosia bistortata* (Riding), *Acidalia subsericeata* (Prout), &c. Partial double-broods are recorded frequently in *Smerinthus populi*, *S. ocellatus*, one or two examples only in a large brood, *Stauropus fagi*, pretty general (Holland), *Choerocampa elpenor*, rarely (Matthews), *Euthemonia russula*, fairly large part of broods (Hutchinson and others), *Nemeophila plantaginis* (Newnham and Cowie), *Clostera pigra* (*reclusa*) (Bowles), *Plusia chrysitis* (Burrows), *P. festucae* (Cross), *Dipterygia scabriuscula* (Burrows), *Metrocampa margaritaria* (Tutt), *Acidalia inornata*, *Ligdia adustata* (Burrows), *Pericallia syringaria* (Robertson), *Tephrosia crepuscularia* (*biundularia*), very rare (Bacot), and numberless other species.

This brings us to a very peculiar fact, *viz.*, the tendency that hybridity has to unsettle the regular habits, as it were, of the parent species as to time of emergence, and the production of continuously brooded progeny. This has been repeatedly observed with regard to the hybrids of *Smerinthus populi* × *ocellatus*, most of which appear to emerge in the autumn, *Tephrosia crepuscularia* × *bistortata* (*vide*, *Trans. Ent. Soc. Lond.*, 1898, p. 39) *Amphidasys strataria* × *betularia*, bred by Chapman, and emerged in late autumn, &c.

Our present knowledge of the changes that occur within the pupa during the progress of the development of the wings leads us to mention a fact that has not yet been very satisfactorily explained, *viz.*, the production of a lepidopterous imago and parasite from the same pupa, the former usually, of course, more or less imperfect. One can only surmise that the larva of the parasite fed on the non-vital tissues of the larva (fat-body, &c.), and pupated before the development of the vital organs of the imago, resting in its quiescent pupal form during the latter period of the host's development. Künckel, however, notes (*Ann. Ent. Soc. France*, 4 ser., vol. iv.) the appearance of *Arctia caia* ♀, which emerged with crippled wings and was accompanied on its emergence by a living larva of a dipterous (at first recorded as "hymenopterous") parasite. Here the larva must have been actively feeding or absorbing during imaginal development. Similarly Robmeau-Desvoidy notices (*Essai sur les Myodaires*, ii., 1830, p. 28) that he has seen *Phyrae* emerge from the imago of *Sphinx ligustri*. Hearder notes (*Ent. Mo. Mag.*, xx., p. 22) that a larva of *Cerura furcula*, when full-fed showed symptoms of internal disease, and that, soon after, the pupa-case of an ichneumon projected through the skin of the larva. The projecting portion of the pupa was crushed, and the lepidopterous larva afterwards made a well-formed cocoon, from which, in due time, an imago emerged. To follow up the subject would occupy much more space than we can afford, and we only mention it as an interesting subject of enquiry from a biological standpoint.

Talbot observes (*Ent.*, vii., pp. 15-16) that, in some pupæ, the imagines emerge by means of the hydraulic pressure obtained through emitting several drops of fluid from the anus into the empty anal space of the pupa, and thus forcing up the imago until it bursts the pupal case. The species observed were *Trochilium bembeciforme* and *Nonagria arundinis*.

Horn notices (*Ent. Mo. Mag.*, i., p. 51) a specimen of *C. vinula* that he extracted from the pupa-case, whose wings remained for two whole days as little lappets about a quarter of an inch in length, the wings then expanding and attaining their full size, the specimen being a specially large and well developed female. Similar observations on other species have been frequently recorded. Chapman notes (*Ent. Mo. Mag.*, xxx., p. 54) that on January 19th, 1894, at 2 a.m., a *Doritis apollina* had emerged on a mantel-shelf in a room with a fire, and at a temperature of 73°F. or 74°F. It searched in vain for some time for a suitable spot on which to rest for wing expansion, so at last he confined it in a muslin bag and took it into another room with a temperature of 51°F. At 9 a.m. it was resting quietly, but with wings absolutely unexpanded. It was then taken back to the warm room, and, in five minutes, the wings were found well advanced in development, and it shortly became a perfectly developed specimen. This is the only case in which lowered temperature is suggested to have been the active factor in the retardation of wing-expansion. Many cases of retarded wing-expansion have been recorded, possibly some may be due to this cause; Chapman states that he has known an imago extracted too early from the pupa to expand its wings two days after. We remember a similar case with *Aglais urticae*.

There are numberless subjects bearing more or less indirectly on the metamorphosis in Lepidoptera that might be discussed, but these must stand over until a later volume.

CHAPTER III.

THE EXTERNAL MORPHOLOGY OF THE LEPIDOPTEROUS PUPA.

The pupal stage is nominally the quiescent state preceding the imaginal stage of insects with complete metamorphosis; really it is, in such, that stage in which the vital processes are most active and most readily impressed by external conditions. It is analogous with, but very different from, the nymph stage of those insects with incomplete metamorphosis, and differs considerably even in those insects that have a pupal stage. In the Trichoptera, the pupa resembles the perfect insect in general form, is at first quiescent, but apparently becomes active before the imaginal ecdysis occurs, although it is the now all but perfect imago within the pupal shell that is really so; in the Ephemerids, the penultimate ecdysis is accompanied by a change of form to the winged condition, the imaginal ecdysis being simply a casting of the skin after the winged state has been assumed, whilst the Odonata also have no pupal stage, these insects, in the stages preceding the imaginal, being known as nymphs. The lepidopterous pupa shows great variation in its structure and capacity for movement, the form with limbs and appendages free from the abdomen and the abdominal segments freely movable on each other, being known as a pupa-libera, that with the appendages, &c., partially free being known as a pupa-incompleta, whilst the pupa in which the appendages are soldered to the abdominal segments and in which movement of the latter is restricted to the incisions between 4-5, 5-6 and 6-7 is known as a pupa-obtecta. The most specialised forms of pupæ such as those of *Leucophasia sinapis*, *Cupido minima*, &c., have no movable abdominal incisions. Some difficulty is experienced in homologising some of the appendages of the obtect pupa in which the cephalic appendages are soldered together. We know of no example of a coarctate pupa among the Lepidoptera. Such are enclosed in the old larval skin which forms a pupal covering, and are particularly well-developed in some Diptera.

The assumption of the pupal stage (as also the appearance of the imago) is the concomitant of an ecdysis, and really commences with the quiescent larval stage that precedes the actual taking on of the pupal form. The pupa can be dissected out of the skin of a mature larva many hours before the occurrence of normal pupation, and under these conditions the limbs are not soldered down by the secretion that afterwards encloses the pupa and fixes the appendages in the pupæ-obtectæ. This fact has led to many authors erroneously describing the wings, legs, &c., as appendages of the imago, and not as pupal structures, a view that has to be corrected before one can arrive at a logical conception of the true nature of the pupal form in holometabolous insects. Chapman points out, with regard to this, that, if an empty case of a pupa-incompleta (*Cossus*, *Sesia*, &c.) be examined, the cover of any appendage is found to be nearly perfect, *e.g.*, the antenna-case is observed to be a tube with an opening on the inner surface close up to the head, through which the antenna has been withdrawn; in a pupa-obtecta it is a plate only, the inner side of the tube may or may not present just a discoverable shred of membrane. Evidently evolution has proceeded further in this direction in the obtect than in the incomplete pupa.

The pupa then must be considered *per se*, not as an extension of the larval state, nor as a mere preliminary to the imaginal, but as an independent stage with organs and functions peculiarly its own. It is evident, therefore, that it is erroneous to speak of the various parts of the pupa, as if they were merely cases for the corresponding parts of the imago, and Poulton observes that the terms ophthalmothecæ, pterothecæ, ceratothecæ, podothecæ, &c., which have been applied to the parts within which the imaginal eyes, wings, antennæ, legs, &c., are developed, tend to obscure the true nature of the pupal organs which are more correctly described as pupal eyes, wings, antennæ, and legs, and it may be here noted that, although the imaginal organs may be formed within the corresponding pupal ones, the form and structure of the latter are different from, and, according to Poulton, are often far more ancestral than, those of the former. They are, he says, "remnants of a time when the last stage of metamorphosis in the ancestors of Lepidoptera was something very different from a butterfly or moth. The old terminology obscured the fact that the pupa has a morphological meaning of its own, and that traces of an exceedingly remote past can be deciphered by the study of its structure." Sharp points out (*Insects*, p. 169) that "although the existence of a pupa is to the eye the most striking difference between insects with perfect and those with imperfect metamorphosis, yet there is reason for supposing that the pupa and the pupal period are really of less importance than at first sight they appear to be. The condition that precedes the appearance of the pupa is really the period of the most important change," &c. Poulton further notes that Weismann's great discovery of the theory of histolysis, by which certain of the tissues break down into nutrient fluids and lowly differentiated units, from which the imago is subsequently built up by histogenesis, a process akin to embryological devolopment, has an important bearing on the subject. He writes: "If we examine a section of a pupal antenna or leg (in Lepidoptera) we shall find that there is no trace of the corresponding imaginal organ, until shortly before the emergence of the imago." It is quite possible that there may never be a corresponding imaginal organ developed within it, but that it is a purely pupal organ, a remnant of a structure once functionally active but now no longer so, *e.g.*, the pupal maxillary palpi of the Sesiids. Poulton then says: "In the numerous species with a long pupal period the formation of imaginal appendages within those of the pupa is deferred until very late and then takes place rapidly in the lapse of a few weeks. This also strengthens the conclusion that such pupal appendages are not mere cases for the parts of the imago, inasmuch as these latter are only contained within them for a very small proportion of the whole pupal period." To both parts of this statement we take objection, for whilst it may be quite true for many pupæ, it is utterly contrary to fact for others. The Tæniocampid pupæ, being formed in July-August, perfect their imagines in September, and the living perfectly-developed imago exists inside the pupa until March or April of the following year. Norman notes that the white stigma on the imaginal forewings of *Panolis piniperda* is distinctly visible through the pupal skin in early October, although the imago will not emerge until the following March-April. So, also, Dadd says that the white stigma of the imaginal forewing of *Valeria oleagina* can be seen through the pupal wing some six months before the emergence of the imago. The latter part, too, is only true to the extent that the imaginal organs, as such, usually exist in the corresponding pupal organs only for a short time before emergence, but certainly the wings are all the time wings and not merely the places where wings are to appear.

We have already (vol. i., p. 22) referred to the fact that Tichomiroff and Graber found eleven abdominal segments in the embryos of *Bombyx mori* and *Gastropacha quercifolia* respectively. Normally, however, the lepidopterous larva has but ten abdominal somites, and in some Geometrid larvæ only nine can be detected. The pupæ of many species show distinctly that the abdomen consists of ten segments, and that the confused mass beyond the 8th abdominal segment of the larva really consists of two segments, much more definite, however, in the larvæ of some families than others. In the pupa, the 9th abdominal segment is generally smaller than, but quite as distinct as, the preceding segments, whilst the 10th segment bears the cremaster (if one be present), analogous with the anal flap of the larva. There is something to be said for Poulton's view that the 10th abdominal segment of the pupa may be really composed of two segments, an upper cremastral-bearing part, and the lower part, but it seems to us that the former is analogous with the anal flap, the latter with the anal prolegs of the larva. We agree with him that the line of separation between the upper and lower parts of the 10th abdominal segment, as exhibited in his *Morphology of the Lepidopterous Pupa*, fig. 7, p. 196, "corresponds to the posterior part of the chink beneath the larval anal flap." He adds that "the constriction which, in certain pupæ, encircles the base of the terminal spine, would then cease to have any morphological significance, and this is also rendered probable by the fact that closely allied pupæ are altogether without it, &c." For the upper (cremastral) portion of the 10th abdominal pupal segment, Poulton has suggested the term "rostral," restricting the term "anal" to the lower portion, the analogue of the anal prolegs.

The head of the lepidopterous pupa consists essentially of the clypeus (or face-piece), the dorsal head-piece (the segment of the head in contact with the front edge of the prothorax), and a separate piece (only existent in some of the most generalised forms) placed between the clypeus and the dorsal head-piece, and which Chapman says is probably "a portion of the anterior head-cover or face-piece." It does not, he says, "divide in the middle line on dehiscence, but remains in one piece; it is probably the dorsal-plate belonging to the antennal section of the head, as distinguished from the face-piece proper which is the anterior plate (or plates) belonging to the mouthparts." The eyes occupy a large portion of the lateral area of the clypeus, the glazed eye being generally conspicuous, and stretching from the base of the antennæ to the base of the first pair of legs. It may be that it is more correct to describe the eye as occupying the whole of the side-pieces of the head, as usually seen, the dorsal head-piece, when present, including the remainder.

The thoracic segments of the lepidopterous pupa are generally well marked, clearly defined, and separated from each other by distinct sutures. The prothorax is attached in front to the head segments, the mesothorax carries the pupal fore-wings, and the metathorax the pupal hind-wings. The prothoracic spiracle is usually buried well in the suture between the prothorax and mesothorax, more or less dorso-laterally. The abdominal segments are usually clearly defined and separate, and the segmental incisions well-marked, movable on each other in the pupa-libera, variable as to the number of movable incisions in the pupa-incompleta and pupa-obtecta, segments 8, 9 and 10, however, being always united into one mass. Chapman notes that the abdominal segments of the pupa of *Eriocrania* are all "free." In the Cochlidids, segments 1-6 are free, *i.e.*, none of them are soldered to the wings and appendages, and they appear to be capable of independent movement on each other. It may be here noted that the abdominal segments 1-2 are so closely applied to the appendages, and that the soldering is so delicate in the pupæ of Nepticulids, Adelids, &c., that it is almost impossible to say whether they are actually free or not. Packard says that in the *Prodoxidae* the abdominal segments 2-9 are free, and armed with enormous dorsal spines. In all lepidopterous pupæ each of the abdominal segments 1-8 bears spiracles; strangely enough the pair on segment 8 are completely aborted and functionless, although their larval homologues are especially well-developed. There are also certain superficial marks on the abdominal segments of some pupæ, which have, so far as is known, no functional value and are, apparently of no morphological value. They are remnants of the larval structures, and constitute depressions in the position of the prolegs, as well as in the positions of the more pronounced larval tubercles, and sometimes, even, occupy the place of the hairs (the latter themselves being also present in many pupæ), and being homologous both in nature and position with those of the larva. Colours, characterising the adult larva and observable in the early pupal stage, Poulton considers may be either "a mere concession to the mechanical condition of the process of pupation, or due to the larval pigment still lingering unchanged in the pupal hypodermic cells." The pupal sexual organs are, in the female, associated with the 8th (anterior openings) and with the 9th or 10th (posterior openings) abdominal segments; in the male, the sexual organs appear to be placed one on each side of the middle ventral line of the 9th abdominal segment.

Lying ventrally along the costal edge of the fore-wings are the pupal antennæ, often distinctly segmented, and, in the Heterocerous pupa, often with two long basal hairs on either side of the head; whilst within these medially are the three pairs of legs (rarely more than two pairs visible), and quite centrally is a double ribbon of varying length, the pupal tongue or maxillæ, originating at the mouth and varying greatly in length in the different superfamilies. The mouth-parts consist theoretically (and actually, although all the parts are rarely to be made out especially in the obtect pupa) of the mandibles, the labrum, the maxillæ and maxillary (1st) palpi, the labium and labial (2nd maxillary) palpi. At the base of the antennæ are the eyes, the glazed lunular portion of which is generally very conspicuous.

The most important of the pupal organs, however, so far as they yield distinct phylogenetic characters, are the mouth and head-parts, and these will have to be considered more or less at length. The Mandibles are, in most lepidopterous pupæ, almost obsolete. They are, however, in *Eriocrania*, of immense size proportionately to the insect, and functionally active, being used, as Chapman has shown, by the insect to free itself from its dense and tough cocoon. He describes them as "great curved organs, proceeding first directly forwards, then, by a sweep of a quarter of a circle becoming directed to the other side, and crossing the jaw of that side, proceeding transversely till the extremity projects rather beyond the margin of the opposite side of the pupa; the shaft is enlarged at either end—proximally with three projections or knobs for articulation, at the other end into a large truncate knob, the margins of whose flat extremity are armed with three or four large teeth and many smaller ones, reminding one in appearance of, as they certainly resemble in function, the fore-paws of a *Gryllotalpa* or Cicad pupa. The inner margin of the shaft is armed by a row of nine or ten teeth, flat, sharp, and leaflet-like." He further writes (*Trans. Ent. Soc. Lond.*, 1893, p. 256): "The mandibles are most remarkable in that, active and powerful as they are, there are no visible means of working them, as they are pupal structures, used only immediately before the emergence of the imago and have no corresponding imaginal parts attached to them. Yet all this may be easily observed by anyone who will get the necessary material—by no means difficult to do—and watch it from 6 to 7 a.m." As an example of the pupa-libera, Chapman's further notes on *Eriocrania* are interesting. He writes: "The pupa has all its appendages apparently quite separate and unfused together in any way, and the abdomen is thus not only unattached to the legs and wings, but preserves freedom of movement in all its segments. The head and thoracic segments are equally free to move on each other, and do so, especially the head, during emergence, yet, when the pupa is quiescent, *i.e.*, removed from its cocoon some time before emergence, it does not move these segments when irritated, but only the abdominal ones . . . The only portions of the pupa-skin at all solid are the labrum, which carries six long hairs on either side, the jaws, and an oval hoop to which they are articulated." The LABRUM of the Eriocraniid pupa forms a brown knob, as we have just noted, and bears six long bristles on either side. It is a large, solid piece, contains no imaginal structure, but doubtless serves, by its hairs, as a tactile organ during the exit of the pupa, and, by its solidity, assists the action of the jaws, probably both as a solid base to act from and as attaching the parts to the imago. Packard notes that the labrum of the Taleporiid pupa forms a thick prominent lip.

The MAXILLÆ are exceedingly well-developed in many lepidopterous pupæ, forming a long double ribbon extending down the medio-ventral line, often passing under the apices of the wings and projecting beyond to some distance, sometimes to the 5th abdominal segment. In certain Sphingids, with enormously developed imaginal tongues, a special arrangement takes place, the pupal tongue being folded towards the base, whilst in the genus *Cucullia* it stands somewhat away from the ventral surface and is bent considerably under towards the tip. The maxillæ are, generally speaking, more or less ill-developed in the more generalised families; in the Eriocraniids, they are very inconspicuous, and in the Cochlidids also "they are small, but are prolonged outwards, and after passing through a narrow neck, terminate in a (sometimes rather twisted) club between the eyes, antennæ and legs. This represents the maxillary palpus which nowhere in Macros has any such development" (Chapman). In the true Tineids the maxillæ are noticeably small, as also in the direct Tineid offshoots.

The MAXILLARY PALPI are absent in many lepidopterous pupæ, especially in the more specialised superfamilies, although some pupæ-incompletæ, *Tischeria*, *Choreutes*, &c., have no trace of them, and in others, as *Elachista*, *Bucculatrix*, &c., they are very small. Strangely, the pupæ of those species of the generalised superfamilies that have inconspicuous maxillæ have often well-developed maxillary palpi. In the Eriocraniids both are well-developed, the palpi being very large, passing directly outwards transversely to the margin of the pupa, afterwards returning to the central line, the returning portion ventral, and, perhaps, a little posterior to the outward half; they appear to be quite free, but are not moved during pupal existence. The position is really the same as in other Heterocerous pupæ that possess these organs, but in them, they are closed in by the neighbouring parts, except the front of the terminal segments. In the Cossids there are only small pupal maxillary palpi, and the lateral flap is not distinct. The maxillary palpus is the structure which Chapman called (*Trans. Ent. Soc. Lond.*, 1893, p. 104) the "eye-collar." In the Adelids, it consists of a narrow strip lying transversely immediately below the eye and stretching from the maxillæ to the antennæ, and appears to come from beneath the antennæ. It also occurs in the Sesiids, but when Chapman examined a pupa of *Trochilium bembeciforme*, from which the imago was ready to emerge, he found no corresponding imaginal part in it, although he discovered that the "eye-collar" was really the case of the maxillary palpus, and that the appearance of coming, not from the mouth, but from under the antennæ, and passing inwards, was in agreement with the actual fact, for the palpus, after leaving the maxilla, passes backwards in the angle between the head and prothorax until it is situated deeply beneath the antenna, then it turns forwards to the antenna, and only reaches the surface by emerging from beneath the antenna, and, turning inwards, forming the "eye-collar," which contains only its terminal joints, the others being concealed deeply. The nature of this observation on the Sesiids shows that they have been derived from ancestors with well-developed maxillary palpi, which are still retained in the pupal state. These organs are well-developed in the Cochlidids and in most of the Tineid offshoots. In a general way it may be said that whilst most of the Lepidoptera with pupæ-incompletæ have more or less distinct traces of maxillary palpi, those with pupæ-obtectæ are without them. Some pupæ of the Pyralids, however, have simple maxillary palpi, whilst Lithocolletids, Pterophorids, and, in some degree, Anthrocerids, have scarcely (if any) traces of these organs, whilst the Gracilariid and the Coleophorid pupæ certainly have none. In the Obtectæ no maxillary palpi are seen in the pupa, and in those Pyraloids that possess them in the imago they are small and simple, and do not reach the surface in the pupa. The maxillary palpus appears to form one of the best pupal characters for distinguishing the Tineids (*i.e.*, *Tinea* and its allies, not Tineina) and Tortricids. In the former, these are almost always well-developed in the pupa, in the latter, they are ill-developed or almost wanting. In *Cossus*, after dehiscence, the cases of the maxillary palpi are small but quite evident, and the same obtains in most Tortricids. We have already referred to the peculiar maxillary palpi of Cochlidids (*ante*, p. 43). Packard notes the maxillary palpi of *Taleporia* as extending under the eye from the antennæ to the labial palpi, which are short but very broad, and says that those of the Psychids generally are similar, whilst in *Thyridopteryx* they unite and form a continuous bar or piece in front of the labrum, and approximate to certain *Hepialidae*. It may be well to notice that the maxillary palpus is preserved in some Pamphilid pupæ as a minute eye-collar, a character not to be observed in any true butterfly pupæ.

The LABIUM (or second maxillæ) is not often to be detected in the pupa. Packard says that it is well marked in *Lagoa superba*, though the labial palpi are only represented by two short lobes. In the Cossid pupa, the labium and its palpi are long and narrow as in *Tortrix*.

The LABIAL PALPI, called by Packard the second maxillary palpi, are also absent in most highly-developed lepidopterous pupæ. In the Eriocraniids, they are large organs, passing forwards, when the head is raised, at an angle to each other of 70° or 80° and reaching quite in front of the jaws (when closed), and used apparently as tactile agents during emergence, but do not seem to possess any freedom of movement of their own. They are also large in *Tischeria*, *Bucculatrix*, the true Tineids, the Taleporiids and the Psychids, and, as a general rule, it may be said that their presence is usually a sign of the pupa belonging to one or other of the generalised families. They are also present in many pupæ-obtectæ.

Between the eye and the labrum, there is, in some pupæ, a small piece marked off distinctly from the other head-parts, and, as it is situated also at the base of the clypeus, Packard has named it the PARACLYPEAL TUBERCLE. He figures it (*Bombycine Moths of America*, p. 74, fig. 34), very distinctly, in the pupa of the Mexican *Phassus* *triangularis* and says (p.75) that, in this species, the two paraclypeal pieces or tubercles appear to be the homologues of those in the *Psychidae*. He states that they are also distinct in the Tineoids, in which he includes the *Tineidae*, *Taleporidae*, *Gracilariidae*, *Lyonetiidae* (*Bucculatrix*), *Prodoxidae*, *Elachistidae*, *Choreutidae*, *Psychidae*, *Hepialidae*, *Cossidae*, *Cochlididae*, and *Tortricidae*. In the *Psychidae*, the paraclypeal turbercles are always present, being convex and very rugose. In describing the pupa of *Hepialus*, Packard notes that, on each side (of the labrum), there are, what he calls, "the paraclypeal pieces or sclerites," of the homology of which he is "not quite sure, unless they are identical with the tubercles seen in most Lepidoptera on each side of the labrum and formerly regarded as the mandibles." Packard notes the structures as being well-developed in Cochlidids and distinct in the Tortricids. He further notes them as being vestigial in *Enaemia*, a genus of uncertain position sometimes referred to the *Hyponomeutidae*, but which Packard, by some method, appears to ally with the Lithosiids. The Nolid pupa has large paraclypeal pieces.

The EYES of nearly all lepidopterous pupæ have an outer portion cut off sharply from the upper and inner portion. This outer piece is usually smooth and glazed, whilst the remainder of the eye is similar to the rest of the pupal skin. Scudder looks on this "glazed eye," as the piece is called, as the remains of an ancestral pupal eye, and says that it occupies the position of the line of larval ocelli. Poulton considers that the inner semilunar portion of the glazed eye is the true eye both of larva, pupa and imago.

Another pupal structure, apparently only noticed by Chapman, is the EYE-FLANGE. Describing the pupæ of the Cochlidids he writes (*Trans. Ent. Soc. Lond.*, 1894, p. 349): "Where, in most pupæ, the eye abuts against the antenna, it is here rather separate, and a flat flange-like margin, with sharp edge, and, in some species, marked with radiating lines, surrounds the eye without quite joining the antenna."

Chapman notes (*Trans. Ent. Soc. Lond.*, 1896, pp. 130-1) the DORSAL HEAD-PIECE as a most persistent feature in the pupa-incompleta, appearing frequently in the highest forms. He states that he at one time considered it to be an anterior portion of the prothorax, but concludes that there can be no doubt that it is the dorsal plate of the last segment of the head, *i.e.*, the one to which the eyes belong. It is not present in the Papilionids, although found in the Hesperids, where it carries the eye-covers on dehiscence. It is also to be found in a few superfamilies that have obtect pupæ—Lasiocampids, Cymatophorids, some Geometrids, &c.—suggesting that, among these, one may find the lowest obtect families and their line of origin from the *Incompletae*. The Tineid stirps (the lower part of the Geometro-Eriocraniid stirps) is remarkable for having a pupa which possesses an exceedingly large dorsal head-plate (cephalothoracic piece), yet the structure is so dwindled in the Coleophorids as to be quite evanescent, in many species, in the middle line.

The NOSEHORN of Chapman comprises the "ocellar tubercle" and "ocellar prominence" of Scudder. It appears to be entirely a butterfly structure, and to have been developed in exposed pupæ in order to protect the head structures, beneath which the imaginal organs are in process of development. In the Papilionid pupa, the nosehorn is double, one portion placed in front of each eye, and they no doubt serve for the protection of the eyes, the bases of the antennæ and possibly all the head organs. They are somewhat similar in position (one on either side of the head) in the Vanessid pupæ, whilst between the double nosehorns are two minute prominences, so that the butterfly pupa has, in reality, an inner and an outer pair of eminences. In *Thais* the nosehorns of *Papilio* appear to be modified into the double central knob that carries the hooks to which the girth is attached, whilst in *Doritis* and *Parnassius* they are reduced to obsolescence. In Pierids there is a simple central nosehorn, apparently formed by coalescence in the middle line.

The ANTENNÆ appear to arise, in the pupa, from the preoral somite of the head and usually are so arranged as to form on either side a boundary enclosing the legs, maxillæ and other head-parts—eyes, clypeus, &c. They vary much, but generally bear some relative proportion to those of the imago not only in length, but also in their shape, general appearance and segmentation, although, in some instances, considerable difference in detail may be observed. The long antennæ of *Adela*, &c., which project beyond the other appendages, remain separate and free to their extremities, and this appears to be so in all incomplete pupæ with abnormally long antennæ. In obtect pupæ, on the other hand, exceptionally long antennæ are carefully carried round the margin of the wing (Chapman). The antennæ of the pupa, we have said, do not always agree in detail with those of the imago. Moseley noted that in *Saturnia pavonia-minor* the sheaths of the antennæ of the female pupa were 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 were merely filiform, and concluded 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." Poulton enters (*Trans. Linn. Soc. Lond.*, 2nd series, v., pp. 245-247) into the matter somewhat in detail, and he asserts that " when there is much difference between the antennæ of male and female moths, there is always less difference between the antennæ of the sexes of their respective pupæ." He found this to be so in pupæ of the genus *Smerinthus*, where the difference between the imaginal antennæ is not great, and in pupæ of *Phalera bucephala*, *Cerura vinula*, and *Notolophus* (*Orgyia*) *antiqua*, in which the difference is much greater, and he considers this fact evidence of comparatively recent increase of the sexual differences in the imaginal state. He further observes that Moseley's conclusions as to the antennæ of *Saturnia pavonia-minor* are supported by a more minute examination of the antennæ of the female imago. He shows that the degree of degeneration varies greatly in different individuals and that rudimentary sensory hairs are scattered over the reduced equivalent of the highly-developed rami of the male organ. The imaginal antennæ of *Aglia tau*, he also points out, are very different in the two sexes, whilst the corresponding pupal organs are not widely different; similarly, the antennæ of the female imago of *Notolophus antiqua* are out of all proportion to the broad pupal antennæ, while the male pupal antennæ are not much larger than those of the female pupa. He concludes by observing that distinct traces of antennæ can be made out upon the pupæ of some female Psychids, the imagines of which are " a mere bag of eggs, without limbs or sense-organs," whilst the same facts are well seen among "the degraded females" of certain Geometrids, for the wingless female of *Nyssia zonaria* possesses thread-like antennæ very different from those of the male, although the pupal antennæ do not greatly differ in size. The similarly degenerate female of *Hybernia defoliaria* emerges from a pupa with comparatively broad antennæ. Poulton concludes that the evidence offered by the antennæ shows that when an imaginal organ falls into disuse and shrinks, the corresponding pupal organ shrinks at a very much slower rate, and so "presents a picture of the long-past condition of the former."

The pupal WINGS are lateral appendages to the mesothorax and metathorax and are generally folded round the venter of the first 4 abdominal segments, the apices of the fore-wings frequently meeting on the median line of the venter of the 3rd or 4th abdominal segment. Usually, but little of the hind-wing can be clearly made out, and then only the hind marginal border, which generally extends just beyond the base of the inner margin of the fore-wing. The fore-wing gives distinct traces of neuration (often differing considerably from that of the imago, at other times agreeing therewith). Poulton makes the general statement that "over the part of the pupal fore-wing beneath which the imaginal wing will develop, lines which correspond to the future neuration are more or less plainly visible. The pupal neuration ceases at Poulton's line, although the direction of the neuration lines may be continued by irregular lines of pigment across the interval between the pupal and future imaginal hind margins. These irregular continuations are, however, very different in character from the more defined appearance of the lines which represent the neuration, and, when the latter are studied in especially favourable species, *e.g.*, *Pyrameis atalanta*, they are seen to correspond exactly with the future neuration of the imaginal wing. This is all the more remarkable inasmuch as the main tracheæ within the pupal wing, which will ultimately be enclosed as important elements in the imaginal nervures, possess at this time an arrangement different from that which they will then assume."

With regard to the pupal neuration, Müller (*Kosmos*, i., p. 390) was the first to observe that its ontogenetic features could be utilised for phylogenetic purposes. He observed that, in the immature pupa of *Castnia ardalus*, the transverse nervures were wanting and that different longitudinal ones, which afterwards more or less completely disappeared, were present, and hence he regarded the pupal neuration as the primitive one. This view Spuler adopted, and, by stripping off the loose skin of a larva just beginning to pupate, examined the incipient neuration of the wings of the young pupa. He then placed the living pupa in water when, the process of thickening and resulting concealment of the nervures of the wing being retarded, the tracheal branches became slightly enlarged, filled with air, and could thus be more easily seen. (Small pupæ from which the larval skin has just been cast and which are transparent are the fittest objects for examination.) He shows further that the transverse nervures are of secondary and subordinate importance, and Packard (*Bombycine Moths of America*, p. 85), by means of two figures of *Gracilaria syringella*, one of the neuration of the imaginal fore-wing, the other of that of the semipupal fore-wing, shows that the generalised neuration of the latter is similar to that of *Eriocrania.*

Parallel with the outer margin is a more or less distinct transverse line, which has been already referred to as "Poulton's line," so called because Poulton first drew attention to its presence and probable meaning. Of this line, Poulton writes :—"Although the wing of the imago expands into a size far beyond that reached by the pupal organ within which it is developed, the former does not entirely fill the latter before emergence. The margin of the imaginal wing lies well within the corresponding margin of the pupal wing which encloses it. Not only are the two margins separated by an interval, but their contours are frequently very different. Furthermore, in many species, the position of the future margin of the imaginal wing can be distinctly made out on the pupal surface from the very beginning of the pupal period and long before the imaginal organs have begun to appear. The line which corresponds to the future imaginal hind margin is especially distinct, and is separated from the hind margin of the pupal wing by a very wide interval." Without committing ourselves to the generalisation involved in the statement that "the imaginal wing does not entirely fill the latter before emergence," the facts of the actual meaning of "Poulton's line" appear, from our subsequent observations, to be fairly accurately set forth. Poulton's line appears to be the line at which the development of the outer margin of the wing takes place, but, subsequently, as the wing grows, it pushes itself out (at least in many species) to the fullest limit permitted by the pupal wing. Poulton further considers that a "careful comparison of the imaginal hind-margin with that marked out on the pupa, supports the conclusion that the angulated outline of the imaginal wing in the Vanessids and allied genera, has been derived from the more usual smooth and continuous form of hind-margin," and states that "the hind margin of the fore-wing of the imago of *Pyrameis cardui* presents a slight bay in its central part, but the bay is even less marked in the corresponding line upon the pupa. In other words, the latter is more normal and is now in a stage through which the imaginal hind margin has passed. Some indications of the black-and-white fringe on the imaginal hind-margin can be made out in the disposition of the pupal cuticular pigment, also the corresponding line. Similarly in *P. atalanta* the bayed hind-margin of the imago is less pronounced in the corresponding part of the pupa. A similar relationship is witnessed in *Vanessa io* although the difference is rather in the angularity and amount of projection of the cusps than in the depth of the bay. In dark varieties of this pupa the pigment is distributed along the line h′m′ ('Poulton's line') in such a manner as to suggest a former black-and-white fringe which is now absent from the imaginal hind margin. . . . A comparison between the pupa and imago of *Eugonia polychloros* similarly shows that the pupal line is rather less indented than that of the imago. . . . An examination of the pupa of *Polygonia c-album* supported, in the most complete manner, the conclusions already arrived at, and it is clear that the hind margin of the imago is far more jagged than that of the corresponding line upon the pupa, which, indeed, is not much in advance of the condition found in the imago of *V. io* or *E. polychloros*. Hence, we see that not only are the traces of lost imaginal parts preserved, but the indications of ancestral forms and markings are also fixed on the surface of the pupa." Although we have made many observations on "Poulton's line" and its relationship to the imaginal wing (and also to the present outer margin of the pupal wing) we have preferred to quote Poulton at length as an earnest of our thanks for the paper which first stimulated our observations in this direction. There is, however, one point we should like to suggest in addition. It appears to us that "Poulton's line" is the boundary at which the hind-margin of the imaginal wing originates. This line varies in individual pupæ as does the hind-margin in individual imagines; it may be, therefore, looked upon as having varied simultaneously and uniformly with the shape of the imaginal wing, and its present form may be looked upon as bearing a relative difference only, when compared with that of the imago, to that which it has borne during the evolution of the imaginal wing in the direction of its present form, and, as Poulton says, its present shape possibly represents one of the phases through which the wing has passed. On the other hand, we are inclined to look upon the hind-margin of the pupal wing as it now exists as representing much more nearly the ancestral wing from which the angulated Vanessid wing has been developed and this differs little (in all the species) from that which now characterises the Nymphalids as a whole that are not particularly specialised in this direction. Chapman looks upon "Poulton's line" as the margin of the membranous portion of the imaginal wing, and considers that the outer portion represents the fringe. This view is "essentially the reverse of that formulated by Poulton, since the pupal margin is not the record of a past imaginal wing, both margins having been always both pupal and imaginal as they are now, but, in certain species, the entire margin (margin of fringe) has submitted to variation in the pupal state to suit the exigencies of the pupal form."

Experiments on a number of pupæ at the time of the final development of the wings of the imagines in *Pararge egeria*, *P. megaera*, *Dryas paphia*, *Argynnis aglaia*, *Brenthis euphrosyne*, all the British Vanessids (except *Euvanessa antiopa*) &c., have tended to show that the development of the membranous portion of the imaginal wing begins at Poulton's line, that it has not proceeded very far before it has slipped away from it, crowding the hind margin of the wing down to the extreme of the available space, also that, in such species as *Polygonia c-album*, which Poulton selected as illustrating the declining size of the imaginal wing, the latter, whilst developing, is really too large for its pupal space and not too small. Bearing on this is an observation on the development of the imaginal antennæ of *Gonepteryx rhamni* and *Pararge megaera*, which, occupying the whole of the pupal antennæ in the very early stages of their development, are, by the time they become visible from the outside, much shorter than the pupal structures and become still shorter before exclusion. Chapman notes, contrary to the facts observed in Argynnids, Vanessids, &c., that the imaginal wing of *Parasa chloris*, after its development along "Poulton's line," slips towards the base of the wing and not outwards as in those we have ourselves examined. The further relation of the pupal to the imaginal wings was worked out at considerable length by Poulton. He observes (*Trans. Linn. Soc. London*, 2nd ser., v., p. 248) that the wings of *Fumea nitidella* ♀ are reduced in the imaginal stage, to minute tubercles, so small as readily to escape detection, and having neither the shape nor the appearance of wings. The female pupa, however, "possesses small but distinct wings of characteristic structure and shape, and with the normal relation to the other appendages and to the meso- and metathorax." In the majority of Psychid female pupæ examined, "the lost imaginal parts—wings, legs, antennæ, &c.—are evidently represented by confused creases on the corresponding parts of the cuticle." In one unnamed species the wings were distinct "as small pouches on the meso- and metathorax, whilst the legs, antennæ, and even the eyes and mouth-parts could be plainly made out, although of a very rudimentary nature." In *Notolophus antiqua*, the pupal wings, though "very much smaller in the female than in the male, are considerably larger than the wings of the female moth." The wings of a female pupa of *Hybernia defoliaria* are large and well formed and "almost equal to those of the male pupa." The same facts hold for *Nyssia zonaria*, the "difference between the wings of the pupæ of the two sexes being quite inconsiderable." The pupæ of the so-called apterous and semiapterous lepidoptera show that the most degenerate species in this direction have been modified from fully-winged forms, and this degeneracy in the imago has been followed by a reduction in the pupal wings, although at a much slower rate.

The SPIRACLES are not, as a rule, very characteristic or important in the pupa. There are, besides the prothoracic pair (usually buried deeply in the suture between the pro- and mesothorax), eight pairs of abdominal spiracles in the lepidopterous pupa. Of these latter, the first (and often the second) pair is covered by the wings, whilst the last (or eighth) pair is always abortive.

The CREMASTER of the lepidopterous pupa is undoubtedly homologous with the suranal plate of the larva. Its modifications in various pupæ are almost endless, and any definition, unless couched in the most general terms, would fail. It may be a smooth pointed terminal spine, a bunch of prehensile hooks, or a few scattered hooks distributed over the rounded and smooth surface of the anal segment. In some species, "it aids the pupa in working its way out of the earth when the pupa is subterranean" (Packard), but generally the cremaster is used for the purpose of attachment. In the pupæ of cocoon-spinning larvæ, belonging to the *Incompletae*, the armature of curved hooks enables it to retain its hold on the threads of the interior of the cocoon, restraining it "at precisely that degree of emergence from the cocoon that is most desirable" (Chapman), whilst in the suspended or girt pupæ of butterflies, the cremaster is the means of attachment to the silken pad to which such pupæ are fastened. Packard states that in many of the more generalised moths—*Eriocrania*, *Gracilaria*, *Prodoxus*, *Tantura*, *Taleporia*, *Zeuzera*, *Harrisina*, Psychids, Hepialids, &c.—there is no cremaster, although in *Tischeria*, *Taleporia* (dorso-anal), and Psychids (ventral) two stout terminal spines perform the office of a cremaster. Two similar dorso-anal spines, as well as sundry simple curved setæ on the rounded unarmed end of the abdomen, occur in the pupæ of the Solenobiids. Packard further says: "In the obtect Lepidoptera, *e.g.*, in the Notodonts, where the cremaster is present, though variable in shape, it may, from disuse, owing to the dense cocoon, be without spines and hooks, *e.g.*, *Cerura*, or the cremaster may be entirely wanting, *e.g.*, *Gluphisia*, or only partially developed, *e.g.*, *Notodonta*. In the butterflies whose pupæ are suspended, the cremaster is especially well-developed. Reference might here be made to the temporary pupal structures in certain generalised moths, which take the place of a cremaster, such as the terminal row of spines in *Tinea*, the two stout spines in *Tischeria*, and the dense rough integument and thickened callosities of the pupal head and end of abdomen of *Phassus*, which bores in trees with very hard wood; also the numerous stout spines at the end and sides of the abdomen in Ægerians. These various projections and spines, besides acting as anchors and grappling hooks, in some cases serve to resist strains and blows, and have, undoubtedly, like the armature in the larvæ and imagines of other insects, arisen in response to intermittent or occasional pressure, stress, or impact."

With regard to the various structures observed in the butterfly cremaster (*e.g.*, as exhibited in Nymphalids), and that take part in the suspension of these pupæ, the following may be mentioned: (1) The dorsal ridge. (2) The ventral ridge. (3) The cremastral hook-pad. (4) The sustainers (sustentores). (5) The sustentor ridges. (6) The anal prominences. The "cremastral hook-pad," Riley says, is "thickly studded with minute but stout hooks, which are sometimes compound or furnished with barbs, very much as are some of our fishing-hooks, and which are most admirably adapted for the purpose for which they are intended." The "sustainers" or "sustentors" are homologised by Riley with the soles or plantæ of the anal prolegs, and the "sustentor ridges" with the limbs, but Jackson disagrees with this, believing that the "sustentor ridges" and "sustentors" are probably peculiar developments of the body of the 10th somite, found only in some Lepidoptera. He further states that the eminences (or "rectal prominences," as they are called by Riley) on either side of the anal furrow represent the prolegs. Packard agrees with Jackson, and states that the "sustentors" and their ridges are not to be found in the pupæ of the more generalised moths, whilst the vestiges of the anal legs are almost invariably present, their absence in the pupæ of *Nola* and *Harrisina* being noteworthy. The "sustentors" assume various forms, but are always directed forwards so as easily to catch hold of the retaining membrane. The "sustentor ridges" form quite a deep notch which doubtless assists in catching hold of the larval skin in the efforts to attach the cremaster. Riley states that it is principally by the leverage obtained by the hooking of the sustainers in the retaining membrane, which acts as a swimming fulcrum, that the chrysalis is prevented from falling, after the cremaster is withdrawn from the larval skin. It is also "principally by this same means that it is enabled to reach the silk with the cremastral hook-pads." Packard goes so far as to give the cremaster systematic or classifactory value. He says that "the cremaster affords excellent generic and specific characters. It is present in the subterranean pupa of *Datana*, and is of use in aiding the pupa to reach the surface of the ground. It is very large and acute in the subterranean pupæ of *Ceratocampidae* and Sphingids. It is evident that, in the presence or absence of the cremaster, and in its shape, and in the number of hooks and their shape, we have a set of very plastic characters (though excellent for distinguishing genera and species) whose variability and plasticity is due to the varying habits of the pupa, whether living above or under ground, whether protected by a very thin, loose, net-like cocoon, or by a solid double one like that of *Cerura* or of the silkworms." The cremaster of the Pterophorid pupa is peculiar in that it consists of an anal and a forward portion, but is paralleled by those of the Elachistids, Pyraloids (*Yponymeuta*), &c. The terminal hooks by which the Pterophorid pupa fixes itself to the pad of silk are specialised and somewhat elaborate, and the cremaster, has, in addition, a separate little group of hooks on the ventral surface of the 8th abdominal segment. It is the latter, possibly, that enables it to assume its normally horizontal position. Chapman notes that a cremaster is very rare in the pupæ of the true Tineids and their closest allies, and he states that its use, when it exists, is "not to retain the pupa within the cocoon, but to restrain it at precisely that degree of emergence from the cocoon that is most desirable ; this is usually attained when the movable segments have so far emerged from the cocoon that they are no longer capable of acting in the cocoon as locomotor organs."

We may here notice that Holland figures (*Psyche*, vi., no. 190) the pupa of *Saturnia arnobia* from Kangwe, West Africa, as suspended from a twig by a cremastral attachment, and partly enclosed by a few silken threads spun from a twig or leaf to a neighbouring one.

The ANUS of the pupa lies just below the base of the cremaster, at the dorsal end of a long anal furrow which represents the furrow or depression between the two anal prolegs of the larva.

In vol. i., pp. 59-60, we have given a brief account of the SEXUAL ORGANS in the lepidopterous larva, and pointed out the stage of development reached during that period. The following remarks, therefore, must be looked upon as a continuation of the notes there to be found. It is really astonishing that the external sexual organs, which are remarkably distinct and conspicuous in many pupæ, were not thoroughly examined long ago. They are to be seen in many old drawings of pupæ, but no one appears to have recognised what they really were. Ratzeburg seems, however, to have been quite aware of their nature and importance and figured (*Die Forst-Insecten*, ii., 1840, p. 6) the Heterocerous type of the genital organs on which the apertures are confluent. Wilde, also, was fully aware of the nature of these external structures (*vide*, *Systematische Beschreibung des Raupen*, &c., 1861, p. 4). Rolleston, in 1870, when making observations on the pupa of *Acherontia atropos*, recognised that they indicated the normal outlet of the generative glands. In his *Schmetterlingsbuch*, Berge gave, in 1876, a brief description of the male characters, but Jackson and Poulton published (*Trans. Linn. Soc. Lond.*, 2nd series, vol. v., 1889, pp. 143-212) the first important memoirs on the subject. Since then many observations have been recorded—scattered, however, and generally in magazines. Poulton notes that Lyonet figures (pl. xxxix., fig. 3) a pupa of *Cossus ligniperda* with distinct male organs, whilst Moore represents (*Lepidoptera of Ceylon*) some large pupæ with indications of the generative structures. Burmeister, in his beautiful illustrations of the *Lepidoptera of the Argentine Republic*, also delineates these parts (*e.g.*, pl. xviii., fig. 11, distinctly represents a male pupa of *Attacus hesperus*, whilst pl. xx., fig. 5 *b* is an equally distinct female pupa of *Ceratocampa imperialis*), and, in the description of these figures, the position of the generative aperture is pointed out, but the sexual differences are not observed. Poulton commenced his studies by an examination of the organs in a male pupa of *Sphinx ligustri*, and afterwards made a careful comparison of the external generative organs in a large number of species, whilst Jackson (*Trans. Linn. Soc. Lond.*, 2nd ser., v., pp. 146-147) gives a long list of pupæ which he has had under examination. The sex can very rarely be made out in the lepidopterous larva without dissection, but, since the external structures which are distinctive of sex in pupæ are developed towards the close of larval life, and the cuticle that lines them is in continuity with the cuticle of the future pupa, it is conceivable that the larval cuticle might be sufficiently transparent to permit the external sexual organs to be seen in the adult larva. Distinctive external anatomical indications of sex are, however, altogether wanting in the lepidopterous larva, and the sex is not to be determined save by dissection, except in the few cases, *e.g.*, *Ephestia kühniella*, where the integument is of sufficient transparency to permit the testes and ovaries to be seen, and where, at the same time, there is a difference of colour in these organs.

Male sexual organs.—With the assumption of the pupal form the external organs are seen to be already formed, and the examination of almost any large *male* pupa with the naked eye will show on the venter of the abdominal segments, "two convex or flattened, roundish, oval, or trianguloid tubercles, placed one on each side of the middle ventral line, in the 9th abdominal segment. Careful examination throws some doubt upon the certainty of this segmental relationship, but there is no doubt, however, that the organs always occur in the zone of the 9th abdominal, *viz.*, in an area which would be included in the segment, if the boundaries of the latter were produced in the direction indicated by their course in the dorsal and lateral regions. Between the tubercles is a furrow which generally becomes a deep pit in its central part; this pit is the ancient opening of the pupal vas deferens, and it now corresponds externally to the termination of the ducts internally" (Poulton). It is further pointed out that some pupæ approach the condition of a perforate orifice, and Poulton states that a favourable pupa of *Smerinthus populi* will show, if examined from the inside, the lips of the depression completely introverted, their internal surface having the black appearance and peculiar roughened texture which is characteristic of the exterior of the pupa, and with which it is, of course, continuous. The surface of the introverted funnel-like opening is covered with the same lustrous white layer which invests the whole interior of the cuticle, and which, therefore, is contrasted very sharply with the internal surface or lumen of the funnel. In this case, the funnel is not closed at its deepest point, the lumen being obstructed a little higher up by the fusion and hardening of the semifluid substance into a solid plug immediately after pupation. When looked at from within, the sides of the sharply truncated funnel are quite free, recalling most vividly the condition in which the lumen was perforate throughout. The whole appearance from within, in fact, singularly resembles that of one of the superficial functional spiracles looked at from the same point of view. These have similar introverted lips, also sharply truncated, and showing the characteristic black surface which lines the lumen. The rudimentary 8th abdominal spiracle, on the other hand, is completely closed below, and the white surface lining the pupal cuticle is unbroken over it. It is very remarkable that this most ancestral generative organ should, in certain cases, retain such strong indications of the time when it was functional. On the other hand, there are proofs of the ancestral nature of the male organs, and of their rudimentary condition, as far as the pupa itself is concerned. Thus the individual differences are very great in position and form, and in the degree to which the structures are developed. Furthermore, these organs are often asymmetrical when all other parts of the pupa are entirely normal. The asymmetry may be slight, or pronounced, or accompanied by marked deformity. With regard to the uncertainty as to whether the male organs are on the 9th abdominal segment, the same observer remarks that although they appear to the naked eye to belong to this segment, yet, when considerably magnified and well-illuminated, they appear to be surrounded by a furrow which is continuous on either side with the boundary between the 9th and 10th abdominal segments. In some highly magnified figures they appear to belong to an anterior median extension of the 10th abdominal.

Jackson, who refers the male organs without question to the 9th abdominal segment, writes: "The male sex is indicated by a linear depression in the sternal region of the 9th somite, a depression which represents the aperture of the ductus ejaculatorius of the imago. It presents itself in one of three slightly differing shapes—(1) A fine line situated in a raised area and provided with two oval lips, one right, the other left—*Pieris*. (2) A more strongly marked line enclosed in a nearly circular cup-shaped area, with edges strongly raised. (In some specimens the edges of the enclosing area are more strongly pronounced on the right and left, forming two lips, the area having a more oblong aspect.)—*Aglais urticae*, *Vanessa io*, *Pyrameis atalanta*, *Eugonia polychloros*. (3) A very well-defined linear depression guarded by two lips, one right, the other left. These lips are tumid, broad at their centres, and pointed at either extremity, or, in other words, they are oval or somewhat triangular, the bases of the triangles being the linear depression itself; the whole structure situated either in the centre of the segment or at its posterior limit—*Papilio machaon*, *Sphinx ligustri*, and all Heterocera examined."

Female sexual organs.—The examination of any large female pupa, shows an anterior median extension of the 10th into the 9th (and sometimes into the 8th) abdominal segment. Lyonet figured (pl. xxiv., fig. 12) this in *Macrothylacia rubi*, but it is conspicuous in many (most) Heterocerous pupæ, less so in those of the Rhopalocera. When the 10th abdominal extends forwards so far as to impinge on the region of the 8th, the 9th also is prolonged into the latter for a variable distance, thus allowing the female generative organs, really on the 10th, to extend beyond the normal zone of the 9th, abdominal. Considerable variation in this extension occurs, even in different individuals of the same species, and Poulton notes that the base of the prolongation appears to be separated from the rest of the 10th abdominal in *Cossus* and *Zeuzera*, and that there is a median line traversing the prolongation of the 10th abdominal in *Macroglossa stellatarum*. He supposes, from the constancy and distinctness of the median prolongation and the relation of its apex to one of the generative apertures, that it has some morphological significance, and suggests that "it may represent an ancestral ovipositor, formed as an anterior ventral extension of the 10th abdominal, and now fused to the pupa in its position of rest." He adds that "just as the male intromittent organ seems to be now only represented by the cuticle of that part of it which appeared on the surface when it was withdrawn, so the ancestral ovipositor is only represented by its external cuticular layer." He further considers that this "hypothesis also explains the fact that there is a separate opening into the bursa copulatrix. Copulation would be almost impossible if the female aperture were placed on the apex of a conical process; hence the necessity for a more accessible aperture. This arrangement having been once set up, would be retained after the disappearance of the necessity under which it originally arose, because of the many co-adaptations which would have been entailed in both sexes."

Poulton further writes: "There are two distinct generative openings in female pupæ—an anterior for the bursa copulatrix, and a posterior for the oviducts. The anterior is probably always associated with the 8th abdominal, it is more distinct than the other, and is usually provided with prominent lips. It is often slit-like, and extends from the posterior to the anterior boundary of the segment, but is especially dilated at its posterior end. In a single individual of *Notolophus antiqua* it appears to be placed on a forward extension of the 9th abdominal into the 8th, but in another individual of the same species its position is normal. We may safely conclude that the anterior generative opening is associated with the 8th abdominal segment. The segmental relation of the posterior generative opening is far more difficult to determine. . . . . In some examples, the posterior aperture is placed on the 9th abdominal immediately in front of, but distinct from, the apex of the median prolongation of the 10th abdominal. In others, the aperture is placed on the apex of the prolongation itself, and, therefore, belongs to the 10th abdominal segment. In the majority of pupæ, the opening occurs at the apex and may or may not be considered to belong to it. . . . . Whether connected with the apex or not, the aperture is always placed close to it. The posterior generative opening is often obscure and unrecognisable on the surface and is often fused with the anterior aperture. Even when the two openings are fused, and are prolonged into a common invagination, the double nature of the latter is shown by a furrow. The posterior opening may be surrounded by prominent lips or by a swollen margin, or it may be without these features." This observer further notes that although the female organs are not asymmetrical like those of the male they are subject to even greater individual differences; also that the pupæ of Rhopalocera possess essentially similar openings, but they are much more difficult to interpret, because of the specialisation in shape and the amount of surface sculpture. The ventral area of the 9th abdominal may be entirely hidden, *e.g.*, *Nemeobius lucina* and *Argynnis aglaia* (which is so hooked round ventrally, that the ventral surfaces of the abdominal segments are almost obsolete), but Rhopalocerous pupæ that show the organs distinctly prove that both the male and female organs are, in the butterflies, essentially similar to those of the Heterocera.

Jackson refers the posterior aperture to the 9th abdominal segment and writes: The female sex is to be recognised by the aspect of the sternal regions of the 8th and 9th somites. There are typically and primitively two linear depressions, one in each of the sternal regions named, but they may be hidden or become confluent. These depressions coincide respectively with two pairs of vesicles invaginated from the hypodermis. The following types of structure may be distinguished:—

(1) A short fine longitudinal line surrounded by an oval and slightly raised area, on each of the 8th and 9th sterna—*Pieris*.

(2) A longitudinal line which is apparently continuous on the 8th and 9th sterna —*Vanessa io*. (The essential difference between this and the preceding depends on the formation of a median furrow corresponding to the course of the azygos oviduct by which the two typical linear depressions seen in *Pieris* are effectually obscured. The inner aspect of the empty cuticle of *V. io* shows the remnants of the chitinous linings of the duct of the bursa copulatrix and of the oviduct respectively, at a late stage of growth, however, and, therefore, of greater extent than in the newly-formed pupa. Still they indicate the existence of the structures evidenced outwardly in *Pieris*.)

(3) The 9th somite very narrow ventrally and crossed by a line as in *Vanessa*. The ventral portion of the 8th somite broader, a line extending forwards from its hind margin for about one-third of its breadth—*Papilio machaon*.

(4) The 9th sternal region prolonged forwards to a greater or less extent as a triangular plate, invading the 8th sternal region, and, at the same time, not clearly limited from the 10th 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. *a.* Two fine longitudinal lines or depressions, one in 8th sternum, and a second, shorter one, at the apex of the triangular forward extension of the 9th sternum—*Protoparce mauritii*. *b.* A single linear depression in the sternal region of the 8th somite, enclosed by triangular lines passing backwards—*Sphinx ligustri*.

Jackson says that the single depression in *Sphinx* represents the two depressions in *Protoparce*. He came to this conclusion (1) from the dissection of a pupa (one day old) of *Sphinx ligustri*, which showed the existence of exactly the same parts as those seen in *Vanessa io*, *viz.*, an anterior vesicle with rudiments of a bursa copulatrix and receptaculum seminis, and a posterior double vesicle; the anterior and posterior vesicles being more closely opposed to each other than in *V. io*. (2) By finding in the cast pupal cuticles of *Sphinx ligustri* and *Smerinthus ocellatus*, 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, and which were with the structures figured in *V. io*. (3) The occurrence of a single or of a double depression in the chrysalids of the same or allied species. Examples of the two forms are noted as occurring in *Sphinx ligustri*, *Smerinthus ocellatus*, *S. populi*, *Cossus ligniperda*, *Zeuzera pyrina*, &c. It is further noted that the female pupa of *Cucullia verbasci* has but one depression, whilst that of *C. scrophulariae* has two, and *Triaena tridens* has one, whilst *T. psi* has two.

The following Heterocerous female pupæ are noted by Jackson as having two depressions:—*Acherontia atropos* (5 examples), *Sphinx convolvuli* (1), *S. ligustri* (1), *Deilephila euphorbiae* (2), *Choerocampa porcellus* (2), *C. elpenor* (52), *C. alecto* (1), *C. nerii* (2), *Smerinthus ocellatus* (1), *S. populi* (3), *Protoparce mauritii* (1), *Daphnis horsfeldii* (1), *Cossus ligniperda* (1), *Zeuzera pyrina* (1), *Cucullia scrophulariae* (1), *Triaena psi* (1), *Nyssia zonaria* (4). The species that he notes as having but *one* depression are—*Acherontia atropos* (2), *Sphinx ligustri* (many), *Choerocampa elpenor* (2), *Smerinthus ocellatus* (many), *S. populi* (many), *S. tiliae* (20), *Euchelia jacobaeae* (11), *Arctia caia* (23), *Cossus ligniperda* (2), *Zeuzera pyrina* (1), *Stauropus fagi* (1), *Leiocampa dictaeoides* (2), *Notodonta dromedarius* (1), *Leucania straminea* (1), *Phalera bucephala* (1), *Triaena tridens* (1), *Gortyna ochracea* (1), *Mamestra brassicae* (many), *M. persicariae* (15), *Panolis piniperda* (1), *Dianthoecia irregularis* (5), *Miselia oxyacanthae* (1), *Agriopis aprilina* (1), *Hadena glauca* (3), *H. trifolii* (13), *Cucullia verbasci* (many), *C. umbratica* (1), *Gonoptera libatrix* (3), *Selenia tetralunaria* (*illustraria*) (2), *Nyssia zonaria* (18), *Biston hirtaria* (13).

We have, in these organs, probably, characters of the highest phylogenetic significance, and when the more generalised species have been thoroughly examined possibly some new light may be thrown on the evolution of the Lepidoptera. That the forms described by Jackson and Poulton comprise the whole of those occurring in Lepidoptera is highly improbable, and Cholodkowsky (*Zeitschrift für wiss. Zool.*, vol. xlii., 1885) states that in *Nemotois metallicus*, a generalised Adelid, there is only one aperture, *viz.*, the posterior of the two normal ones.

Some very interesting superficial structures appear to be carried on from the larval to the pupal stage, *e.g.*, the anal prolegs of the larva can sometimes be traced distinctly as convex cushion-like structures on each side of the anus, and, in certain individuals, may even retain the relative size and appearance which are characteristic of the larva. Packard figures (*Bombycine Moths of America*, p. 74) a pupa of *Phassus triangularis* with longitudinal flattened tubercles representing vestiges of the anal prolegs. Poulton figures (*Trans. Linn. Soc. Lond.*, 2nd ser., v., pl. xx., figs. 8, 9, 10) the different aspects of such an example in an extreme form of *Smerinthus populi*. The four pairs of ventral prolegs, however, only leave functionless traces on the pupal cuticle, and Poulton says that, although " the first and second pairs are hidden beneath the forewings, yet on the latter being raised (in pupæ placed in spirit immediately after throwing off the larval skin) the scars can be seen, and they may even be detected in living pupæ with exceptionally transparent wings (*e.g.*, *Miselia oxyacanthae*), the third and fourth pairs of prolegs nearly always leave conspicuous scars upon the 5th and 6th abdominal segments." The same observer further notes that the caudal horn of the Sphingids always leaves a scar on the pupa even in those species (*Choerocampa elpenor*, &c.) in which it is but feebly developed at the end of the larval stage. It is especially distinct in the pupa of *Macroglossa stellatarum*, whilst in that of *S. tiliae* it is quite smooth, the rest of the pupal surface being corrugated. The blunt horn of *Endromis versicolor* also leaves a large scar, very different from the rest of the pupal surface in appearance. In some Sphingid pupæ, there is also a well-marked depression on the 8th abdominal segment behind the scar, which appears to be due to the horn becoming horizontal before the last larval ecdysis so that the adjacent larval cuticle is depressed, leaving a permanent impress upon the then soft cuticle of the pupa. Poulton further notes that scars, representing the soft elevations on the 1st and 8th abdominal segments of the larva of *Triaena psi*, can be plainly detected upon the corresponding segments of the pupa ; he also considers that the rough plate upon the dorsal surface of the anal flap of the larva of *Smerinthus tiliae* is represented by the extremely rough dorsal surface of the terminal spine of the pupa, and that the glabrous corneous black plate occupying the dorsal surface of the anal flap in the larva of *Phalera bucephala* is represented on the anterior dorsal part of the 10th abdominal segment of the pupa, which forms a deep furrow with the 9th abdominal, the edge of the furrow being crenated. The brightly-coloured hair-bearing warts of the larvæ of the Saturniids, also leave hairless scars, which are usually much smoother than the rest of the pupa and somewhat depressed below the general surface.

Somewhat different from these are the actual hair-tufts, corresponding more or less with the tussocks found in the larvæ of certain Liparid moths. These are distinctly marked on the first three (or four) abdominal segments of the pupæ of *Dasychira pudibunda*, *Leucoma salicis*, *Notolophus antiqua*, &c. In *Lymantria monacha*, the hair-groups on the abdominal segments are suggestive of tubercles i, ii, iii, iv, and v of the larva, whilst in *Porthetria dispar* the hairs fringe the slightly-raised bosses that appear to represent the larval tubercles. In *Dasychira pudibunda*, Bacot notes the dorsal surface as being slightly raised and roughened, apparently scars of the dorsal tufts of the larva, whilst the hairs form bands across the segments, the pupa also presents traces of the supra-, post-, and subspiracular groups of hairs. In *Notolophus antiqua* and *N. gonostigma* he observes that the pupal hairs, which occupy the position of the larval tufts, have the appearance of whitish circular scales, that appear to be attached at the centre and occasionally overlap one another. They have a semi-transparent, opalescent appearance, and are wrinkled in a more or less regular spiral pattern, the flutes or crenulations, starting from a central button, curve outwards to the circumference. Poulton also notes the presence of large tufts on the first three abdominal segments of the pupa of *Notolophus antiqua*, those on the 4th abdominal segment of the larva, he says, are not represented. He adds that the three tufts in the pupa form squarish light-coloured patches, which are very distinct against the dark pupal cuticle, and are especially prominent and well-defined in male pupæ, which are much blacker than those of the females. The absence of any trace of the fourth tuft is very remarkable. . . . There is a long pencil of hairs on the 8th abdominal segment of the larva of *Dasychira pudibunda* of which he could detect no trace in the pupa. . . . These appearances on pupæ, he considers, belong to a very different category from the merely mechanical scars, such as those produced by the caudal horn in *Sphingidae*, &c., for the pupa does not bear a scar of the larval tuft, but possesses a true hairy tuft itself. On the other hand, hairy prominences may be represented by mere scars, as in *Triaena psi*. Bacot considers that, since the pupa is older phylogenetically than the larva, it by no means follows that if the tubercles and hairs on the larva undergo alteration of structure or position, those of the pupa must be altered also. In the Psychids, the arrangement of the tubercles (and their setæ) appears to be identical in the larva and pupa. In the Liparids (much more specialised Lepidoptera), the pupal hairs follow the larval tufts in position, but the pupal hairs differ in structure from those of the larva. Bacot says (*Ent. Record*, xi., p. 173): "In the Liparid larvæ that I have examined all the larval hairs (so far as my knowledge extends) are thorny, branched, or plumose, and circular in section, while the pupal hairs are, with three exceptions, without thorns or branches and are frequently flat or ribbon-like. In *Notolophus antiqua* and *N. gonostigma*, the situation of the larval dorsal tufts is occupied in the pupa by structures which are not hairs at all in the usual sense of the word, although they may be homologous in a physiological sense. The three exceptions to be noted are as follows—*Lymantria monacha* and *Porthetria dispar* (in both of which the pupal hairs are thorny), whilst *Leucoma salicis* also has a few of its hairs of this character. These pupæ are, however, greatly exposed, in the case of *L. monacha* and *P. dispar* they are suspended in a slight silken hammock, while the cocoon of *L. salicis* is often very slight. The pupæ of *Porthesia similis* (*auriflua*) and *P. chrysorrhoea* are well protected by the irritating larval hairs in the cocoon, and we find that these pupæ are less hairy than those of the other Liparids. The above facts appear to point to the pupal hairs of the Liparids having a special and independent development, quite apart from those of the larva, only we must not forget that *Dasychira fascelina*, which has the stoutest cocoon of all the British species, is the most hairy of all, and, further, that we have still the position or arrangement, so similar to that of the larva, to account for. Is the stimulus (if any) of the position of a tubercle or tuft in the larval skin sufficient to determine where, on the pupa, the independent or ancestral pupal hairs shall develop, or must we look for an explanation to a (?) possible mixing of larval determinants with the pupal ones, and if so, what prevents imaginal ones from doing the same? Or, finally, are we to consider the pupal envelope a hybrid structure, partly ancestral imaginal and partly modern larval?"

Chapman has noted that as soon as the final larval skin of *Smerinthus ocellatus* has been moulted, the larval stripes are visible in dark green, as well as the sites of the prolegs; the lips and the oral spine of the 1st spiracle are chitinous. In another specimen, the stripes and prolegs were observed to be of a vivid blue, as well as the lips of the mandibles and four spots at the base of the labrum. Poulton has also made observations on the persistence of the characteristic markings of the larva on the pupa, immediately after the latter state is assumed, and he states that it appears to be due to the fact that the hypodermic cells 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, such colours, of course, being concealed in the living pupa by the opaque cuticle. They may be fixed, however, by placing the newly-formed pupa in spirit, and thus checking the darkening of the surface. The persistence of the lateral larval stripes may also be observed in the freshly-formed pupa of *Sphinx ligustri*, and the purple borders of the stripes are seen to bear a relation to the segments similar to that borne in the larval stage, whilst the relation of the coloured borders to the spiracles is just the same as that of the larva. Poulton proved conclusively that the constitution of the coloured stripes in the pupa is similar to that in the larva, and entirely different from, and independent of, the darkening of the pupal cuticle. Similar facts are true of the pupa of *Acherontia atropos*, which, if examined immediately after pupation, shows the purple stripes and small circular patches (which probably spread from the bases of shagreen dots) of the larva, through the undarkened pupal cuticle. Poulton adds that he has also observed the light oblique stripes, with their dark green borders, of *Smerinthus populi* and of *S. ocellatus*, conspicuously appearing upon the surface just after pupation. One can readily understand how important these observations are in homologising the larval and pupal segments and structures. In this way, Poulton has shown (*Trans. Ent. Soc. Lond.*, 1888, p. 566) that the terminal spine of the pupa of *Aglia tau* is the homologue of the anal flap of the larva. In the freshly formed pupa of this species the markings of the larva are especially distinct and the subspiracular line (which forms so prominent a feature of the larva, and is continued along each side of the anal flap to its extreme apex) is equally conspicuous in the pupa and occupies an identical position in relation to the terminal anal spine, which, in this species, is blunt, and covered with an immense number of irregular hook-like cuticular processes. Further observation would undoubtely prove that such markings as these are of very general occurrence.

With the external assumption of the pupal stage, there is, as we have noticed (*ante* p. 10), a cuticular secretion formed by the hypodermic cells, which hardens on exposure to the air and fixes the wings, legs, &c. to the surface of the body. The nature of this fluid has not yet been thoroughly investigated. It has been suggested that it may be analogous with that found in lizards, snakes, &c., where certain cells break down completely and provide a liquid which facilitates the exuviation of the old cuticle. It has also been suggested that the secretion may be regarded as a modified cuticle thrown off with the first formed pupal cuticle. The Ephemerids cast a thin pellicle after escaping from the subimago state, and an imago of *Acherontia atropos* has been observed to moult a complete and thin pellicle after its emergence from the pupal cuticle (Curtis, *Brit. Entomology*, desc. pl. cxlvii), whilst some Hymenoptera (*Bombus*) are known to cast a thin pellicle with the pupal skin, which has been supposed by Packard to be identical with the skin cast by the active subimago of *Ephemera* soon after it takes its flight. Whatever explanation may be finally given of this phenomenon, it may be well to remark here that possibly all imagines of Lepidoptera are partly swathed in a transparent almost structureless membrane, in which the wings, legs, &c., are encased until the emergence of the imago, and one must carefully remove this internal pupal covering (or external imaginal covering) from the limbs of an imago extracted just previous to the point of emergence from the pupa, otherwise the imago will fail to develop its wings. We have repeatedly taken a fine pellicle from the wings of *Aglais urticae*, removed from the pupa (when fully coloured), and find that if this be not done, it is not successful in shedding it, as was the *Acherontia atropos* noted by Curtis. The fine skin shrinks up on the emergence of the imago and traces of it can generally be found in the cast pupal skins of the large moths, but its attachment suggests that, normally, it must be cast with the pupal envelope and that the difficulty of the emergence of the imago is due to the fact that it must release itself from these swathings rather than any difficulty of freeing itself from the hard pupal shell with which it is never really in contact. The question here suggested, properly followed up, might throw light on the obscure question of the origin of the quiescent pupal stage. Chapman asserts the belief that the delicate skin here described is only the layer of the cuticle that covers the unexposed portions of the organs, only external parts being provided with the typical dense covering, and that it exists for no other parts. We have ourselves only observed it around such organs, and his explanation, therefore, is highly probable. He says that "these delicate films are the coverings of parts that are not superficial, and consequently retain the delicate character of the skin of the pupa, with all parts free. Of course, in some pupæ-incompletæ, some of these inner surfaces (in pupæ-obtectæ) are more or less exposed, and have dense coverings ; the body, each of the four wings, and each of the appendages, has a pupal skin, and all these have to be shed as well as the outer hardened surface," but he objects entirely to the attempt to interpret these as a second pupal skin.

We ought, perhaps, to notice here, the substance that forms the remarkable bloom found on the surface of the pupæ of *Catocala*, *Cosmia*, *Halias*, *Parnassius apollo*, &c. The substance which produces this appearance is a kind of wax and, on the pupa of the latter species, which is completely coated with it, the material is so thick that it can be scraped off. Chapman finds that it melts, is perfectly insoluble in water, and that water runs readily off it, and there appears to be no doubt that it is a water-proof coating for the protection of the pupa, in its sometimes damp haunts. The pupa of *Pyrgus galba*, from Mhow in north-west India has a similar surface bloom, almost as thick as that of *Parnassius*, whilst Walker notes that in Chile the pupa of *Alamis poliodes* is covered with a white mealy powder. As the pupa is always placed in a slight cocoon under stones, it is possibly of the same nature as the resinous bloom of the Catocalid and Parnassiid pupæ.

We have already divided lepidopterous pupæ into three groups—pupæ-liberæ, pupæ-incompletæ, pupæ-obtectæ—and have stated that one of the essential differences of the two last consists in the number of movable abdominal incisions possessed by the pupæ, in other words the number of "free segments" they exhibit. The pupa-incompleta varies somewhat in the actual number of movable incisions, and these, as a rule, show a sexual variation, the 7th abdominal segment being free in the male, fixed in the female; it thus presents characters that bring it into line with those of bees and beetles. On the other hand, the obtect pupa is remarkably constant in this matter, having the 5th and 6th abdominal segments, and these only, free in both sexes. This pupa usually presents a hard chitinous exterior, the appendages, legs, wings, &c., lying together, forming a smooth, hard and solid exterior, whilst the surfaces that are hidden by being applied against each other are formed of a delicate skin, represented, when the moth emerges, by a few flimsy shreds, the previous position of which it is almost impossible to determine, so that the empty pupa-case consists almost entirely of that portion which formed the outer covering. In the pupa-incompleta the exposed surface is usually less solid, but the skin of the covered surfaces is much tougher (than are those of the pupa-obtecta) and, on the emergence of the imago, the pupa hangs together so that the nature of each portion is rarely difficult to determine, and some parts, *e.g.*, the inner wing-coverings, the portions of the abdominal segments 2 and 3 covered by the wings, and the intersegmental membranes are only a little less firm than the coverings that are fully exposed. On dehiscence, these covered portions become exposed, the appendages show a certain independence of each other never observed in an obtect pupa, and, even, before emergence, the appendages separate and the segments open out without any fracture or tearing occurring.

On the dehiscence of an incomplete pupa the head-coverings separate from the rest of the pupa, yet remain attached to one another in one piece. These head-parts consist of the plate covering the head and eyes, the antennæ, and the mouth-parts. In the obtect pupa these parts frequently separate from each other—the head-cover forming one piece, the antennæ separate, the mouth-parts also may be separate, but more usually they remain attached to the legs in one piece, the antennæ going either with these or with the wings, whilst in the few cases (Sphingids, Bombycids, Notodonts, &c.) in which the head-coverings remain in one piece, they do so because they remain attached to the leg- or wing-coverings; they never remain in one piece when detached from the rest of the pupa. Similarly for the other segments in the *Incompletae*, the pupal coverings of the wings, legs, &c., separate more or less from each other and retain their attachments to their own proper segments, so that the empty pupa-case often affords more information as to the true relation of its several parts than the living pupa does. On the other hand, an empty obtect pupa shows at once that the 5th and 6th abdominal segments were free in the living pupa, and no others; but an empty incomplete pupa-case leaves much doubt as to which were free segments, because, at many places where no movement was allowed in the pupa, movement has taken place in dehiscence, *e.g.*, in the Tortricid pupa the free abdominal segments are 4, 5, 6 (and 7 in male), yet, on dehiscence, it would appear as if the wings were partially free from abdominal segments 2 and 3, and, as if these segments, too, were free. It may be here well to note that some obtect pupæ have, in the male, a more marked incision between the 7th and 8th abdominal segments than has the female, even looking, sometimes, as if the incision admitted of movement. This is never the case, but it appears to prove unquestionably an ancestry in which the 7th segment was "free" in the male at a later period than in the female.

The pupa-incompleta is remarkable for its ability to leave its cocoon; thus the pupa of *Adscita statices* usually emerges entirely from its cocoon before the imago appears, and the pupa-case of the Eriocraniids is also found at some distance from the empty cocoon. Few obtect pupæ can leave their cocoons before the emergence of the moth—those of *Endromis versicolor* and *Choerocampa elpenor* have, however, retained this ancestral habit, and that of *Macrothylacia rubi* is said to move up and down in its long cocoon. Scudder states that the pupæ of the Sphingid genus *Macrosila* emerge from the earth for the escape of the imago, using for the purpose certain flanges in the spiracular region. All pupæ-incompletæ, however, do this, and are armed with various rows of hooks and spines to facilitate the process. The attachment of the Pterophorid pupæ makes them exceptions to this general rule, for although pupæ-incompletæ in structure and dehiscence, they are, of course, quite unable to change their position from that they have once taken up. Chapman also notes that *Epermenia* has a pupa of incomplete structure, but does not emerge from its cocoon. Whilst discussing the matter of pupal movement, it may be well to call attention to the fact, discovered by Chapman, that certain Gelechiad pupæ can only move the free segments antero-posteriorly, with "something of the manner that belongs to the movement of the click-beetles."

The pupæ-incompletæ show more variety than the obtect pupæ, and their incomplete character suggests that they are of a lower form, a suggestion comfirmed, Chapman says, by their close resemblance to many Tipulid pupæ, especially those of some gall-gnats, a resemblance that appears to be one of relationship rather than accidental, from the dipterous pupa having hindwings, although the imago has halteres, and from the imago possessing scales of quite a lepidopterous character.

With regard to the movement of which the butterfly pupa is capable, we may notice that by means of the movable incisions 4-5, 5-6, 6-7 the posterior segments of the Papilionid pupa can be moved in any direction, whilst in the Pierids, by the development of certain dorsal tubercles at the margins of the segments (possibly due to the fusion of the anterior trapezoidal larval tubercles), antero-posterior movement is lost, only lateral movement being possible. In *Aporiinae*, the 5th and 6th abdominal segments are movable, in the *Pierinae* and the *Rhodocerinae* only the 5th abdominal segment is movable, whilst in the *Anthocharinae* the pupa is solid and immovable. With regard to this, the movable incision of *Anthocharis belia* shows a remarkable transition. This species is double-brooded, one section, known as var. *ausonia*, feeding up in the spring and appearing in the imaginal state in June, the second overwintering as a pupa. In the pupæ producing the summer imagines the incision between the 4th and 5th abdominal segments is movable, in the winter pupæ this is fixed and the pupa solid (*Ent. Record*, vi., p. 288). The Nymphalid pupa possesses only lateral movement like the Pierids, and, like them, varies in the number of movable segments, being restricted to two incisions in the Argynnids, Vanessids, &c., to one in *Enodia hyperanthus*, the pupa being solid in *Hipparchia semele* and *Melanargia galathea*. The Euplœine and Brassolid pupæ, too, have also lost all power of movement whilst the Lycænid pupæ are solid and possess hairs and bristles.

The pupa of *Troides amphrysus*, if disturbed or blown upon, makes quite a loud noise by the movement of the abdominal segments one over the other, which noise is so loud that it is probably sufficient to scare away some of its enemies (Nicéville).

The pupæ of Lepidoptera vary much in adaptation to their surroundings, and Chapman has pointed out that they afford important taxonomic and phylogenetic characters. With regard to this we have already stated that some pupæ are much more generalised than others, the pupa-libera and the pupa-incompleta being more ancestral than the pupa-obtecta. The connection between the most generalised lepidopterous pupa-libera, as exhibited in *Eriocrania*, in which the large pupal jaws enable it to free itself from its cocoon, and those of other orders of insects with active mandibles, has led Chapman to consider that their evolution has largely been dominated as to how the pupa could escape from the cocoon without the aid of active pupal jaws. He points out that in the Coleoptera and Hymenoptera the imago is perfected within the cocoon, not only throwing off the pupal skin there, but remaining till its appendages have become fully expanded and completely hardened when the imaginal mandibles are used to force an outlet of escape. He further points out that, in many cases, the mandibles are of no use whatever to the imago, except in this one particular, and he cites the *Cynipidae* as the most striking instance known to him. In the *Hemerobiidae*, Trichoptera, &c., that spin silken cocoons the pupal mandibles are used to cut a way out of the cocoon by the pupa. In the *Myrmeleonidae* the pupa partly emerges from its cocoon as does the lepidopterous pupa-incompleta, so that the fundamental methods of obtaining freedom from the cocoon, *viz.*, by pupal mandibles and partial emergence, as exhibited in the more generalised Lepidoptera, are also in use among other orders, presumably more generalised than any Lepidoptera.

Although the Eriocraniids are the only Lepidoptera known to have mandibles with which the cocoon can be ruptured and which (assisted by the vermicular action of the abdominal segments) can be used also to drag the pupa through any superincumbent earth, yet most of the pupæ-incompletæ possess a sort of beak or hard process adapted for breaking open the cocoon. In all these cases, the pupa emerges from the cocoon precisely as in the Eriocraniids, but not, as a rule, so completely, and to do this the pupa seems to have found 3, 4, or 5 abdominal segments capable of movement necessary, but to have kept the terminal segments soldered together. Many different means have been adopted to enable the pupa to free itself from the cocoon, such as specially constructed weak places in the cocoon, a particular arrangement of the silk that allows free egress with but slight internal pressure, a softening fluid applied by the newly-emerging moth, pupal spines of different kinds, and even imaginal spines (*Actias*), &c. Comstock describes the "cocoon-breaker" in *Lithocolletis* (*hamadryadella*) as a toothed crest on the forehead which enables it to pierce or saw through the cocoon. Of its action in some individuals that he was observing, he writes: "Each pupa first sawed through the cocoon near its juncture with the leaf, and worked its way through the gap, by means of the minute backward-directed spines upon its back, until it reached the upper cuticle of the leaf. Through this cuticle it sawed in the same way that it did through the cocoon. The hole was in each case just large enough to permit the chrysalis to work its way out, holding it firmly when partly emerged. When half-way out it stopped, and presently the skin split across the back of the neck and down in front along the antennal sheaths, and allowed the moth to emerge." Packard notes the similar structures in *Bucculatrix*, *Taleporia*, *Thyridopteryx*, and *Œceticus*, and states that rough knobs or slight projections answer the purpose in Hepialids, Megalopygids, Zeuzerids, &c. He further calls attention to the spine on the frontal point of *Sesia tipuliformis*.

Packard states that "the *imagines* of the Attacine moths cut or saw through the 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." He further notes that the "cocoon-cutter" occurs "in all the American genera, in *Samia cynthia*, and is large and well marked in the European *Saturnia pavonia-minor* and *Endromis versicolor*. In *Platysamia* the cocoon-cutters, though well-developed, do not appear to be used at all, and the pupa, like those of the silkworm and other moths protected by a cocoon, moistens the silk threads by a fluid issuing from the mouth, which also moistens the hairs of the head and thorax, together with the antennæ. It remains to be seen whether these structures are only occasionally used, and whether the emission of the fluid is not the usual and normal means of egress of the moth from its cocoon." Trouvelot says that this fluid is secreted during the last few days of the pupal state, and is a dissolvent for the gum that so firmly unites the fibres of the cocoon, the liquid being composed in great part of "bombycic acid." One is inclined to enquire for what purpose *E. versicolor* imago has a cocoon-cutter, seeing that the pupa emerges from the cocoon.

With regard to the manner in which the silk of the cocoon is moistened from the mouth of the emerging moth by certain Saturniids, &c., in order to enable them to escape from the cocoon, Chapman gives some interesting details (*Ent. Mo. Mag.*, vii., pp. 81-82), referring more especially to *Platysamia cecropia*. One is inclined at first to question the possibility of this happening at all, for it is just these moths that have no proboscis and hardly any oral appendages that soften their cocoons with a special fluid. Chapman notes that he has examined many specimens of *P. cecropia* at the moment of emergence, having first taken the pupa from the cocoon. As soon as the pupal skin bursts, the head of the imago appears; the red hairs at the front of the head are at first moist, but soon become quite wet, and, if removed, the fluid is replenished to the quantity of at least one minim, and it is remarkable that, although the wool on the head is as wet as a sponge, the scales of the collar and prolegs which touch it remain quite dry. The fluid is colourless, slightly alkaline, and when applied to the silk of the cocoon at once softens it, so that the silk can be easily eased out. The fluid appears not only to soften the gum that stiffens and binds the silk, but to a certain extent to destroy or neutralise it, for the silk so affected remains soft and pliable. Chapman says that the fluid comes from a narrow slit, separated from the wool of the face by a narrow naked surface that must be the labrum, and that it is prevented from reaching the eyes by means of two small projections which appear to be mandibles, whilst immediately below the slit are two rounded elevations which appear to be the maxillæ. This orifice from which the fluid proceeds, Chapman considers must be the mouth.

CHAPTER IV.

THE INTERNAL STRUCTURE OF THE LEPIDOPTEROUS PUPA.

The marvellous changes that take place in the anatomy of the Lepidoptera (and other holometabolous insects) during the larval and pupal stages have been already foreshadowed in the preceding chapters, and are no less important than the external differences that occur during the same periods. The internal organs of an insect are, in many cases, totally different in the larval and imaginal stages, and these changes are usually greatest in those insects whose food requirements undergo a radical change in the imaginal state. In this respect, Lepidoptera are profoundly modified, and, although less is known of the internal changes in this than in some allied orders, considerable progress has been made during the last two or three decades.

The real nature of the internal changes wrought during the process of metamorphosis was first revealed by Weismann in 1864 when he discovered the "imaginal germs" or "imaginal discs" in the Diptera and formulated his theory of histolysis, *i.e.*, the almost complete destruction of the larval organs by a gradual process of disintegration, and the histogenesis or rebuilding of new organs from the imaginal discs, by utilising the nutrient material obtained from the histolytic products present in the pupa. The intermediary agents in histolysis are the phagocytes, cells similar to the leucocytes or corpuscles of the blood, whilst the intermediary agents in histogenesis are said to be portions of tissue existing in the larval state, incorporated with, or preserving a connection with, the different organs. It is these portions of tissue that form the structures now generally known as the imaginal discs; they are present in very young larvæ, and exist for each part of the body, the appendages, wings, &c. At certain periods of the larval (or pupal) existence they commence to grow rapidly and replace the earlier structures, and, although the two processes of histolysis and histogenesis are mutually dependent on each other (the former supplying the material which is utilised by the latter), they do not go on side by side, although, to a certain extent, contemporaneous. During the quiescent period preceding pupation, many of these discs enlarge and grow rapidly, whilst, at the same time, there is a destruction of the larval tissues, due to the activity of the phagocytes, certain of the larval organs and the fat-body forming a creamy mass, the imaginal discs resisting the leucocytes and living on the nutrient matter thus produced by the dissolution of the fat-body and these larval organs, and, as the last steps in the destruction of the larval organs only take place after those of the imago have assumed their definite shape and size, it follows that the connection of the organs in question remains, in most cases, entirely continuous.

It is, perhaps, not quite correct in Lepidoptera (although somewhat difficult to avoid in treating this technical subject in general terms) to speak of the imaginal discs of legs, antennæ, and other organs that exist in the larva. The point of development of the imaginal organ is, in reality, the larval organ, not a disc existing throughout larval life as a structure separate from that of the larva, *e.g.*, the larval leg is modified, some of its parts are destroyed by histolysis, but the embryonic cells that form the imaginal leg are derived from the larval leg, and so on. Where any other suggestion appears to be implied it must be considered rather as a weakness of diction than any wish to assert the contrary.

It might be remarked here, that the old idea of the imago existing in the larva, and its appearance after various outer shrouds have been successively cast off, is not so very different from the real truth as it was represented to be when the first novelty of a more definite idea of the processes involved still affected us, and tended to warp or numb our appreciation of the actual facts. The imago does exist in the larva, even in the very young larva, not only potentially but actually. The imaginal parts are all represented either by actually similar structures, or by imaginal discs. These may be merely a few cells of no definite structure, certainly none similar to the structures they represent, and into which only they are capable of developing, and are recognisable only by their special anatomical relationships. Development goes on, to some extent, during larval life, but it is, however, only at its end, and in association with the change to pupa, that they assume forms recognisable as those of the fully developed organs. During the pupal stage, after a period of quiescence, both outwardly and physiologically, in those species that hybernate (or æstivate, &c.), the full development of the several organs occurs. The store of material that nourishes the developing tissues is chiefly that contained in the fat-body, but some material is provided by the histolysis of larval structures that are no longer required and disappear. Though there are thus whole organs that are fully developed in the imago and do not exist in the larva, except as imaginal discs, there are hardly any complete organs in the Lepidoptera that wholly disappear at this stage, although, of many, the modifications are so profound, that, to describe what takes place as a complete histolytic destruction of them, is not much exaggerated. The alimentary canal, for instance, remains, but is altered almost beyond recognition by the disappearance of glands and muscles, and by the diminution of its length. Certain mouth-parts also disappear and so on.

The changes that take place in the Lepidoptera are certainly not so extreme as in some of the higher Diptera, where, after the larva has done feeding and before the stage corresponding to the lepidopterous pupa is assumed, extreme histolysis of the larval tissues takes place before the imaginal discs show any signs of development. Some observers have even asserted that the state here reached is comparable with that which takes place in the ovum, and that the imaginal parts, even as discs, do not exist before this stage is reached. This does not seem to be at all likely, notwithstanding that the Diptera do afford many surprises to those whose views are based on a study of the less highly specialised orders. Lowne says, "As all the discs preserve an embryonic character, it is probable they are all present in the young larva or even in the embryo, as distinct groups of cells." In the *Muscidae*, it would appear that all muscles, for instance, disappear by histolysis before the imaginal discs have made any obvious advance. In the Lepidoptera, on the other hand, certain muscular structures persist throughout.

Most of the changes that take place in the pupal period and culminate in the development of the imago, are in active operation, at least, during the final (quiescent) period of larval life. It is during this period that the greatest changes occur in the alimentary canal, the nervous system, &c., and, in many respects, the modifications now cause the organs to approach more nearly to the imaginal structures than the larval from which they have originated. Many of the internal organs represent, at this time, the imaginal organs already in an advanced state of development, whilst others have yet to be almost entirely broken down by histolysis and the new imaginal structures built up from the imaginal discs already present, the latter, as already stated, obtaining their nutrient material from the histolytic products present in the pupa. As a general statement, we may assert that, during the quiescent larval stage, histolysis is predominant, in the pupal stage histogenesis. The "imaginal discs" remain quiescent whilst the other tissues are being disintegrated without sharing in the disintegration, and then commence a career of development, although, as we have already pointed out, this is much less true of Lepidoptera than of the *Muscidae*.

Although this chapter is nominally one on the internal structure of the pupa, it becomes absolutely necessary to consider the previous development of the organs that are found in the pupa, before it is possible to comprehend the nature of the internal organs, or to understand the further changes that take place in them, in the pupal stage. We are especially indebted to Gonin for our knowledge of the part of our subject that immediately follows.

In the adult larva, the TRUE LEGS offer no vestige of an imaginal disc, but they contain a great number of embryonic cells. These cells, round and fusiform, are almost always ranged about a nerve or trachea, sometimes independent, and, at others, retained to the peritoneal sheath. They appear to be formed by the proliferation of this sheath. Some thus contribute to the elongation of the tracheal branch or nerves, others, detaching themselves, constitute the leucocytes of the blood. The ultimate destination of these cells is unknown. Their presence reveals a special activity and they are found in all places where great changes are taking place. They are very numerous in the legs at the commencement of the 4th stadium, disseminating themselves some days later in all the body-cavity. During the histolytic period they attack the larval tissues and increase in size at their expense, on the other hand, they serve for the nutrition of the imaginal structures, on which they have no destructive action. Van Rees agrees with Kowalewski in comparing the attacks of the embryonic cells, now victorious, then powerless, to the struggle that the leucocytes carry on against attenuated and virulent bacteria.

Capillary tracheoles appear in the leg at the same time as in the wing. They originate at the termination of a tracheal trunk near the base of the limb on the dorsal and convex side. This point of origin is analogous with the umbilicus of the wing. After the third moult, the hypodermis thickens in its neighbourhood. It forms a pad or cushion in a few days, then a large bud with circular invagination. This bud elongates before and behind, pushing out the thin envelope; it soon extends beyond the limit of the leg but remains lodged in a depression of the lower surface of the thorax. It then makes a projection, like the wing, in the body-cavity, and, on opening the larva, it is seen to emerge from the interior of each of the true legs. Lyonet has well described these six little masses as having "a very bright iridescent white" appearance, and he surmised that they might be "the germs of the imaginal legs." The nerves and a tracheal branch, before distributing themselves over the rest of the limb, penetrate into the bud and form there a little loop that marks the point of junction of the femur with the tibia. This (which Gonin calls the femoro-tibial) bud is none other than a combination of these two parts, intercalated, so to say, between the larval leg and its base (or root). There is not yet a separating membrane, and the body-cavity still remains in direct communication with the extremity of the limb. This is indispensable to the normal functioning of the muscles, which have not yet completed their duty in the larva. The tracheoles also follow this shortest route without passing through the bud.

In the caterpillar at the period of pupation the extremity only of the imaginal leg germs are drawn from the larval legs. The other parts are applied closely to either side of the thorax. Near the ventral line is a little swelling representing the hip and the trochanter; the femur and the tibia are clearly recognisable, but united to each other, and separated only by a slight furrow. They form, at their union, a very sharp knee. The femur is movable on the swelling or pad of the hip; the tibia is continued without precise limits, with the extremity hidden in the larval leg. The three divisions of the latter do not appear to have any connection with the five joints of the imaginal leg. Under the microscope, the rudiment or disc appears very strongly folded at the level of the tarsus, much less in the other regions. A large trachea penetrates into the femur with some capillaries; arrived at the knee, it is bent inwards to the tibia by a sharp curve, but only becomes really sinuous as it approaches the extremity. It is then the tarsus that is particularly susceptible of elongation, and it is likely in being withdrawn to give the impression that the entire organ frees itself from the larval leg. If, therefore, one cuts the larval leg at its base, one only cuts away that part that becomes the tarsus of the imago, the femur and tibia remain intact. Réaumur, therefore, was wrong in the assumption that the whole imaginal leg was contained in the larval one (Gonin on *Pieris brassicae*).

In the above description, Gonin pictures the leg as it exists towards pupation, when the enlarged leg has left its narrow quarters in the larval leg, from which, however, it takes its origin. He appears to fall into the remarkable error that was originally made with regard to the larval head, when certain authorities averred, from their observation of larval moulting, that the head was developed within the prothorax. We have already noticed (*ante*, p. 18) the inconclusive character of experiments of ablation, and we still consider our explanation of the phenomena as probably the correct one, *viz.*, that the imaginal bud grows out of the larval leg, and finds a lodgment during the progress of development for some of its elements in the thorax at the base of the leg. It will be observed that the stage at which the development of the leg has reached, at the end of larval, and commencement of pupal, life, is such that the greater part of the earlier stages of the development of the imaginal legs has already taken place when the process of pupation is completed. These organs simply complete their development in the pupal stage. The development of the tarsus may now be considered separately.

The TARSUS undergoes a series of transformations. In the last larval stadium the surface is folded in a very complicated manner. At the level of each of the corneous joints, but only on the inner and concave aspect of the foot, a deep fold is developed; there is a hypodermal thickening of the one part, a simple membrane enveloping the other. We think that this new duplication is to permit a complete renovation of the interior of the entire fold, whilst preserving for some days longer the muscular insertions and the connections of the surface with the sensory hairs. These organs, supported by the central face, must be useful to the larva during its preparation for pupation. The envelope unites later, by its base, with the parietal hypoderm, and these two membranes are destroyed together with the large cells of the hairs. The internal part and the extremity of the tarsus are, therefore, merely reorganised, and waste removed, whilst the external (and convex) region undergoes complete reproduction. From the base of the larval leg the hip and the trochanter are derived, being well differentiated from the base of the thorax only in the first pair. A day or two before pupation the femoro-tibial bud, which has preserved till now its antero-posterior direction, is placed transversely in relation to the larva, and then deviates obliquely forward. This see-saw movement around the hip is, perhaps, to be attributed to the enormous extension of the anterior wing, which pushes the first two pairs of legs before it. The last pair, on the contrary, finds itself simply covered by the hindwing, and undergoes only a slight displacement. This new arrangement of the limbs is already that belonging to the imaginal state. The knee of the first pair is placed a little before the tarsus, that of the second pair faces a little more to the outside, that of the third pair is directed backward (Gonin on *Pieris brassicae*).

The first important stages in the development of the imaginal HEAD practically occur in late larval life, the imaginal discs for the antennæ, ocelli, maxillæ, &c., undergoing most of their development in the quiescent stage preceding pupation, whilst the final growth and final histolytic processes that complete the imaginal growth alone take place in the pupal stage.

The ANTENNÆ of the imago bear the same relation to those of the larva as the imaginal bears to the larval leg. The larval organ is only the point of departure of the imaginal development. Weismann has shown how, in *Corethra*, at the approach of each moult, an invagination like the finger of a glove allows the antenna to become elongated from its base. The process is identical in the larva of *Pieris*. At the last moult the invagination is so pronounced that it is not effaced with the renewal of the chitinous skeleton. Some days later it commences to enlarge. As the bud sinks into the head cavity it forces back the hypodermal wall, and makes of it an envelope for itself. Its base, widely open, allows the entrance of the nerves, capillaries, and a large trachea. As soon as it reaches the posterior region of the head, the antennæ, in order to become still more elongated, become strongly folded, and describe large curves (compared by Réaumur with a ram's horn). The membranous envelope thickens inwardly and around the base of the organ. Its subsequent behaviour is connected with that of two other hypodermic structures. It is, in the first place, entirely a base for the cells which, in the larva, carry the ocelli. This base, hidden on each side beneath the parietal wall, is thickened and regenerated, whilst a circular pad or cushion gives it the outline and the form of the imaginal eye. Lastly, we have a conical prolongation, surmounting the head, which presents, at emergence, a tuft of long hairs, to which Gonin has given the name of "cimier." It is characteristic of the Pierid pupæ. It is only differentiated towards the end of the 4th larval stadium in a median depression of the head, and is an imaginal disc in the widest sense of the term. On each side the base of the antenna comes in contact with the germ of the "cimier." The envelopes approach, and their thickened part constitutes, with the ocellar discs, a new cephalic wall. The imaginal head, thus bounded, is triangular, and all the larval structures remaining outside this area have to disappear. The muscles and the nerves are resolved by histolysis, then the external part of the imaginal envelope and the old hypoderm wall, thinned out and degenerated, becomes detached in shreds. The antenna then becomes external throughout its whole extent. Consequently, the transformation is almost as complete here, in *Pieris*, as in the thorax of the Diptera or Hymenoptera. It is necessitated by the change of form and of volume of the head. The ocellar region persists almost alone from the larva to the imago. As for the rest, the limit is not very exact between that which is replaced by substitution or that by direct renewal from the epithelium.

The development of the trunk or MAXILLÆ is so similar to that of the antennæ that it is scarcely necessary to give a special description. Starting from the last moult, the hypodermic contents of the maxillæ draw back into the cephalic cavity in the form of a hollow bud, of which the base is turned internally. The invagination remains less accentuated than around the antennæ. It does not even extend to the anterior part of the œsophagus. The two symmetrical halves of the maxillæ approach and become folded when the larva ceases feeding, each of these incurves in the form of an S, and remains entirely lodged under the floor of the mouth. Two other buds are seen beneath those that give rise to the tongue, which, by an identical process, form the LABIAL PALPI. At the anterior part of the head, where the organs are very close together, the envelopes form many folds without any final use. The two layers then unite and fall on the surface of the tarsus. In the MANDIBLES and the LABRUM there is only a cellular thickening without invagination. On pupation, the trunk is three times folded on the head, and, before raising the cuticle, one observes that a furrow already divides it into two halves. By its size it prevents the approach of the mandibles, whilst the maxillæ and filière remain strongly depressed. The CIMIER, before straightening itself as in the chrysalis, covers the head in the fashion of a Phrygian bonnet (Gonin on *Pieris brassicae*).

It will thus be seen that most of the head-appendages have undergone considerable differentiation by the time the pupal stage is entered and the pupal structures formed. The histolytic processes are largely confined to the tissues not involved in the formation of special imaginal organs, and, to a great extent, the latter structures themselves have only to complete their growth in the pupal stage.

It is necessary, in order to obtain a clear understanding of the changes that occur in the pupal WING, by means of which it is converted into the perfect imaginal structure, to consider briefly the manner in which the wing undergoes development during the larval period. The details as to the facts have been worked out by many observers, and we would here acknowledge our indebtedness to the work of Gonin and Mayer for most of the facts in the following brief summary. Verson has shown that traces of wings may be found in the embryonic larva of *Bombyx mori* some days before it leaves the egg, when the wing consists of a few cells in close propinquity to a tracheal branch placed on the interior of the wall of the body in the meso- and metathoracic segments. They arise from four dorsal imaginal discs, placed two in the mesothoracic and two in the metathoracic segments, which appear towards the close of embryonic life. Landois (1871) and Pancritius (1884) discovered the rudimentary winglets in young lepidopterous larvæ only 4mm. long. At this time they appear as infolded hypodermal pockets, penetrated by tracheæ. When the larva is full grown it is evident that the wing is really a folded portion of the hypodermis (*h'drm.*, Pl. i., fig. 1) itself, enclosing a thin layer of mesodermal tissue (*mbr. m.*, Pl. i., fig. 1). The conditions, however, are complicated. The wing-pad proper is a pocket-like *out*folding of the hypodermis, which is more or less folded upon itself. This pocket, instead of lying exposed between the hypodermal covering of the larva and its cuticula, is protected by being sunk into a deep saclike *in*folding of the hypodermis, the walls of which are very much thinner than those of the wing-pad, and, indeed, thinner than the rest of the hypodermis. The walls of the infolded sac follow quite closely the foldings of the wing-pad itself. In penetrating, from without inward, one would traverse, in succession, in the region of the wing-pad, five layers of the epidermis: (1) The outer and inner layers of the operculum-like fold of the hypodermis which covers in the wing. (2) The thick outer and inner layers of the wing-pad. (3) The thin inner layer of the infolded sac (Mayer).

In larvæ in the 1st stadium, 3-4mm. long, Gonin found the wing-germs (discs) as a thickening of the hypodermis, with the embryonic cells of Verson on the convex border. The two sides of the wing begin

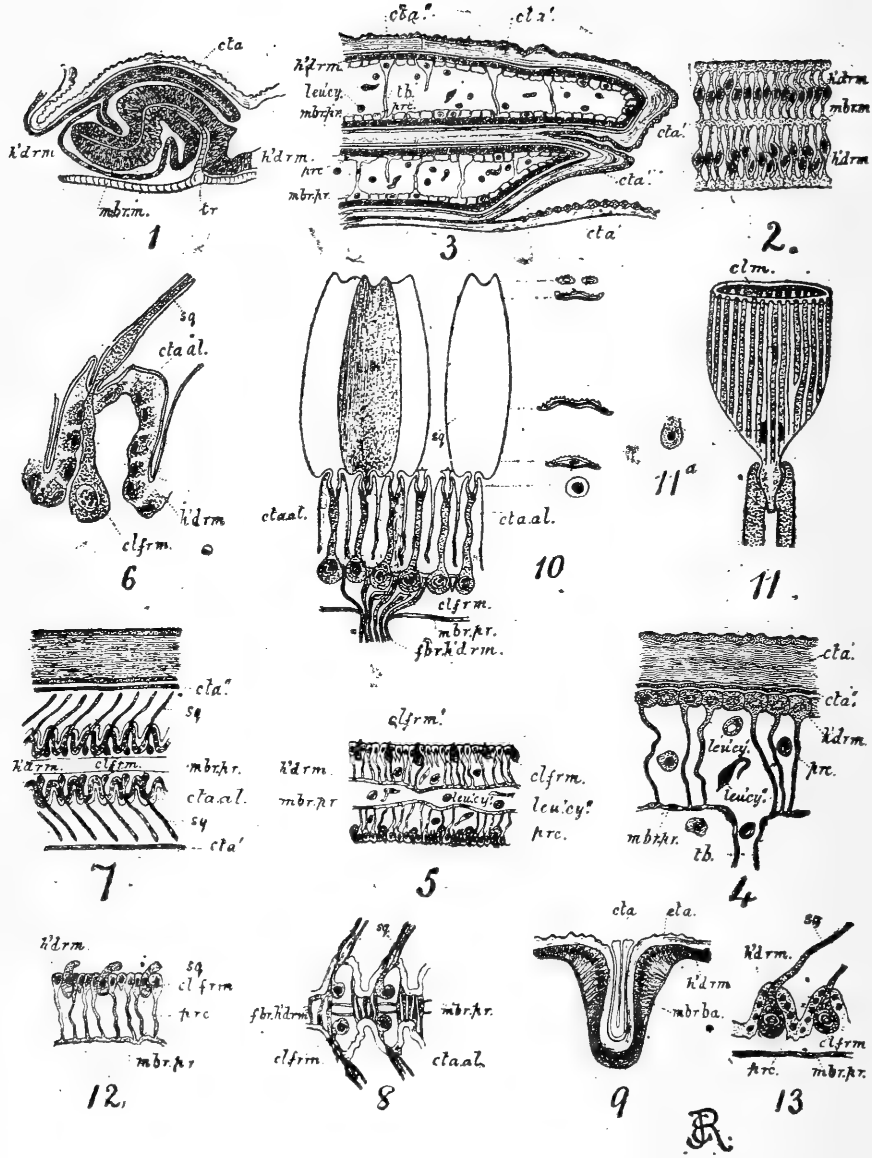

PLATE I.

THE DEVELOPMENT OF THE WING, WING-SCALES AND THEIR PIGMENTS IN BUTTERFLIES AND MOTHS.

DESCRIPTION OF PLATE I.

Fig. 1.—Longitudinal section through the left hind-wing of the mature larva of *Pieris rapae*. The plane of the section is parallel to the frontal plane of the larva, *i.e.*, perpendicular to its dorso-ventral axis.

Fig. 2.—A portion of a cross-section of the larval wing of *P. rapae*.

Fig. 3.—Longitudinal section (*i.e.*, with the trend of the nervures) through the pupal wings of *Samia cecropia*. The section is taken near the lower free edges of the pupal wing cases.

Fig. 4.—Portion of a longitudinal section through the pupal cuticula and wing tissue of *S. cecropia*. Specimen killed in January.

Fig. 5.—Portion of a longitudinal section through one of the young pupal wings of *Euvanessa antiopa*.

Fig. 6.—Portion of a longitudinal section through a pupal wing of *Anosia archippus*, about eight days before emergence.

Fig. 7.—Portion of a longitudinal section through one of the pupal wings of *A. archippus* about eight days before emergence.

Fig. 8.—Portion of a longitudinal section through a pupal wing of *A. archippus*, about five days before emergence.

Fig. 9.—Portion of a cross section through the mid-dorsal region of a larva of *P. rapae*, taken just back of the head, in the place where the cuticula splits when moults occur.

Fig. 10.—Portion of a cross section (*i.e.*, perpendicular to the trend of the nervures) through the pupal wing of *A. archippus*, about six days before emergence.

Fig. 11.—View looking down upon the upper (*i.e.*, exposed) surface of one of the large scales situated upon the nervures of *A. archippus*. Stage, about four days before emergence.

Fig. 11a.—Leucocyte found within the scale represented by fig. 11, about four days before emergence.

Fig. 12.—Portion of a longitudinal section through one wall only of the pupal wing of *E. antiopa*, slightly more developed than fig. 5.

Fig. 13.—Portion of a longitudinal section (*i.e.*, parallel with the trend of the nervures) through the pupal wing of *Anosia archippus*, about eight or nine days before emergence.

ABREVIATIONS USED IN PLATE I.

a.	anterior.
cl. frm.	formative cells of the scales.
clm.	chitinous pillars found in scales.
cta.	outer chitinous cuticula of the larva.
cta′.	outer chitinous cuticula of the pupa.
cta″.	inner cuticula membrane of pupa.
cta. al.	wing membrane.
fbr. h′drm.	hypodermal fibres of pupal wings.
h′drm.	hypodermis.
leu′cy.	leucocytes.
leu′cy′.	vacuolated leucocytes, as found in the very young pupa.
leu′cy″.	elongated spindle-shaped leucocytes.
mbr. ba.	basement membrane of the larval hypodermis.
mbr. m.	middle membrane of the larval wings.
mbr. pr.	Grundmembran of Semper.
nl.	nuclei of the stellate cells that secrete the Grundmembran.
p.	posterior.
prc.	processes of young hypodermis cells.
sq.	scale.
tb.	tubes produced from the newly - formed Grundmembran.
tr.	trachea.

to differentiate in the 2nd stadium, whilst in the 3rd, the tracheæ begin to proliferate, and the capillary tracheæ or tracheoles arise. The wall of the principal trachea appears to be resolved into filaments, and all the secondary branches assume the appearance of bundles of twine. Landois regarded them as the product of a transformation of the nuclei, but Gonin thinks they originate from the entire cells, stating that from each cell arises a ball (peloton) of small twisted tubes. As the large branches penetrate into the wing, the balls (pelotons) of fine tracheal threads tend to unroll, and each of the new ramifications of the secondary tracheal system is accompanied in its course by a bundle of capillary tubes. This secondary system of wing-tracheæ, then, arises from the mother-trachea at the end of the 3rd stadium, when we find, already formed, the chitinous tunic which will persist through the fourth stage up to pupation. It differs from the tracheoles in not communicating with the air-passage; it possesses no spiral membrane at the origin and takes no part in respiration. Gonin thus sums up the nature of the two tracheal systems in the rudimentary wing, which he calls the provisional and permanent systems, "the first, appearing in the second stage of the larva, comprises all the capillary tubes, and arising from numerous branches passes off from the lateral trunk of the thorax before reaching the wing; the second is formed a little later by the direct ramification of the principal branch. These two systems are absolutely independent of each other within the wing. Their existence is simultaneous but not conjoint. One is functionally active after the third moult; the other waits the final transformation before becoming active" (Packard).

The tracheæ (*tr.*, Pl. i., fig. 1) penetrate between the two thickened layers of the wing-pad, the outermost layer being destined ultimately to form the upper wall of the future wing, the inner layer becoming the lower wall. The cells which compose the wing-pads are more crowded in the longitudinal direction than in the direction across the wing. The cells forming the tissue at this time are spindle-shaped hypodermal cells (Pl. i., fig. 2). When the larva changes into a pupa, the wings expand to about sixty times their former area, and the cells, being no longer crowded, lose their spindle shape, and flatten out into a pavement epithelium.

The wing is evaginated, and becomes an external organ during the quiescent period preceding pupation. Gonin says that in *Pieris*, six or seven days after the last larval moult, the chitinous wall is formed, the wing remaining transparent. It grows rapidly, and its lower edge extends near the legs. It is now much crumpled on the edge, owing to its rapid growth within the limits of its own segment. Partly from being somewhat retracted, and partly owing to the irregularity of its surface, the wing gradually separates from its envelope, and the cavity of invagination becomes more like a distinct or real space. The outer opening of the alary sac enlarges quite plainly, though without reaching the level of the edge of the wing. Forty-eight hours later, examination of a caterpillar which had just spun its girdle showed that the wings had become entirely external, the partition of the sac had disappeared, and with it the cavity and the leaf of the envelope. After the destruction of the partition, what remains of the layer of the envelope is destined to make a part of the thoracic wall, and undergoes for this purpose a superficial desquamation. The layer of flattened cells is removed and replaced by a firmer epithelium like that covering the other regions. It is this renewed hypodermis which conceals the wing within, serves to separate it from the cavity of the body, and gives the illusion of a complete change in its situation.

The chitinous outer cuticula (*cta.'*) of the pupa encloses each wing in a separate sheath (Pl. i., fig. 3), exhibits a stratified condition, and is deeply pigmented near its outer surface (Pl. i., fig. 4). A delicate structureless membrane, known as the inner cuticula (*cta''*, Pl. i., fig. 4), lies between the outer cuticula (*cta.'*) and the hypodermis (*h'drm.*). At this stage each wing consists of a hollow bag, the wall of which is composed of a single layer of hypodermal cells (*h'drm.*, figs. 3 and 4) which contain large oval nuclei, the latter exhibiting chromatin granules arranged near the periphery. One now finds a delicate membrane (*mbr. pr.*, Pl. i., fig. 4) lining the whole interior of the wing-bags. This is the "grundmembran" of Semper (1857), who showed that it was produced by mesenchymatous cells, which applied themselves to the deep surface of the hypodermis, and sent out lateral processes, serving both to connect the cells with one another and to give them a stellate form. These stellate cells secrete an intercellular substance, filling up the interstices of the network formed by them, and this substance, together with the metamorphosed cells that produce it, finally become the thin structureless membrane to which Semper gave the name "grundmembran." This membrane is widely separated from the hypodermis as a whole, and the space between them contains lymph corpuscles in large numbers (Mayer). It appears to be probable that there are communications between the sub-hypodermal spaces and the chief lumen of the wing. At rather regular intervals the "grundmembran" of one wall becomes continuous with that of the other by means of hollow tubes (*tb.*, Pl. i., figs. 3 and 4), formed by the folding of the membrane itself. The cavities of these tubes are direct continuations of the sub-hypodermal spaces of the upper and lower walls of the sac. Leucocytes are frequently found within the tubes. A slender thread-like prolongation of the hypodermic cells (*prc.*, Pl. i., figs. 3, 4, 5) extends inward from each cell of the hypodermis to the "grundmembran"; each cell gives rise to only one, and occasionally a cell is seen without any, process. The wings at this stage are still little more than simple out-pocketings of the general hypodermis of the chrysalis. In fact, in the larva itself the general hypodermis of the body is lined on the inner side by a thin membrane, coincident in relative position with the "grundmembran" of the wings, and where this membrane is stretched, as in Pl. i., fig. 9, the hypodermal cells send out processes which are connected with the membrane. This reminds us of the condition of the processes (*prc.*, Pl. i., figs. 3 and 4) in the pupa.

The wings are filled with hæmolymph (blood), and this fluid contains blood corpuscles of different shapes (*leu'cy.*, *leu'cy.'* *leu'cy.''*, Pl. i., figs. 3 and 4), some of which are vacuolated (*leu'cy.'*, Pl. i., figs. 4 and 5) and appear to be corpuscles in the course of degeneration. Mayer supposes that these are the fat cells of Semper.

About three weeks before the insect will emerge (a less period, of course, in those species in which the pupal period is very short), "certain of the hypodermic cells (*cl. frm.*, Pl. i., fig. 5), which occur at regular intervals, begin to be modified. They commence to increase slightly in size, to project a little above the level of the ordinary hypodermic cells, and, most remarkable of all, to acquire each a vacuole." These modified cells are destined to give rise to the scales. They are the formative cells of the scales, the "Bildungzellen" of Semper. The evidence at present available tends to show that these scale-producing cells are hypodermal, and not mesenchymatous cells, that they are, in fact, modified hypodermal cells.

It may be well to add here, that Jackson has observed (*Trans. Linn. Soc. Lond.*, 2nd series, v., p. 166) a cuticular secretion apparently fluid, formed by the hypodermis just before the appearance of these scales. He says that, at this period, the hypodermic cells themselves readily separate from the pupal cuticle, and that on their surface is a darkly staining layer, looking like a new cuticle, which he believes to be a coagulable fluid, for, in the next stage, it is increased in amount, and, in some of the sections, the growing scales may be seen imbedded in it. He also notes that it appears at a later period to be drawn out into irregular bands and filaments by the separation of the pupal cuticle from the hypodermis.

In the next stage the scale-producing cell (*sq.*) has already grown outward as a blunt process, which bends distad or towards the outer edge of the wing. The protoplasmic prolongations at the deep ends of the formative cells have nearly all disappeared. There is usually only one vacuole, occasionally there are two, in each of these cells (Pl. i., fig. 12).

The pupal wing of *Aglais urticae*, three days after pupation, shows a slight advance in development on the above. The formative cells are quite large, and each contains several small vacuoles; they no longer exhibit any trace of protoplasmic processes.

At a slightly more developed stage (the pupa examined is that of *Anosia archippus*) the formative cells have greatly increased in size, and the vacuoles have entirely disappeared. The upward projections, which are to form the scales, have grown outward to a much greater extent than in the stage last described. The hypodermis is thrown into a regular series of transverse ridges (across the nervures), each ridge corresponding in position with a row of formative cells, and each furrow with the interval within two adjacent rows. As a consequence, the scales always project from the tops of these ridges. The "grundmembran" does not partake in the folding, and the deep processes of the hypodermal cells, that once extended to this membrane, have now disappeared (Pl. i., fig. 13).

About eight days before the emergence of the imago of *A. archippus*, the inner cuticular membrane, which previously lay almost in contact with the hypodermal cells, has been pushed outward by the development of the scales (*vide*, Pl. i., fig. 7). The growth of a single scale at this period, separating the cuticular covering of the pupa, is shown in Pl. i., fig. 6, where the scale *sq.* is seen in connection with the formative cell (*cl. frm.*) of the scales (*vide*, Pl. i., fig. 7). The protoplasmic processes which joined the hypodermis to the "grundmembran" (*mbr. pr.*) have disappeared, the latter being now nothing more than a simple homogeneous structure, with the appearance of a structureless membrane lying below the hypodermis (Pl. i., fig. 7). At this, and, still better, at a little later, stage of development, it is observed that the body of the large formative cells lies below the level of the ordinary cells, and sends a protoplasmic process upward to form the scale. This is well exhibited in Pl. i., fig. 6. The scale at this stage is a minute flattened chitinous bag, filled with protoplasm, and, whilst the scales remain full of protoplasm, they appear as transparent as glass, but when the protoplasm shrinks out of them they become whitish.

The hypodermal cells, although no longer separated by well-defined cell walls, are still well marked out by the peculiar arrangement of the finely granular contents of the cells. The hypodermis, too, has now begun to secrete the chitinous cuticula of the wing membrane ; but it is as yet very thin, becoming much thicker as the wings develop. Each of the hypodermal cells, at this stage, gives rise to a new prolongation (*fbr. h'drm.*) from its base, which, piercing the grundmembran below it, traverses the lumen of the wing, pierces the grundmembran of the opposite side, and finally unites with the cuticula of the opposite surface of the wing (fig. 8, *fbr. h'drm.*), and thus every hypodermal cell becomes converted into a long, thin fibre, stretching from the upper to the lower surface of the wing, and the similarity of their appearance to muscular fibres suggests that they may be contractile, although Mayer believes that they, in time, become tendinous cords, serving to hold the opposite membranes of the wing together during its great expansion, directly after the exclusion from the chrysalis. Schäffer thought that these fibres were merely the original protoplasmic prolongations (such as are shown in Pl. i., fig. 5, *prc.*) fused together, but he was quite unaware of the absorption of these prolongations, and the subsequent development of the fibres uniting the opposite membranes forming the wing.

In the scale itself, the protoplasm which fills the primitive scale undergoes contraction, and becomes coarsely granular, and gradually withdraws from the scale, leaving little chitinous pillars (*clm.*, Pl. i., fig. 11) which bind the upper and lower surfaces of the scale together. Mayer says that the protoplasm is entirely withdrawn, and that the scales then become merely little flattened, hollow, chitinous sacs, containing only air. Chapman, however, dissents entirely from this view, and states that no air enters any of the scales until the pigment is fully elaborated. We have ourselves noted that the scales, at this so-called "white" stage, are very different in appearance from the opaque whiteness which characterises actually white scales filled with air, at the final stage of development. It appears that the scales, at this stage are not filled with air, but are filled with a clear secretion from the hæmolymph, containing all the necessary materials for going through the chemical changes which result in pigmentation. The striations of the scale may be observed, at this stage, to be due to a series of parallel longitudinal ridges on the upper surface (Pl. i., figs. 10-11), the under surface of the scale is provided with but few, and these ill-developed, ridges.

The next stage of development shows the wings of a yellow-ochre colour, for the secretion from the hæmolymph, which fills the scales, begins to undergo the chemical changes which result in pigmentation. The formative cells now show great change, and the formation of the scales being completed, and there being no further use for these cells in the economy of the insect, they undergo degeneration. At this stage, certain scales (? androconia) situated either upon the nervures or near the outer edges of the wing, have a leucocyte enter them; the pigmented scales contain no leucocyte.

The insertion of the scale into the wing membrane is brought about by the filling of the narrow cylindrical stalk of the scale into a minute close-fitting socket, which perforates the wing membrane (Pl. i., fig. 10). It is not set into a tube, as Landois supposed, nor did Mayer discover anything resembling the "Schuppenbalg" described by Spuler, for the insertion of the scales.

The transverse folding of the wing membrane is very sharp, and the latter is, in fact, thrown into a very regular series of closely compressed folds (*cta. al.*, Pl. i., fig. 10), a single scale being inserted on the crest of each fold. When the imago emerges from the chrysalis, the hæmolymph (blood), within the wings, is under considerable pressure, and this would tend to enlarge the wing into an inflated bag; but the hypodermal fibres (Pl. i., fig. 8), before described, hold the upper and lower walls of the wings together, and the bag becomes a flat, instead of an inflated one. In *A. archippus*, Mayer points out that "the area of the wing of the imago is 8·6 times that of the pupa. The wing of the newly-formed pupa has about sixty times the area of the wing in the mature larva, so that it is evident that, in passing from the larval state to maturity, the area of the wings increases more than five hundred times."

We have already seen that when the scale first appears it is only a small protoplasmic cell, which very soon increases in size, and flattens out, and finally assumes the outward shape of the mature scale. A layer of chitin is then secreted over its entire outer surface, so that the scale becomes a thin, flat chitinous bag, filled with protoplasm, the chitin upon the upper surface of the scale being striated, the lower surface smooth. Many scales have two sets of striæ—a well-developed longitudinal set, and a finer transverse set. These striations diffract the light, and give rise to the iridescent colours observed on the wings of many Lepidoptera.

So long as the scales remain filled with protoplasm, they are quite transparent, but the protoplasm afterwards becomes coarsely granular, and appears to give place to a secretion from the hæmolymph, which contains the necessary material for the elaboration of the pigment, the white coloration being different from the opaque whiteness noticeable in air-filled scales. Mayer says that "the scales which are destined to be white upon the mature wing are now completely formed, and undergo no further changes, hence, ontogenetically speaking, the white spots (? scales, J. W. T.) upon the wing are the oldest of all." Here we would offer two notes of criticism: (1) That the white scales of an insect's wing are of two entirely different classes. Some white scales are quite richly pigmented (see *Entom. Rec.*, vol. vi., pp. 35 *et seq.*, 109 *et seq.*, 204 *et seq.*), *e.g.*, the white areas of the wings of *Melanargia galathea*, the white spots on the wings of *Syrichthus malvae*, and numerous other examples, which have been already fully discussed.* (2) That the whole of the scales (pigmented and unpigmented) are supplied with air, only in the final stage of their development.

The secretion from the hæmolymph (= the "pigment factor" of

* "The genetic sequence of insect colours."—*British Noctuae and their Varieties*, vol. ii., pp. i—xviii.

Riding) which fills the scales destined to become pigmented, now enters them. It does not enter scales which will finally be white (due to air contents), but does, in many insects, enter other scales, which are ultimately white. Mayer says the hæmolymph of the chrysalis, which is a clear amber yellow fluid, now enters them, but Chapman has already adversely (*Ent. Rec.*, ix., pp. 78-79) criticised this view, and has suggested that only a secretion of the hæmolymph does so. The material in the scales now becomes "ochre-yellow" in tint, whatever their ultimate colour is destined to be, and, having remained in this stage for about 24 hours (in the case of *A. archippus*), the mature colours begin to show themselves. These mature colours always appear first within scales which are situated between the nervures. They are faint at the beginning, but gradually increase in intensity. For example, if a scale be destined to become black, it first becomes pale greyish-brown, and this colour gradually deepens into black†. This pigment is no doubt derived from the hæmolymph within the scale at the time it first appears. It is probably produced by chemical processes that are somewhat analogous to the clotting of the blood, for the pigment is found to be sublimed over all the surfaces of the cavity of the scale, the layer of pigment being especially thick upon the upper surface of the scale.

Landois, in 1864, found that when the blood of beetles and butterflies was allowed to evaporate in the air, crystals separated out. He also found that the blood consisted chiefly of egg-albumen, but that globulin, fibrin and iron were present. He further observed, that when the blood was allowed to dry in the air, it generally became brownish or yellowish, and that, while the colours of the blood were different for different species, the colour assumed by the dried blood was apt to be similar to the ground-colour of the wings of the mature insect from which the blood was drawn.

Mayer states that he believes the pigments of the scales are derived from the hæmolymph, or blood of the chrysalis; and his chief reason for believing this is, that he can find no evidence that there is anything but hæmolymph within the scales during the time that the pigment is formed. Chapman doubts whether the crude hæmolymph ever enters them, but thinks that a secretion from it does so, and that the latter contains the materials necessary for going through the chemical change resulting in pigmentation.

Mayer has made a chemical analysis of the pupal blood, which agrees with that made by Landois. When the hæmolymph is agitated with ether, the proteid substances are coagulated, and a clear amber-yellow solution is left. When thus isolated the proteids are slightly yellowish, but they soon dry into a drab-coloured mass, very much as the hæmolymph does upon exposure to the air. Spectrum analysis shows that the colour of the amber-yellow solution is due to xanthophyll, and Poulton found that the colours of many lepidopterous larvæ and pupæ were due to chlorophyll and xanthophyll, derived from their food. The hæmolymph is acid to litmus, and contains a large amount of orthophosphoric acid. The mineral bases of the hæmolymph are iron, potassium and sodium—the iron in considerable quantity.

† This fully bears out our contention as to "pigmentary blacks."—*Brit. Noct.*, ii., pp. vi—vii; *Ent. Record*, vi., pp. 38-40 and pp. 107-111.

"The freshly-obtained hæmolymph is a clear opalescent amber-yellow fluid; it soon becomes turbid upon exposure to the air, and in less than half-an-hour after removal from the chrysalis becomes opaque, and drab or greenish-drab in colour." Mayer further notes that the drab colour, assumed by the dried hæmolymph obtained from the pupa of *Callosamia promethea*, and the greenish-drab assumed by the dried hæmolymph of *Philosamia cynthia*, are very similar to the principal colour of the moths' wings. The change in colour exhibited by the hæmolymph upon exposure to the air is probably not due to a simple process of oxidation. It takes place slowly in an atmosphere of hydrogen; an atmosphere of CO_2 prevents it; whilst, if the hæmolymph be sealed up in air-tight glass tubes, it retains its amber colour indefinitely. Heated to 54°C., it begins to congeal, and above 63°C. solidifies into a chrome-yellow mass, and, in this condition, it will keep indefinitely, and retain its original chrome-yellow colour; but when congelation is produced in hæmolymph that has become drab by exposure to air, the congealed mass is also drab in colour.

To test whether the colours of the mature wing are derived by various chemical processes from the hæmolymph of the pupa, Mayer performed the following experiments: (1) He treated the hæmolymph of *Samia cecropia* with warm concentrated HNO_3, when it congealed into a deep chrome-yellow mass. Ammonia (in excess), added to this, changed it to reddish-orange, very similar in colour to the reddish-orange band that crosses the upper surface of the hindwings of the moth. The reddish-orange band of the moth is changed to chrome-yellow by HCl or HNO_3, and, on ammonia being added, the original red colour returns. Exactly the same sequence of reactions is produced with the pigment derived from the hæmolymph. (2) Treating the drab-coloured outer edge of the wing of *S. cecropia* with warm HNO_3, and evaporating the acid off at a gentle heat, the drab pigment of the scales was found to be changed to a deep chrome-yellow. The addition of ammonia makes it reddish. Similar reactions are obtained from the hæmolymph, after it has congealed in the air into a greenish-drab mass. (3) The drab hæmolymph of *Callosamia promethea* is dissolved and changed to a sepia-brown colour by warm HCl, to which a crystal of $KClO_3$ is added. An exactly similar change occurs when the drab-coloured edges of the moth's wings are treated in a similar manner.

These experiments, like those of Coste (*Entomologist*, 1891, *et seq.*) and Urech (*Zeit. f. wiss. Zool.*, lvii., 1893-1894), get no further, in fact, not so far, in relation to the white pigmentary scales as Coverdale and ourselves got some twelve years ago (*Brit. Noct.*, vol. ii., pp. iii—xviii). A brief statement of the general action of alkalies in changing pigments, and of acids in restoring the changed pigments to their original colours, was published by Coverdale (*Entom.*) in 1886.

As to the chemical nature of the pigment in the scales, we know but very little. Hopkins has shown that the white pigments in the *Pieridae* are due to uric acid. Mayer quotes this, and yet seems to have failed entirely to apply the self-evident deductions to his own observations on the white scales. Throughout his paper we read nothing of the pigments in the white scales of certain butterflies, but the general assumption is more than once expressed, that the colour of all white scales is due to their being devoid of pigment and to the reflection of light. Hence the justice of Chapman's criticism

(*Ent. Rec.*, ix., pp. 78-79) becomes still more evident. Hopkins not only isolated this white pigment, but proved that under certain conditions it could be readily changed into yellow. It happens that the white Pierids, which have become mimics of the orange Nymphalids, have really changed their colour from white to orange. The chemical change, Hopkins has shown, is easy. Yet we know nothing as to how it has been brought about.

Hopkins has demonstrated that the pigment-factor in the wings of the *Pieridae* was of an excretory nature, containing uric acid. The production of the yellow Pierid pigment may be obtained by heating uric acid with water, in sealed tubes, at high temperatures. This "lepidopteric acid," as the yellow Pierid pigmentary matter is called, is closely related to a red product, easily obtainable. To the practical entomologist it will at once occur that white, yellow and red are the three colours that function chiefly in the ornament of the *Pieridae*, and its importance is at once evident. The uric acid derivatives, however, appear to be confined to the *Pieridae* among butterflies, for when a Pierid mimics an insect belonging to the *Nymphalidae*, the pigments are chemically quite distinct. Griffiths (*Comptes Rendus Acad. Sci. Paris*, cxv., pp. 958-959) shows that the green pigment found in certain Papilionid, Hesperiid and Nymphalid butterflies, as well as in certain Noctuid, Geometrid and Sphingid moths, also consists of a derivative of uric acid, which he also calls "lepidopteric acid" (C_{11} H_{10} Az_2 N_8 O_{10}). By prolonged boiling in HCl it is converted into uric acid. Since it is the modification of these pigments, into whose origin we have been enquiring, that produces variation in the colours of insects, we would again reiterate what we have repeatedly asserted during the last few years, *viz.*, that all changes of colour in the scales of insects are but outward manifestations of the living activities and physiological processes of the animal in its earlier stages—egg, larva, pupa—or some interference with the normal course of these activities, or with its usual conditions of development. We need not here repeat what we have already published* on these points, but the truth of which is being substantiated by recent enquiry, and it is quite evident that in studying variation we must consider the vital processes of the animal, and the peculiarities under which they are carried on, if we are to get a true conception of the actual causes of variation.

Mayer further states that, "in connection with the phenomena of pigmentation, it is interesting to note that, while uric acid may easily be demonstrated by the muroxide test to be present in the fluids of the alimentary tract of the pupæ of the *Saturniidae*, it is never present in the hæmolymph of the imago, nor can it be detected in the drab-coloured pigment of the outer edges of the wings. The amount of uric acid in the fluids of the alimentary tract of the pupa increases as the pupa becomes older, so that the fluid which is voided upon emergence is always strongly impregnated with it. In the case of *Pieris rapae* there is no uric acid, either in the alimentary tract or hæmolymph of the larva, but it is present in the alimentary tract of the pupa. It seems to me probable that the uric acid of the alimentary canal

* *Brit. Noctuae*, vol. ii., pp. i—xviii. "Variation considered biologically."—*Ent. Rec.*, vi., pp. 181 *et seq.* "Pupal development and the colour of the resulting imago."—*Ent. Rec.*, iv., pp. 311-315, etc.

of the pupa may be a product of the metabolism of the hæmolymph that is removed from the fluids of the body by the Malpighian tubules."

It is important to notice that Mayer's proof that the scales are formed from modified hypodermic cells makes them truly homologous with the hairs of Arthropods.

Another important fact insisted on by Mayer is that "the pupal wings exhibit two sets of corrugations or foldings, one being parallel to the trend of the nervures, and the other at right angles to it. In either cross or longitudinal section these corrugations appear as a regular series of ridges, and a single scale arises from the crest of each ridge." He further writes: "Very large scales are found along the nervures and upon the outer edges of the wings in *A. archippus*. In fact, these scales are so large, that, after the protoplasm has withdrawn from them, a single leucocyte enters each one. These leucocytes degenerate and finally disintegrate, without, however, contributing directly to the pigmentation of the scale. The fact that the leucocytes degenerate after entering the scales, indicates that the hæmolymph within the scale is not in a normal condition."

Yet another point insisted upon by Mayer is that "dull ochre-yellow and drabs are, phylogenetically speaking, the oldest pigment colours in the Lepidoptera, for these are the colours that are assumed by the hæmolymph upon mere exposure to the air. . . . Dull ochre-yellows and drabs are at the present day the prevalent colours among the less differentiated nocturnal moths. The diurnal Lepidoptera have almost a monopoly of the brilliant colorations, but even in these diurnal forms one finds that dull yellow or drab colours are still quite common upon those parts of their wings that are hidden from view."

Mayer's demonstration that the pigmentary matter deposited in the scales of Lepidoptera is a derivative of the blood, secreted at a time when the histogenesis of the tissues of the imago has been completed within the pupa, gives a hint as to the actual nature of scale pigments. They would appear to consist of the nitrogenous material left in the blood after the building-up of the essential tissues of the insect, formed into definite secretions, which the insect is able to get rid of in a purposeful manner in the form of pigments. It must not be forgotten that all the vital activities of the pupa are taking place in a multitude of ways in a closed cell, that no new material can be obtained, and that only water and CO_2 can escape from the animal, there being no external outlets in the pupa for getting rid of the used-up material, although the urea and urates can accumulate in the urinary tubules. The new combination of the chemical elements which form the tissues of the imago, must, therefore, balance to a nicety that which existed in the very different structures of the newly-formed pupa (less that which is utilised in producing the change). It is well-known that almost all newly-emerged lepidopterous imagines void one or more drops of fluid with an uric base after emergence from the pupa. This must represent the material which has been utilised by the vital functions accompanying the processes of histolysis and histogenesis, and that has afforded the necessary force for the formation of the new tissue. Hopkins, Griffiths and others have demonstrated that the pigments of Lepidoptera are derivatives of uric acid, that these uric pigments must arise as the result of the vital activities of the pupa during the time that the imago is being developed, is, we consider, beyond question.

With regard to the INTEGUMENT of the imago, Packard writes that the portion of the wing-sac which persists when the pupal-wing passes to the exterior (*i.e.*, the basal portion, the "peripheral pad" of Bugnion, or the "annular zone" of Künckel), serves at first to attach the appendage, whilst forming, to the hypodermis of the larva, then afterwards, to more or less completely regenerate the adjoining portion of the integument. In this way, the hypodermis of the thorax is partially, that in the head is almost entirely, replaced by the imaginal epithelium which proliferates at the base of the appendages, while that of the abdominal segments persists, at least in a modified way, and only undergoes, at the end of the pupal period, transformations as regards the appearance of the scales and pigment.

Reference to Newport's figures (*Insecta*, 1839) of the internal organs of the larva, pupa and imago of *Sphinx ligustri* will convey a better idea of the changes that occur in the DIGESTIVE ORGANS than any amount of description. Reference to these will also show that the alimentary canal of the pupa is almost as much differentiated as is that of the imago, though the reservoir or "sucking stomach" of the imago is not indicated in the pupa. These changes are quite in accordance with the needs of the animal and accommodate themselves to the great change that occurs in an insect which has passed from a larva with an enormously voracious appetite to an imago that exists on a small quantity of water and nectar or that practically abstains from all food. Corresponding with the reduction in the size of the alimentary canal, the salivary glands and other organs actively employed in the processes of larval digestion undergo a thorough reduction. Newport's figures are reproduced by Packard (*Textbook of Entomology*, p. 646, figs. 598-600).

The smaller TRACHEÆ, and even some of the larger branches, undergo destruction with those of the larval structures to which they belong, when they disappear as already described, whilst similar ones are developed in the imaginal structures which take definite form at this period. One portion of this development has already been described as part of the growth of the imaginal discs of the young larva into the pupal wings. The changes in the general plan of the tracheal trunks and their main branches are not so sweeping as occur in the higher Diptera. The great change that occurs is the development of larger trunks and more numerous branches in the thoracic and cephalic regions and the destruction without replacement of abdominal tracheæ. In the larva, the prothoracic spiracle is an important one. It is, if anything, more so in the pupa. The mesothoracic spiracle, which does not exist in the larva, is present in the pupa, though it can hardly be said to be functional, being, like the first abdominal one, covered by the wings. This spiracle possesses a representative in the larva in a fine filament passing from the skin at the junction of the meso- and metathorax to the tracheal trunk. At the moults, this filament serves to draw out, with the skin, the tracheal lining of the adjacent trunk and branches. The track of this filament is no doubt supplied with embryonal cells, which replace it at each moult, and, with others beneath the hypodermis, form, in fact, an imaginal disc for the development of the (pupal and) imaginal spiracle and tracheal trunk. More important, if anything, in the larva, than the first spiracle, is the last, that of the 8th abdominal segment. At the change to pupa, tracheal linings are withdrawn from the spiracle as from the others and as at each of the larval moults, but the cells that replace these linings where the tracheæ remain, now fail, and are, in fact, exhausted. The pupa develops here no spiracle (but only a scar) nor any tracheal tube from the spiracular position to the main trunk. It is of interest to note that this 8th abdominal spiracle is the one that is of such paramount importance in the dipterous larva, and that it equally disappears on the change to pupa.

The NERVOUS SYSTEM of the lepidopterous pupa is much nearer to that of the imago than is that of the larva. Already the ganglia of the central chain have (especially in the shortened thoracic areas) become united, but the amount of centralisation, even then, is small compared with the final imaginal nervous system. Packard gives (*Text-book of Entomology*, p. 649) ten figures, after Newport, of the changes in the nervous system of *Aglais urticae* during and after pupation. Packard (quoting Newport) writes: During the last larval stage certain changes have already taken place in different parts of the cord, which show that they have been a long time in progress. Besides the lateral approximation of the cords, the first change consists in an union of the 11th and 12th ganglia, the latter one being carried forwards, these two ganglia being entirely separate before the third moult. Two hours after the larva of *Aglais urticae* has suspended itself for pupation the brain has not enlarged, but the subœsophageal ganglion is nearly twice its original size and the ganglia behind are nearer together. A little while before the old larval skin is thrown off there is great excitement throughout the body of the insect. About half-an-hour before this occurs, the alary nerves and the cerebral, 2nd, 3rd, 4th, and 5th ganglia are slightly enlarged and the 1st subœsophageal ganglion very considerably. Immediately after the insect has entered the pupal state, all the ganglia are brought closer together. One hour after pupation the cerebral ganglia are found to be more closely united, the 4th and 5th ganglia are nearer, and the distance between the remaining ganglia is also reduced. Seven hours after pupation, there is a greater enlargement of the cerebral ganglia, optic nerves and ganglia, and cords of the future thoracic segments. After twelve hours, the 5th pair of ganglia has almost completely coalesced with the cord and the 4th; at eighteen hours, the whole of the ganglia, cords and nerves have become more enlarged, especially those of the wings, while the 4th and 5th ganglia of the cords have now so completely united as to appear like an irregular elongated mass. After 24 hours, the 4th and 5th ganglia are completely united, the 5th being larger than the 4th. After 36 hours the optic nerves have attained a size almost equal to that of the brain. The 1st subœsophageal ganglion now forms, with the cerebral ones, a complete ring around the œsophagus, the crura having almost disappeared. The 6th ganglion has now disappeared, but the nerves arising from it remain. After 48 hours, the cord is straight instead of being sinuous and the 7th ganglion has disappeared, while the thoracic ganglia are greatly enlarged. At the end of 58 hours, the 2nd and 3rd thoracic ganglia have united and the double ganglion thus formed is only separated from the large thoracic mass, composed of the 4th, 5th, and part of the 6th, ganglia, by the short but greatly enlarged cords which pass on each side of the central attachment of the muscles. The optic and antennal nerves have nearly attained their full development, and those numerous and most intricate plexus of nerves in the three thoracic segments of the larva form only a few trunks, which can hardly be recognised as the same structures. The whole of these important changes are thus seen to take place within the first three days after the insect has undergone its metamorphosis, and they precede those of the alimentary canal, generative system, and other organs, which are still very far from being completed, and, indeed, as compared with the nervous system, have made but little progress (*Art. Insecta*, pp. 962-965).

It may be noted that no such extensive changes as are here described occur in some Lepidoptera. In the grublike apterous female of the higher Psychids very little change in the nervous system takes place and the ganglia, still separate in most of the segments, are readily examined owing to their dark colour showing through the almost transparent skin.

The development of the GENITAL ORGANS has been studied by many anatomists and Jackson states (*Trans. Linn. Soc. Lond.*, 2nd ser., v., p. 174) that there are three stages traceable in the evolution of the genital ducts in the Lepidoptera, *viz.*, (1) An Ephemeridal stage, which ends towards the close of larval life. (2) An Orthopteran stage, indicated during the quiescent period preceding pupation. (3) A Lepidopteran stage, which begins with the commencement of pupal life. This raises many interesting suggestions respecting the development of these organs in the pupal stage, by means of which they reach, before the emergence of the imago, their final development. Jackson writes: "In the full-grown female larva of *Pieris brassicae*, the species investigated by Herold, the larval oviducts which are continuous with the larval ovaries run backwards near the dorsal middle line, pass between the tracheæ given off from the 7th pair of stigmata and are attached to the main trachea of the bundle by a filament; they each turn towards the ventral middle line in the 7th somite, behind the 7th stigmata, pass beneath the main longitudinal and oblique muscles of the somite, and are attached close together to the hypodermis in the middle ventral line at the posterior margin of the 7th somite. From the attached ends of the larval oviducts start fine longitudinal striæ, which traverse the 8th sternal region and connect the larval oviduct to a white mass composed of two oval pieces attached to the hypodermis beneath the rectum upon the intersegmental membrane immediately following the 8th somite. During the quiescent stage preceding pupation, the two oval pieces become approximated to the ends of the larval oviducts, owing to a shortening or contraction of the hypodermis. As soon as pupation has taken place, they fuse with the oviducts and acquire a soft loose consistence. During the pupal state the two larval oviducts fuse together, at their point of union with the oval pieces, to constitute the common (*i.e.*, the azygos) oviduct, whilst the oval pieces give rise to three processes, a left larger, the rudiment of the bursa copulatrix (Herold's 'Samenbehalter'), a right smaller, the rudiment of the receptaculum seminis (Herold's 'ein-hörniges Absonderungsorgan'), and a bifid posterior, the paired sebaceous gland (Herold's 'zwei-hörniges Absonderungsorgan'). The mass which gives rise to these processes disappears, whilst they increase in size and acquire the form they possess in the imago."

Suckow's investigations were carried out on *Dendrolimus pini*.

His results agree in the main with those of Herold, although certain slight differences may be noted. It would appear that the two filamentous oviducts are prolonged beyond their point of attachment between the 7th and 8th 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. 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. A nerve derived from the terminal ganglion of the chain passes to each of them. Whilst the formation of the vagina is taking place, the knobs approach one another 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 (a statement which seems somewhat at variance with what is said as to the origin of the vagina). They are destined to give rise to four swellings, the rudiments of the bursa, the receptaculum, and the two sebaceous glands. The latter, with a want of consistency, are said to be derived from "the knobs themselves."

Jackson's own investigations were carried out on *Vanessa io*, and were particularly directed to the development of the azygos oviduct with its accessory organs. He deals with five stages in the development of the genital organs—(1) The full-grown caterpillar. (2) The formation of the azygos oviduct, which occurs during the quiescent period preceding pupation. (3) The stage during the time in which the bursa copulatrix is still in direct union with the oviduct. (4) The stage in which it acquires its adult indirect union. (5) The formation of the terminal papilla of the abdomen.

It is totally impossible to discuss in detail the whole of Jackson's observations showing in what points his conclusions differ from those of Herold and Suckow, nor is this at all necessary as his paper is so readily accessible. The following is a summary of the conclusions arrived at on the subject (*Trans. Linn. Soc. London*, 2nd series, v., pp. 168 *et seq.*) :—

(1) The paired oviducts of the imago are developed from the larval oviducts. The latter are, as stated by Herold, Suckow, and Bessels, attached at their ventral ends to the hypodermis near the posterior margin of the 7th somite, close together and in the median ventral line. They are at first solid but acquire lumina early in pupal life. A little later their lumina open into the lumen of the azygos oviduct.

(2) The azygos oviduct is derived from the hypodermis; it may be divided into three sections, a median, an anterior, and a posterior. The median section develops as two folds, one on either side of the anterior hypodermic vesicle (5 *infra*). The folds meet ventrally and fuse, leaving, however, an aperture, the future bursal aperture. The anterior section, the first completed in order of time, appears to develop, so far as its posterior portion is concerned, by the ventral union of two folds extending forwards from the median section; but so far as its anterior portion is concerned as a solid ingrowth of hypodermic cells which subsequently becomes tubular. The anterior end of this section unites with the ventral ends of the larval oviducts while they are still solid. The posterior section, the last to be completed in order of time, develops as a deep furrow formed by two lateral folds, an extension backwards apparently of the lateral folds, which give rise to the median section. They unite with the base of the posterior hypodermic vesicles (6 *infra*). The future oviducal aperture is left when the base of the posterior vesicle closes.

(3) The anterior aperture of the azygos oviduct or bursal aperture retains a constant position; it opens in the sternal region of the 8th somite. At first it leads directly into the azygos oviduct, but during growth the connection between the two

becomes tubular, the tube being formed from the oviduct, and forming eventually the ventral portion of the bursal duct of the imago.

(4) The posterior or oviducal aperture is at first close behind the anterior aperture, but during pupal life shifts backwards and comes to be placed immediately below or in front of the anus.

(5) The bursa copulatrix and receptaculum seminis are both derived from a paired anterior vesicle, invaginated from the hypodermis of the 8th somite in its middle sternal region. The vesicle loses its paired character and overlies the median section of the azygos oviduct. It grows in length antero-posteriorly. Its anterior end becomes swollen and develops into the bursa copulatrix; its posterior end becomes elongated and pointed, and develops into the receptaculum seminis. The rudiment of the bursa copulatrix gives origin to the terminal vesicular portion of the organ and to that portion of the bursal duct which is dorsal to the point of entrance to the seminal canal. The bursa and its duct at first open into the dorsal aspect of the azygos oviduct; they then shift to the left side and are continuous with the tubular portion of the oviduct leading to the bursal aperture, which becomes the portion of the bursal duct ventral to the point of entrance of the seminal canal. Finally, the lateral connection between the bursal duct and the azygos oviduct becomes tubular and forms the seminal canal. The rudiment of the receptaculum seminis is at first bent down upon itself to the left side; it increases rapidly in length and straightens out. It has a transitory pyriform vesicle appended to it. Later on it is differentiated into the three sections recognisable in the imago.

(6) The two sebaceous glands of the imago, their vesicles and common duct leading to the azygos oviduct, are derived from the median dorsal portion of the paired posterior vesicles invaginated from the hypodermis of the 9th sternal region, whilst the common or basal ventral portion of the same vesicles becomes the extreme posterior end of the azygos oviduct. The anterior end of the dorsal portion retains an aperture into the azygos oviduct and becomes subsequently the tubular duct and the vesicular dilatations of the glands. The posterior end of the dorsal portion grows out into two tubes, a right and a left, the sebaceous glands proper. They are at first curved upon themselves and parallel to one another. As they lengthen they diverge and turn forward.

(7) The odoriferous glands of *Vanessa* originate as separate tubular ingrowths, a right and a left, from the hypodermis just in front of the oviducal aperture. Later on they acquire a common vestibule.

When the ABDOMEN of the imago is completely developed within the pupa, it is not only less in size and bulk, but also appears to consist of only nine somites, of which the first is short, its sternum fused to that of the second somite, its tergum composed of a middle lobe and of two lateral lobes, its spiracle hidden at the bottom of a deep recess. The following segments (2-7) with their spiracles are quite distinct, but the 7th sternum is fused to the 8th abdominal segment, which has a distinct tergum and sternum, the latter containing the orifice of the bursa copulatrix. The spiracles of this (8th) segment are lost, indeed, the atrophy of the tracheæ which originates from the abortive 8th spiracles of the pupa, is nearly complete by the fourth or fifth day of pupal life in *Vanessa io*. Slight scars indicating their position have been observed in a male pupa of *Sphinx ligustri*. Beyond the 8th abdominal segment there remains the anal cone or papilla which contains the oviducal aperture as well as the anus, and is usually denominated the 9th somite. When the oviducal aperture shifts backward till it is close beneath the anus, an ingrowth or fold of hypodermis takes place, surrounding the anus, the oviducal aperture and the odoriferous glands. This fold corresponds with a small portion only of the 10th somite, *i.e.*, to the anal area. Consequently it appears to be more correct to maintain, at least with reference to *Vanessa io*, that the part of the abdomen from the posterior edge of the 8th sternum and the spot where there is a slight fold in the pleural membrane of either side backwards, represents the 9th and 10th somites of the larva and pupa, whilst the terminal cone is a new formation within the area of the 10th somite. The pupal cremaster, it may be added, undergoes complete atrophy, and is not represented in the imago (Jackson). As to the actual formation of this structure he writes: "The terminal papilla of the abdomen of the imago is formed by the growth of two folds of hypodermis, a right and a left, inclosing a small portion only of the area of the 10th somite. Accordingly it does not represent the 9th somite as is generally held; the whole 9th somite and the rest of the 10th somite of the pupa are not clearly marked off from the 8th somite of the imago. The apparent 8th tergum of the imago probably represents the 8th and 9th pupal terga and the 10th, if any portion of it is persistent. The pleural region of the 9th pupal somite and of the 10th, so far as it exists, is represented by the soft membrane lying behind the ridge extending dorsally from the eighth sternum of the imago. As the bursal aperture lies near the centre of the eighth sternum, this region may possibly include in the imago a portion of the 9th sternal region as well. The softer integument behind, connecting it to the base of the terminal papilla, would, in that case, coincide with a portion of the 9th sternum, and the ventral portion of the 10th somite of the pupa anterior to the place of origin of the terminal papilla."

CHAPTER V.

THE PHYLOGENY OF THE LEPIDOPTEROUS PUPA.*

The essential cause of metamorphosis in insects is the differentiation of function between the earlier and later stages. In the Orthoptera, the insect has the same form and the same functions throughout its existence, differing only in size and the possession of wings. Although reproduction is especially the function of the adult winged form, even this is not always so, but nutrition is equally attended to, and in the same manner at all ages. Specialisation occurs in the Metabola, in the direction of feeding being especially the function of the early stages, the dispersal and reproduction of the species of the last. This leads to differences of structure in the early and last stages, only to be bridged over by an intermediate, quiescent (the pupal) stage.

We find this stage fully established in the Coleoptera and Hymenoptera. In these orders, the pupa is absolutely quiescent and helpless, and, therefore, in need of protection from enemies and accidents of all sorts. This protection is secured by the pupal stage being passed in a cavity prepared by the larva. As we are only incidentally interested in the pupæ of these two great orders, we pass by, as comparatively rare and unimportant, the cases in which the pupa is exposed, and in which it is protected in other ways, instructive though these cases are as instances of further pupal evolution. Nor need we go into detail as to the character of the pupal nidus, whether it be a

* This chapter has been entirely written by Dr. T. A. Chapman, to whom we express our warmest thanks.

cavity in the earth, a silken cocoon, a space in the timber in which the larva has fed, the centre of a gall, or what not. In all cases it is necessary for the imago to make its escape from this cavity, and it always effects this by biting or gnawing an opening by which to do so. Having thrown off the pupal integument, it remains within the pupal nidus until all its parts have become hard and mature, a process often occupying many days. It then bites its way out, being provided with suitable jaws, in some cases, jaws that are of no use to it whatever but for this purpose (*Cynipidae*).

If we now pass to the Neuroptera with complete metamorphosis (*Sialidae*, *Hemerobiidae*, *Panorpidae*), we find again, as always, that the helpless pupal state has to be passed in some protected nidus, but the escape therefrom of the imago is accomplished in quite a different manner. It is, indeed, the imago that escapes from the cocoon, but it does so clad in the pupal skin, and, to break a way out it, uses its own jaws, but armed with the hard chitin of the pupal jaws. It throws off the pupal skin *after* emergence from the cocoon, and has to undergo expansion of wings and hardening of surface after that, a process, however, that takes place rapidly. No association of this method of escape from the cocoon with that taking place in the bees and beetles has been suggested, nor any probable derivation of one from the other. These Neuroptera all have jaws as imagines, and it is by aid of these that they escape from their cocoons, but the necessary hardness is given by the pupal jaws that enclose them.

These families lead directly to two others—the Trichoptera and Eriocraniids, which are really intermediate between the Neuroptera and Lepidoptera, the former being often treated as a family of Neuroptera, or as a separate order. They differ in pupal characters from the Neuroptera in this important respect that, escaping from the cocoon in apparently the same manner, *i.e.*, as an imago, encased in the pupal skin, they do so without aid of any jaws of the imago (the imago being without mandibles), but entirely by aid of the pupal jaws, energised in a manner different from that in which insect jaws are usually worked.

We begin here, then, with the lepidopterous pupa in the Eriocraniids. Unfortunately, that of the Micropterygids, a still lower family, is unknown ; but even so, though the Eriocraniids are acknowledged Lepidoptera, it must be admitted that, on pupal structure, they have almost more claim to be Neuroptera, and, in any case, are closer to the Trichoptera than to any typical forms of either Neuroptera or Lepidoptera.

The problem of the bees and beetles as to how to escape from the cocoon, readily solved by them by the use of the imaginal jaws, is here complicated by the added condition that imaginal jaws are not to exist, and the solution is found in using the pupal jaws. It is convenient to speak as though the problem was set first and the solution found afterwards, in reality, of course, the solution (*i.e.*, the new habit) was hit upon first, and found to be useful in opening up other methods of existence, and so persisted and became further altered and developed. The problem then of how to escape from the cocoon is solved among Hymenoptera and Coleoptera, by the mature imago biting its way out ; among the Neuroptera by the immature imago breaking its way out, still encased in the pupal skin, but still using its own jaws for the purpose, though armed with the hard material of the pupal jaws. In the Palæo-Lepidoptera (*Eriocraniides*) and Trichoptera (*Phryganeides*) the work is still done by the pupal jaws, nor do the imaginal jaws work them, it having been found that they could be worked by variations of pressure of the parts beneath, and the imaginal jaws became unnecessary.

We have here, then, the first appearance of imagines (with mandibulate larvæ) that did not require jaws for this purpose. We have already noted that there are in Hymenoptera, families (*Cynipidae*, &c.) that needed their jaws for no other purpose, and to which they must be an unnecessary appendage, and, therefore, an inconvenience afterwards. It is easy, therefore, to understand that a large field for further evolution was thus opened. As a matter of fact, there can be little doubt that this opening gave rise to the two large orders of Diptera and Lepidoptera. Up to this point the pupa is always of soft and delicate texture, except as regards the jaws, and the imago is often able to walk and move about freely whilst still encased in the pupal skin. In the Palæo-Lepidoptera the vermicular movements assist the escape of the pupa (imago in pupal skin), and it is easy to understand that greater density and roughness of the pupal surface, would much assist the emergence, and would be preserved and increased, if, in any case, they appeared. The Eriocraniids have been left us, however, as a very isolated scrap of the Palæo-Lepidoptera, enough to show us how the interval between the Neuroptera and Lepidoptera was bridged over as regards pupal evolution, but we know of no intermediate stages in existence till we come to the Adelids and Nepticulids. In the Nepticulids the pupal skin is still very soft and delicate, so that it shrivels up a good deal when the imago emerges. Its parts are very feebly soldered together and easily separated, so that one sees it would hardly be impossible for the imago to walk about clothed in it; all the first six abdominal segments retain freedom of movement. It differs from the Eriocraniid pupa in the loss of pupal jaws, in the gain of some soldering together of parts, and of roughness of pupal surface in the form of minute spines covering the dorsal surfaces of some abdominal segments. In the Adelids, we find, more marked than in the Nepticulids, another feature of the earlier pupæ in the Neo-Lepidoptera, *viz.*, a prominent spine or beak on the pupal head. It would, therefore, appear that the pupal jaws have been lost, their function being efficiently replaced by a valved, or otherwise easily opening, cocoon, a beak to the pupa for forcing this, and a roughened surface to enable vermicular action to move the pupa out of the cocoon.

In the Adelids, which in many respects are the nearest of the Neo- to the Palæo-Lepidoptera, we find that the delicate texture of the pupal skin, still partially preserved in the Nepticulids, has given place to a more densely chitinous texture. Though the wings, legs, &c., are still soldered together, and to the body, in a rather flimsy manner (in the lower forms), the thorax is now certainly one solid mass, and the terminal abdominal segments form another, whilst the chitinous rings of each are so solid that there is no difficulty in recognising the intersegmental membrane, where this remains functional, and its solidification where segments are soldered together.

In most lepidopterous pupæ, and especially in the lower section (*Incompletae*), there are, more or less obvious, the basal remnants of the jaws. It is usual to regard these as an incomplete disappearance of the larval jaws, but there is good ground for regarding them rather as representing the pupal jaws of the Palæo-Lepidoptera. We may parallel them with the maxillary palpi of some pupæ, where the larvæ have no such developed palpi on the one hand, and the imagines have none whatever on the other, but they persist in the pupæ by descent from pupæ that possessed them, not, as is often stated, from imagines that had them, for, assuming the pupa to be descended in this way from an imaginal ancestor, it would be able to follow the imago more closely than it does and would lose the palpi *pari-passu* with the imago. The tendency to pass characters from one stage to another is too strong for the current explanation to be valid. Some hairy larvæ (*e.g.*, Liparids) pass on hairs to the pupæ, and, because they are advantageous, they remain; other hairy larvæ no doubt tend to pass hairs to the pupæ, but not being advantageous they are eliminated as rapidly as transmitted. The pupal maxillary palpus is descended, then, from a pupa with a maxillary palpus, a pupa that possessed it for many ages, no doubt because the imago had it, but which possessed it as a transmissible character, and retained it as presenting no serious inconvenience long after the imago, under severer selection, had lost it. The pupal mandible is, therefore, more probably descended from a pupal mandible than continued on from the larva, though no doubt the tendency for the larva to transmit a mandible to the pupa, which would by itself be ineffective, does assist in preventing natural selection eliminating it, a task difficult in itself on account of the ancient lineage of the structure.

The lower Neo-Lepidoptera, then, escape from the cocoon without imaginal jaws and without pupal jaws, but do so by aid of the effete pupal skin, by means of which a way, usually prepared in some manner, is broken out of the cocoon by a beak, or wedge-shaped end to the pupa, and the necessary force exerted by rough or spined surfaces on the abdominal segments. This (physiological) character forms the best general definition of a pupa of the Lepidoptera-Incompletæ. There are many subsidiary characters, structural and other, usually associated with it, but at times wanting, whilst as rare and interesting exceptions, the definition would include such obviously obtect pupæ as that of *Endromis versicolor*.

The most universal character of the pupa-incompleta is, that the free segments of the abdomen, *i.e.*, those that are free to move on their fellows on either side of them, are always one more in the male than in the female pupa. The 7th abdominal segment always forms part of the terminal solid mass in the female, but is free in the male. The total number of free segments varies from seven in a Nepticulid or Cochlidid male pupa, to two in a female Gracilariid pupa. A very large proportion of the pupæ-incompletæ have the 3rd, 4th, and 5th segments free, so that we may suppose this to have proved the most advantageous number for the purpose of forcing the pupa out of the cocoon. In those instances in which only 4 and 5 are free, practically only the Gracilariids, some special circumstance must have dominated the position. Since the large number of free segments characterise families usually accepted as lower, there can be no doubt that the loss of the abdominals 1, 2, and 3, as free segments was a useful advance, and that a segment once becoming fixed never afterwards became free. It does not follow, however, that a family with three free segments is higher than one with four, as they may be evolved in different stirpes; all that is certain is that the one with four free segments is not derived from the one with three; the latter being the higher, *qua* pupa, proves that if one is derived from the other, it is the derivative, but it is not proved that there is any derivation at all.

It is an almost universal rule that the pupa-incompleta does not completely emerge from the cocoon, but is retained, as it were, half-emerged, usually by the elasticity of the cocoon seizing the softer abdominal segments and by other devices; assisted always, no doubt, by the imago, finding the thorax and appendages free of the cocoon, at once directing its efforts to quitting the pupa-case, and not to further extrusion of the pupa from the cocoon. One of the means of checking the pupa at the right degree of emergence is a cremastral cable extending from the bottom of the cocoon to the cremastral hook of the pupa, and sufficiently loose to tighten at the right point. This is met with in some Tortricids. It is of course important that the pupa-case should be retained by the cocoon, or the moth would have difficulty in getting rid of it. A pupa deprived of its cocoon often produces a cripple for this reason. The cremastral cable is interesting as suggesting one possible way by which the next great advance in pupal evolution took place. This is the step from the pupa-incompleta to the pupa-obtecta.

The pupa-obtecta remains in the cocoon, the imago alone emerges. It has solved the problem that we may picture as having been set before it from the first, of how to emerge from the cocoon without imaginal jaws. Unlike the Coleoptera and the Hymenoptera, it leaves the cocoon at the same time as it casts the pupal skin, and performs its expansion of wings, hardening of cuticle, etc., outside; but, in respect of leaving the pupa-skin in the cocoon, it has got back to their more primitive type.

The obtect stage was probably reached by several different lines of advance from the pupæ-incompletæ, and we may suppose it to have begun in some measure accidentally, the imago coming out of the pupa before emerging from the cocoon, possibly by the cremastral cable having been too short, or from some other accident, the cocoon being sufficiently loose or valvular to allow of the moth escaping. We have, in *Epermenia*, preserved a transition stage. In this genus, the free 7th abdominal segment in the male pupa makes it belong to the *Incompletae*, its non-emergence from the cocoon shows that it has acquired the habit of the *Obtectae*.

It is clear that the obtect habit might arise at any time from the pupa-incompleta after it had made some progress. Three conditions were necessary: (1) A cocoon flimsy or valvular enough for the moth to break through. (2) A pupal head and thorax sufficiently rigid to be held back by the opening in the cocoon (or a cremastral cable). (3) A pupal skin altogether rigid enough to form a base from which the moth could force its way out.

Once established, the obtect habit so enforced this last condition that, with hardly an exception, the obtect pupa has only two free segments, and, in this respect, is identical in both sexes. Too large a number of free segments would obviously make the pupa-case insufficiently rigid to transmit to the base of the cocoon the thrust necessary to open it, whilst too few would not give a good ladder for the abdominal segments to climb by their vermicular action.

It is almost universal that the pupa-skin is used as a ladder in this way, still, there are exceptions. In the Cerurids, for instance, the cocoon closely embraces the pupa, and the necessary thrust is taken by the moth from the base of the cocoon; in some Noctuids the pupa-case collapses and the moth makes its escape by the vigorous action of the hind legs. These, and other instances, are, however, all secondary derivatives of further evolution. Similarly, the two other conditions suggested as necessary to the establishment of the obtect pupa are not found to be essential on further evolution. The cocoon, again, may become dense, and have to be softened by special fluids, or cut by special appliances.

Amongst the pupæ-obtectæ there is here and there a tendency shown to further solidification, but this always affects both the 5th and 6th segments equally, and in certain Arctiids we have actually, or very nearly, a solid pupa, as in *Spilosoma*.

In one instance, that of the *Nolidae*, we find a pupa with only one free segment. In this pupa, there are arrangements of the appendages that prove that it is not derived from any ordinary obtect pupa; the egg also proves that this family is not related, not only to any families with which it is usually associated, but even, at all directly, to any Macro-lepidopterous family.

Amongst the Micro-Lepidoptera many families have obtect pupæ, and a few have completely solid pupæ. In some cases, as in some species at present accepted as Gelechiids, this stage may have been reached from an obtect form, but, in others, it seems likely that the solid form has been attained more directly, and, as it were, by a short cut. This seems likely to be the case in the *Lyonetiidae* (*Cemiostoma*, &c.). Whether others, such as *Enicostoma*, *Bedellia*, &c., will prove to be more nearly related to each other, and to the Gelechiids referred to, remains to be seen. Other Gelechiids may, or may not, be really related to these, but they present a restriction of movement that may be a step towards fixation. In these, only antero-posterior movement is permitted. These Gelechiids are clearly close to the Depressariids that are similarly limited.

So far, we have treated pupæ as if they always had a cocoon of some sort. This is almost correct with regard to the Lepidoptera-Phalænæ, but the butterflies form so large a class that they are more than an exception. Originating from some incomplete pupal form, they must, directly on reaching the obtect condition (in the Hesperiids), have abandoned cocoons and started on a fresh course of evolution thus opened up to them. They were no longer affected by the question of how to escape from a cocoon, and thus had no need to preserve two free segments, and so, on different occasions, in each family, and possibly for different reasons, these were successively lost, and thus we find, in the higher members of each family, that the pupa is solid and without movement. Our knowledge of butterfly pupæ is sufficiently full to enable one to be sure that the solid pupæ of *Parnassius*, of *Anthocaris*, of several Lycænids, of Danaids, and of some Satyrids, are all of independent origin, and it is not improbable that five is by no means the full number of such separate origins of solid butterfly pupæ, and that, in each family, the loss of movement occurred in frequent separate instances. There are no facts to suggest that movement was ever regained when lost, and as such an occurrence would be contrary to the ordinary course of evolution, it is tolerably certain that it never took place. The great dominating influence in the butterfly pupa was unquestionably protection against enemies by assimilation in form and coloration to its surroundings, so as to escape observation.

It is curious that in two of the examples of the loss of cocoon in the Lepidoptera-Phalænæ—Elachistids and the Ephyras (*Zonosoma*)—the pupa should be disposed much in the same way as in typical butterfly pupæ, and in *Zonosoma* the pupa itself should have many points of resemblance to a *Papilio* pupa ; yet it is quite certain that, its spines and ridges, the girth, and the cremastral pad, have all developed in *Zonosoma* from a pupa that had no trace of any butterfly affinity, and, in fact, had no such affinity. The pupal suspension in *Zonosoma* is probably reached from some slight cocoon structure as in *Ennomos*, just as the slight cocoon of some Hesperiids leads to the butterfly suspension in others.

The pupa of *Hepialus* clearly does not belong to the Palæo-Lepidoptera. It is a somewhat advanced form of pupa-incompleta, and has acquired many characters that bring it very close to *Cossus*. It has sundry characters that shew it to be a terminal form, and that *Cossus* is not directly derived from it, however close a common ancestor they may have had. The most important of these is the entirely exceptional one amongst the pupæ-incompletæ of having the 7th segment fixed in the male. The great vertical flange in this segment, for use as an implement of progression, is no doubt associated with this fixity of the segment, and is an equally unusual character. As a pupa, it is as advanced as that of *Psyche* or *Anthrocera*, and much more so than that of *Cochlidion* or *Nepticula*, and, whatever primitive characters it may have retained in the imaginal state (chiefly neurational), it is as far removed from *Eriocrania* as many other Neo-Lepidopterous families.

The progress of pupal evolution throughout the Lepidoptera, then, has always been in the direction of greater soldering together of parts, and of greater solidity of the enveloping surfaces ; so that at one end we have the Eriocraniids with all parts movable and separable and a very flexible delicate surface, on the other we have the hard solid case of *Spilosoma*, in which no separation of parts can be effected, none are movable, and only surface lines evident, the points where such separation and mobility once occurred. A description of the intermediate stages and of the many variations in the parts that may be detected in the lower pupæ, and are lost in the higher, would be lengthy ; but it may be noted that there is an oval head-plate existing in nearly all the lower forms and persisting in some of the higher, that it carries, on the dehiscence of the pupa, in the lower forms, the eye-covers that remain attached to it by a chitinous sheet passing under the antenna. In the higher forms, this connection becomes too flimsy and evanescent to perform any such function ; all others beneath the surface equally become mere films in the higher pupæ, so that, in dehiscence, the separation of organs is quite irregular, and the leg- and antenna-cases may even be irregularly fractured.

A typical pupa-obtecta may be found in most Noctuids, *e.g.*, *Xylophasia monoglypha*. It is smooth and polished from end to end, has no spines or roughness, except the anal spines forming the cremaster (not a good name here, as they hold in no silk), and corresponding to the suranal plate of the larva, and some pitting on the anterior margin of the 4th, 5th, 6th, and 7th abdominal segments. The anterior portion of the pupa is a solid mass down to the 4th abdominal segment inclusive, and on this are seen marked out the eyes, proboscis (maxillæ), two pairs of legs, antennæ, and wings, whilst a portion of the labial palpi is seen between the two portions of the proboscis, and between them and the first legs a portion of the first femur, but these are smoothed down to one cylindrical surface including them all. It is quite hopeless to attempt to separate these parts, and when the moth emerges we have difficulty in finding the delicate membranes within that represents the pupal skin (two layers) of these parts (legs, wings, &c.) where they lay against each other. Dorsally, all the segments are represented except the head; the 5th and 6th abdominal segments are free; the 7th-10th are fused in one mass; there is no dorsal head-plate, no maxillary palpus, &c. The "waist," a narrowing of the 3rd thoracic and the 1st and 2nd abdominal segments, is not noted till looked for, and is very slight.

It is characteristic of the pupæ-obtectæ to have a great general resemblance to each other, even when, almost certainly, they belong to families derived from different sources. The Geometrids are not related to the Noctuids, yet it would be difficult, in many cases, to point out in a Geometrid, any definite character that distinguishes it from a Noctuid, pupa. The Deltoid pupa has a very Geometrid aspect. The Geometrid, pupæ differ, as a whole, in being less uniform than those of the Noctuids, *i.e.*, there is a considerable range from lower to higher forms within the family. Some few Geometrids possess pupæ with a fairly developed dorsal head-piece, tending to carry the eye-pieces, a feature not observed in any other pupæ-obtectæ, except that of the Hesperiids. The mass of them, however, are very close to the Noctuids in appearance, as already stated. They are usually more slender, and taper more generally and regularly to the anal extremity, but there are many exceptions. This wide difference of pupal structure is hardly met with in any other family. It is paralleled by the similar variation in the Geometrid eggs. The flat egg that characterises the family gives place in a few Acidaliids and others to an upright egg, ribbed like that of a Noctuid or Pierid. This uniformity of the pupæ-obtectæ seems to be referable to the fact that it represents the most desirable structure to meet the requirements of emergence of the imago leaving the pupa case behind.

Amongst the pupæ-obtectæ, besides those that have already been referred to, the Cymatophorids, the Lasiocampids, and some Notodonts, carry a dorsal head-piece. Amongst our British Cymatophorids, the form of this dorsal head-piece is characteristic in each species, and would serve for its identification. There is usually little difficulty in distinguishing a Notodont from a Lasiocampid pupa. The Notodont has not always the head-piece, the Lasiocampid has. The Lasiocampid usually has a dull surface, and any cremaster consists usually of numerous hairs like a brush; whilst the Notodont pupa is usually polished and smooth, and the cremaster is usually of a solid, spinous character. Still, it seems impossible to frame any general description of each, that might not make, say, *Cerura vinula*—a Lasiocampid, and *Eriogaster lanestris*—a Notodont.

The character presented by the pupa-incompleta of always emerging from the cocoon has very few exceptions. Some Nepticulids are recorded as not emerging from the cocoon, even in species that usually do so. The female pupa of the *Psychidae* does not do so, but this concurs with the circumstance that the moth herself does not do so, except as the last act of her existence.

The Pterophorids are very exceptional. They rarely have a cocoon to emerge from, and attach themselves by cremastral hooks to a silken pad that is paralleled in a Tineid family with obtect pupæ, *viz.*, that consisting of *Hypercallia*, *Anchinia*, and their allies. They have preserved three free segments, either because they have never had occasion to make it desirable to lose them (as has happened with so many butterflies), but more probably because it enables them to make that remarkable somersault movement backwards, a movement no doubt useful in repelling or frightening enemies. They, as well as the Hypercallias, have cremastral hooks on the 8th abdominal segment, as well as on the usual 10th, giving an extended and solid hold of the silken pad, and affording a special means of meeting the difficulties of the pupal moult. The pupæ of *Agdistis* are typically Pterophorid in the head sculpturing, in the free segmentation, in the method of attachment, and in dehiscence (dorsal head-piece carrying eyes, &c.) they differ in being smooth and very elongated. The pupæ of the *Pterophori*, on the other hand, appear always to be short, very broad and blunt forward, and usually to be rough. There is a strong tendency to a longitudinal subdorsal ridge in the line of the trapezoidal tubercles, and this carries either bundles of hairs or great horns of pupal tissue. The former being more common in those species with hairy larvæ, the disposition of hairs on the larvæ and pupæ being much alike ; the horned pupæ are more common in those species whose larvæ have simple tubercles.

The Anthrocerid pupa illustrates a question that may be difficult, perhaps, to answer as regards the pupa-obtecta, *viz.*, how far is the delicacy of the welded portions of the pupal covering a persistence of the delicacy of the whole covering of the primary pupa (*Eriocrania*), and how far is it acquired ? In *Anthrocera* (we may take *A. filipendulae* as fairly typical of the family), the 1st abdominal segment is fixed slightly to the wings, but all the others are certainly free, yet, where covered by the wings (though not adherent to them), not only the 1st, but the 2nd, 3rd, 4th (and even a scrap of the 5th) abdominal segments have a very delicate colourless covering. It also illustrates how, in the lower forms, it is difficult to define what segments are "free." In a Noctuid pupa, the 5th and 6th abdominal segments are free—there is no doubt about it—the three incisions involved admit of abundant movement in all directions. Nowhere else is there any trace or suspicion of movement. In *Anthrocera*, the 4th, 5th, 6th (and 7th in ♂) are unquestionably movable, the 3rd is slightly fused to the 2nd laterally, but dorsally and ventrally motion is provided for, and may be seen in a living pupa ; the 2nd is not even quite solid with the 1st, and some movement occurs here. The pupal skin, generally, of the abdominal segments, though black and solid-looking, is thin and flexible, and maintains its form largely by being filled with the living contents. It has, therefore, in these respects, advanced little from the primitive form, which it also exhibits in the way in which the wing-cases, the leg-cases, and the antenna-coverings separate from each other and curl up individually after the moth emerges. It is chiefly in secondary matters that it shows any advance. The eye-covers remain with the face-piece on dehiscence, there are no (or a mere) trace of maxillary palpi, the rows of dorsal hooks are well-developed. It presents another interesting feature, of which the explanation offered may not be correct, but it is one that in any case invites study. In front of the hooks is a piece of delicate membrane, between them and the narrow line forming the anterior border of the segment. This is collapsible, though it does not curl over like the intersegmental membrane. In the well-developed pupa-incompleta, that is fully evolved as regards hooks, there is a row at the anterior, and another at the posterior, border of the segment. Our British species of *Tischeria* show how, within the limits of a single genus, the important stages of the development of this final result may be presented. In one (*T. marginea*) we have the ordinary chitinous points developed into small spines uniformly over the segment; in another (*T. angusticolella*) we see these segregating into a central patch of spines behind the trapezoidal tubercles; in a third (*T. complanella*) they are massing towards the anterior margin of the segment; whilst in a fourth (*T. dodonaea*) they are beginning to form a posterior row of spines. It is rare, however, to find such an illustration as this, and there is usually considerable uniformity within the same genus, or even family. The lower the stage of development, however, the greater variety there usually is. In *Anthrocera*, there is no great variation, the previous stage must be looked for in some other family. We find it, probably, in *Nepticula* (not that I suggest *Nepticula* as an ancestor of *Anthrocera*, but that the ancestor of *Anthrocera* probably resembled *Nepticula* in this particular). *Nepticula* has a patch of spines in the centre, or towards the anterior margin of the segment. I suggest that, in *Anthrocera*, this became an anterior row by the failure of the anterior portion of the segmental chitin, now represented by the delicate membrane alluded to. It is not, then, a truly anterior row of hooks as in *Tortrix* or *Tinea*, but a central row attaining an anterior position by means of this special device.

The Psychides present an assemblage of characters that bind them together as one superfamily, yet with variations that show certain lower groups to be very close to the Adelids, whilst the higher ones have made some approaches to Obtect structure in various subsidiary characters. They are all characterised by having the first two abdominal segments fixed, the 3rd free dorsally, the 4th, 5th, 6th, and 7th in the male free. The lower families have a pair of dorsal hooks on the 10th abdominal segment; the higher have similar hooks, but ventrally, and also a set of dorsal hooks reversed and on the intersegmental membrane of certain abdominal segments. These posterior hooks, on the intersegmental membrane, are directed forwards when the membrane is extended, and are, therefore, useful for backward movement of the pupa, but can be thrown out of action by the infolding of the membrane, when they disappear. To do this without injury to the opposite surface they lie very flat. The very long needles they form on a large pupa, lying closely appressed to the surface, are very characteristic and noticeable, but they are essentially identical in small species such as *Fumea*, except in the Luffias, where they are very obvious but not so fully developed as in *Psyche*. I do not know any other family that has the hooks otherwise than on the solid plate of the segment. It is no doubt the case, however, that there is no fundamental difference between the solid and the flexible (intersegmental) portion of the segment, and that the segment may be divided between these in different proportions, and so it may be that the position of this row of hooks in Psychids corresponds to that of the fixed posterior row in the Tortricids, &c. It seems to be certain, however, that these hooks have developed within the superfamily and meet a special requirement. The pupæ of the lower Psychids cannot be absolutely differentiated by description from some Adelids. They have dorsal spines on abdominal segments 3-8, arranged as a patch four or five deep. They have the dorso-anal hooks on the 10th abdominal segment, and they have very short maxillæ of length equal to that of the labial palpi and so placed outside these as to fully expose them. The lower Psychids differ from Tineids in having the dorsal spines arranged as a patch instead of a row, and, in this, they agree with sundry Adelids, *Tischeria*, and a few others. These differ only in having the 2nd abdominal segment nearly free instead of the 3rd, as in Psychids. The higher Adelids, such as *Lampronia rubiella*, have the dorsal spines in one straight row or nearly so as in Tineids. We have then to fall back on forms as low as *Incurvaria* (*muscalella*) to find anything from which the Psychids can be derived. *I. muscalella*, except for the well-developed maxillary palpus and the slightly greater freedom of the anterior abdominal segments, might be an early Solenobiid, at least, the ♀ might be, as its pupa has the dorso-anal spines exactly as in *Solenobia*. The ♂ also has dorsal spines, but has others as well. These anal spines are very various in these different early families, *e.g.*, *L. rubiella* has the dorsal spines on the 10th abdominal in the male, but they are wanting in the ♀, which has a pair on the dorsum of the 8th abdominal. *Scardia boleti* has a ventral pair, very similar to those of the higher Psychids, and *Myrmecocela ochraceella* has a complete coronet of them. *Tischeria* and some others have them lateral, but directed a little dorsally, very rounded in *T. dodonaea*, very sharp in *T. angusticolella*. As *Incurvaria muscalella* is about the lowest of the Aculeate-Lepidoptera above the Eriocraniids, and presents the only pupa not distinctly in advance of Psychids (lower in some respects), the Psychids clearly can have no very close relatives except any that may be derived from themselves, and there do not appear to be any such derivatives that are not fairly within the family itself. *Tinea*, *Tischeria*, and perhaps a few others, such as *Psychoides*, deserving separate rank, originated at about the same point. In the higher Psychids there are some few subsidiary characters of an almost obtect nature. The passage from the lower to the higher Psychids is bridged over by the family containing *Bacotia sepium* and *Luffia lapidella*, which have, in the male pupæ only, the posterior hooks of the lower Psychids, the female pupæ being without them ; the males also have the dorsal spines placed into an alignment of one row, and the posterior intersegmental hooks are in process of development, being small conical points on one row of the minute plates that form the tessellated structure of the soft intersegmental membrane.

The Tortricids may be taken as presenting very typical pupæ-incompletæ. Throughout the whole superfamily there is very great uniformity of character. The first three segments of the abdomen are fixed and attached to the wings, but not so firmly but that, on dehiscence, the incision anterior to the third abdominal opens dorsally more or less. Two rows of hooks extend across the dorsum, an anterior and posterior on the 2nd and following abdominal segments, but so close together that, in a dehisced pupa, the space between them may not exceed one-fourth the width of the segment. On the 8th and 9th abdominal segments they are reduced to one row (the anterior), and on the 10th there is usually a cremaster with hooked hairs or bristles. The spines, even when nearly obsolete, are always represented by a transverse ridge. The maxillæ are separated widely enough basally to show nearly all the labial palpi, and a maxillary palpus is sometimes actually or very nearly wanting. A dehisced Tortricid pupa is a most beautiful and instructive object, but difficult to handle by way of description. The whole pupa is arched by the extension of all the abdominal incisions, even that between the 1st and 2nd abdominals being often opened a little. The dorsal slit extends through the whole thorax. The head and antennæ are lifted forwards, the antennæ quitting their groove between the wings and legs. The first two legs, including the 1st femur, form the two pieces between this and the wings. At the front of the prothorax, which opens a little from the mesothorax, is a small plate, the dorsal head-piece. Forwards from this, and connected with it by a film that passes under the antenna, is the eye-cover. These parts are all sustained in their places by the pupal skin of the covered parts. From under the face-piece a film extends backwards, formed of the front covering of the thoracic, and first three abdominal, segments, and, from each side of this, the coverings of the trochanters, femora, &c., form supports for, and connections with, the leg-pieces.

The distinction between the Sesiid and Tortricid pupæ is very narrow. The Sesiid is very close to, if really distinguishable from, that of a true *Tinea*. The Sesiid pupa has always anal spines arranged more or less as a circle or coronet, never a true cremaster; the Tortricid pupa, when without a cremaster, is here indistinguishable. In the Sesiid pupa, the wing-cases project beyond the 3rd abdominal, which is never the case in the Tortricid pupa, though it is very probable that there will be found to be exceptions here, as possibly in another of these characters, which all mark *Sesia* as a less generalised form than *Tortrix*. This is in the dehiscence, the Tortricid pupa retaining the three leg-covers of each side (1st femur, 1st leg, 2nd leg) in one piece, whilst in the Tineid and Sesiid pupæ they distinctly separate. The maxillary palpus is well developed in *Sesia*.

The pupa of *Zeuzera* has a somewhat intermediate position, the femoral piece separates, but not the two legs; there is no cremaster, but a provision of ventral spines; the wings separate from the abdominal segments on dehiscence, but are previously loosely attached to the 1st and 2nd abdominals, and extend to the end of the 3rd. It agrees with the Sesiid rather than the Tortricid pupa in the full development of the maxillary palpus. This is not, however, distinctive, since many Tortricid pupæ have well-developed maxillary palpi, such, for instance, as *Semasia woeberana*, which has, however, the femur attached to the legs and a true cremaster. The Cossid pupa, in all these respects, is truly a Zeuzerid rather than a Tortricid, it is, in fact, a very slightly generalised Tortricid. The pupa of *Retinia* differs from that of *Cossus* in the femur being fixed to the legs on dehiscence, in having a smaller maxillary palpus, and in having a cremaster, which is, however, nothing more than the ordinary hairs of the last segments, hooked at the tips.

A number of groups of the Tineina (= undifferentiated groups of *Incompletae* and lower *Obtectae*) have obtect pupæ, and though these are not necessarily related to each other, each group must be higher than any group of *Incompletae* to which it may, perchance, be related. There are other groups that have solidified pupæ. It is improbable that these are all related to each other, but the present state of our knowledge is not sufficient to unravel the matter, nor is space at command to discuss such details as we have, nor is the present nomenclature equal to specifying the groups by name, since our latest authority in classifying these (Meyrick) mixes up *Obtectae* and *Incompletae* in the same families in a bewildering way, and many even of his genera are incongruous and absurd in view of pupal structure. As *Obtectae*, mention may be made of *Argyresthia*, *Elachista*, *Yponymeuta*, *Depressaria*, *Plutella*, *Coleophora*, *Œcophora*, *Chimabacche*, *Dasycera*, *Laverna*, *Epermenia*, &c. It would, perhaps, hardly be going too far to say that the old Tineina formed an Obtect group, from which we require to separate Nepticulids, Adelids, Gracilariids, Tineids, and some others (to be placed with Cochlidids, Tortricids, Zeuzerids, Anthrocerids, Sesiids, Pterophorids, already separated). The genera with solidified pupæ include *Perittia*, *Bedellia*, *Enicostoma*, *Parasia* and allies, *Thyris*, and some others. The pupæ of the *Lyonetiidae* also appear to be solid, but the parts separate with great facility, and it is doubtful if they are really solid. They are certainly unrelated to any of those mentioned above, except probably *Bedellia*, which appears to be a Lyonetiid. In the Lyonetiids, the wing- and leg-cases extend to the extremity of the abdomen, and all fit together absolutely, so that, when separated, one cannot believe otherwise than that adhesions have been broken down. This facility of breaking down is very different from the obtect solidity of *Thyris*, *Bedellia* and *Enicostoma*.

These notes partake, perhaps, rather of the nature of a gossip on some pupal characters, than an attempt to discuss the phylogeny of the Lepidoptera at length by means of them, but it sets forth some of the more general lines on which study in this direction has proceeded, and shows also, probably, in what direction future students may help to unravel the intricacies of this interesting subject.

THE SPHINGO-MICROPTERYGID STIRPS.

(Continued from Vol. I., p. 546.)

Superfamily V: PSYCHIDES.

The Psychides form undoubtedly one of the most difficult, the least known, and most puzzling of the superfamilies of Lepidoptera. The difficulties are largely increased by the extraordinary resemblance of many of the imagines, the apterous females in the various groups being particularly troublesome, and presenting similarities so close that they are almost inseparable. The larvæ, too, are so very much alike, structurally, in each genus, that only very exact comparisons are of the slightest use in determining those of the different species. The pupæ present many general characters, dividing up, however, into two very marked forms, the Micro-Psychid or Taleporiid (including all the generalised families as well as the specialised *Luffiidae*) and the Macro-Psychid (including the *Fumeidae*, *Epichnopterygidae* and the higher Psychids, usually so called). The descriptions of the imagines of the old authors are so vague and general that each of them would frequently cover a whole group, whilst many of the figures are of the most unsatisfactory character, in some instances even those of Bruand have changed colour, and are utterly unrecognisable. Some of the different families have been treated at length by various authors, but *The Essai Monographique sur la Tribu des Psychides*, of Bruand, published in 1853, is still the only complete work on the whole of the families comprised within the limits of this superfamily.

One of the most remarkable of the phenomena connected with this superfamily is the reputed tendency for some of the species to produce parthenogenetic progeny. This has already been dealt with in vol. i., pp. 23-30. Réaumur was greatly puzzled by the facts that he observed in *Luffia lapidella*, and considered that the wingless examples might consist of both males and females, or suspected that the winged males had escaped his observation, whilst De Geer and Pallas both held the opinion that many of the insects were parthenogenetic. Other entomologists noticed the development of entire broods of wingless females without observing the parthenogenetic tendency and explained the occurrence of these broods as being due to the supposed fact that some broods produced only males and others only females. Bruand was not of this opinion, and states positively that he had obtained examples of both sexes every time that he had reared more than a dozen larvæ of any species, and that he had found, as a rule, the sexes about equal, or the females in excess. As he had never observed parthenogenesis, and had frequently noticed that unfertilised eggs did not hatch, he was utterly sceptical as to the occurrence of the phenomenon, and, after pointing out that Siebold had clearly shown that Psychids had, like other Lepidoptera, very well developed organs of reproduction, and that "l'éclosion doit être le résultat de l'accouplement," he concludes: "Je crois fermement que les deux sexes se reproduisent chez les *Psychides*, comme chez les autres genres du même ordre." Other authors have also expressed views equally strong, but too many observations appear to have been made for the suspicion to be indulged that all the observers who have recorded the phenomenon have been mistaken. Among the more modern authors, Heylaerts unhesitatingly condemns (*Ann. de la Soc. Ent. de Belgique*, xxxv., pp. 59-60) those who hold the possibility of the occurrence of parthenogenesis, and states that authors who have published assumed facts asserting it, have been misled by erroneous observations.

The constitution of the PSYCHIDES has been a burning question for many years, and the alliances of this superfamily have been repeatedly discussed. Even now modern authors like Meyrick have followed Duponchel, Zeller, and Herrich-Schäffer in sub-dividing the group into two sections, one being placed with the so-called Bombycids, the other with the Tineids. The comparative generalisation of the species, in all their stages, makes them most difficult to deal with, but Chapman protests (*Ent. Record*, xi., pp. 200-203) as strongly against the separation of the two sections as did Bruand half a century ago. The latter author (like many others) included the *Heterogynides* [the life-history of one species of which, *Heterogynis penella*, has recently been worked out by Chapman (*Trans. Ent. Soc. Lond.*, 1898, pp. 141-150)] among the Psychids, but although we are inclined to allow considerable affinity between the two superfamilies, yet there can be no doubt that the Heterogynids are more distinctly allied to the Anthrocerids (in spite of the apterous female, the arrangement of the larval tubercles, the mode of egg-laying, and the general appearance of the Heterogynid imago), the habits of the larva, the structure of the cocoon, and the pupa, being decidedly Anthrocerid in character. Chapman considers that, if *Heterogynis* has any relationship with the Psychids, it must have branched off before the latter left the Tineids, *i.e.*, before it had made the first steps to a vermiform female, before, in fact, it was a *Psyche*. Our own opinion, of little value in the face of Chapman's more mature conclusions, is that there is a less distant alliance between the two superfamilies than is here suggested, and that the apterous female, the mode of copulation, the re-entry of the female into the cocoon to oviposit, the arrangement of the larval tubercles, &c., have not been entirely developed independently, but that the two have come from a common stem, even if reaching back as far as the point at which the Psychids and Tineids had a common ancestor. Still, it is recognised as one of the debatable points in the construction of our phylogenetic tree (*ante*, vol. i., pl. i) and as such must be left open for future discussion.

It now becomes necessary to define the terms relating to this superfamily. There appears to be little doubt that *Psychoides verhuella*, referred to this superfamily by Bruand, is rather a Tineo-Lamproniid, and as such, is properly excluded. On the other hand, the genera *Diplodoma*, *Narycia*, *Lypusa*, *Psilothrix*, and *Melasina* appear to fall distinctly within its limits, although possessing winged females. There can be no question as to *Taleporia*, *Bankesia*, and *Solenobia*, all of which retain more or less characteristic generalised larvæ and pupæ, whilst the *Luffiidae* (a specialised Taleporiid family) and *Fumeidae*, *Epichnopterygidae*, *Psychidae*, and *Oiketicidae* comprise the higher Psychids generally so-called. These latter, as well as the Taleporiids (*Taleporia*, *Bankesia* and *Solenobia*), have apterous females, but all the families detailed above have case-bearing larvæ that cover the outside of their cases with earth, lichen, grass-stems, pieces of leaves, or some other extraneous substances. The alliance of these families and the classification of the genera included in the superfamily will be considered later.

The Psychid egg belongs, like those of all others referred to the Sphingo-Micropterygid stirps, to the "flat" type. It is oval in outline, ovoid or egg-like in shape (Heylaerts states that the eggs of the *Oiketicidae*, *Psychidae*, *Canephoridae* and *Apteronidae* are all elliptical in outline and of the shape of a pigeon's egg), whitish or yellowish in colour, without markings, and comparatively, very large. The excessively delicate texture of the egg of *Pachythelia*, &c., is hardly credible. Two modes of egg-laying seem to be general. The winged females deposit their eggs outside the case and cover the batch with wool from the anal tuft. The apterous females lay their eggs in the case, similarly covering them with the silky wool from the anal tuft (when the latter is present). The eggs of the Solenobiids, Taleporiids, and Fumeids are fairly firm, and not of the exceeding delicacy of those of the Epichnopterygids and higher Psychids. Heylaerts states that, for those species he has observed, 200 has been the minimum, and 500 the maximum, number of eggs laid. He adds that they are rarely attacked by hymenopterous parasites, and that the young larvæ are hatched in three or four weeks.

The newly-hatched larvæ of most Psychids are very similar. They have a black, and relatively large, head, the thoracic segments are covered dorsally with corneous shields, generally black, without markings but with more or less ill-defined striæ. The abdominal segments greyish, yellowish, or, occasionally, reddish; the tubercular hairs rather long. The true legs dark, shiny, strong; the short prolegs carry an oval of crochets, broken, however, on the inner margin. As soon as hatched, the larva commences to spin its case, often utilising some of the material of which the maternal case has been formed; others (*e.g.*, *Sterrhopterix hirsutella*), however, at once fasten to the silk pieces of the leaves or lichens on which they feed. The newly-hatched larvæ appear to have the tubercles arranged very similarly to the adult. Thus, in that of the specialised *Thyridopteryx*, the arrangement of i and ii is identical with that of the adult, i farther from the median line, and ii well up on the segment towards the line of i, iii is supraspiracular, iv and v (without hairs) form a tubercular plate, with the two tubercular points well marked, vi is also a point on a plate, and vii very similar. In the newly-hatched, and more generalised, Solenobiid larva, the tubercles appear to be identical with those of the adult, i and ii being typically trapezoidal with i nearest to the median line, iii (with strong seta), iv (strong) and v (weak) both subspiracular, with vi and vii both showing single setæ. On the other hand, in the newly-hatched Taleporiid (*tubulosa*) larva, Chapman notes i, ii, and iii as being so minute as to be observed only with difficulty, iv and v subspiracular each with a seta, vi below these, and vii again below, at the base of the prolegs, all single and with one seta, a sufficient difference to show that, however simple the Psychid tubercles may be in structure, the larvæ are distinctly specialised. [This variability of structure within the Psychid stirps renders null Dyar's generalisations on these larvæ (quoted *ante*, vol. i., pp. 46-47) and many of his statements as to the Psychid tubercles are at variance with the facts as we have observed them in our British species.] Sufficient may be gathered, however, from the variation of larval structure to suppose that a very complicated system of classification will be necessary when the details of the life-histories of a greater number of (especially exotic) species are better known.

According to Heylaerts the normal length of life for most Psychids is two years, although a few species of *Psyche* and *Fumea* complete their metamorphosis in a single season. Our own experience tends to show that most of the British species appear to take only one year. After each moult, the form of the case and the markings of the larva are more pronounced, there being considerable difference between the case of the newly-hatched larva and that of the adult, as also in some small details of colour and shape between the larvæ themselves. The number of moults is stated to be five or six.

The adult larva is somewhat short, but very powerful. Its head is large; the female larva has, according to Heylaerts, a rather larger head than the male; the mandibles are strong, the antennæ short, the palpi quite ordinary. The ocelli are arranged in semicircular form on either cheek, whilst the long tubercular hairs are conspicuous. The thoracic segments carry shiny, dorsal, corneous shields, which are generally marked with longitudinal striæ, the medio-dorsal almost always the most strongly marked, whilst the metathoracic shields are usually weaker than those of the pro- and mesothorax. The arrangement of the tubercles on the abdominal segments is one of the most important characters presented by the adult Psychid larva. In the lower subfamilies, i is nearer to the median line than ii, forming, in fact, quite typical trapezoidal tubercles. As we ascend to the more specialised families, ii is gradually brought into line (behind) with i (*Taleporia*), whilst in the higher families it becomes nearer to the median line than i, and at last moves forward, so as to be within, and almost in the same straight line transversely with, i. Tubercle iii is supraspiracular and strongly marked, iv and v close together below the spiracle, iv with a strong, v with a weak, seta, vi is below the subspiracular and vii occurs as a marginal tubercle at the base of the prolegs. All except vii are simple and bear a single hair or seta. The anal flap is usually corneous, often dark and shiny. The true legs are short and powerful, the third pair specially well developed, the prolegs are very short but comparatively strong, carrying, also, an almost complete oval of crochets, the anal pair being still more powerful and enabling the larva to cling to the inside of the case. Dyar states (*Class. of Lepidopterous Larvae*, pp. 198-199) that "the three tubercles above the spiracle are retained on the middle segment; the substigmatal tubercles are approximated; the anterior one of the four on the base of the leg seems to have been moved up forming tubercle vi, which is thus anterior." He further states that "the primitive form of tubercle (consisting of a little chitinous button on the skin bearing a single long hair), present in the less specialised families of all the groups, is found exclusively in the *Jugatae* (Hepialids and Micropterygids) and *Psychidae*." On larval characters, Dyar makes (*Ibid.*, pp. 204-205) the *Psychidae* equal in rank to all the remaining *Frenatae*, although later (*Additional Notes on Class. of Lep. Larvae*, p. 53) he retracts, and says that "although the larvæ of the *Psychidae* differ markedly from those of the other families in the reversed alternation of tubercles i and ii (ii being retained on the same subsegment as i and not on a posterior one), the family cannot be given superfamily rank on this character." Bacot considers with us that it is an important feature of the Psychid larva that i is more remote from the medio-dorsal line than ii. It is clear that Dyar is referring, in the above quotation, to the higher Psychids only, in which ii has not only lost its position outside i as a posterior trapezoidal, but has migrated first inside i and then been moved up anteriorly until in line with i, the most highly specialised arrangement of the tubercles found in Psychids. The position of iii as supraspiracular, iv and v as subspiracular, vi below these, and vii as marginal tubercles, does not suggest any such alteration as Dyar indicates, but appears quite normal. The fact is that, in the generalised genera—*Diplodoma*, *Narycia* and *Solenobia*—i and ii are arranged in typical trapezoidal form, i nearer, ii farther from the medio-dorsal line; in *Taleporia*, ii has migrated directly behind i; in *Fumea*, ii has passed inside i, whilst in *Epichnopteryx* and *Luffia* it has, in addition, moved anteriorly; in the higher Psychids it actually gets in line (or almost so) with i. We wish to insist on this because we have here an exact illustration of the evolution of the Psychid tubercles from the most generalised to the most specialised forms. Through all this modification in position the tubercles maintain their original simple structure, each consisting of a simple chitinous base with a single seta.

Bruand considers that the Psychid larvæ show alliance with *Stygia* and *Cochlidion*, whilst *Heterogynis*, which Bruand and Herrich-Schäffer considered to be a Psychid, and to which we have already referred, has, in spite of its evident Anthrocerid affinities, its exposed feeding-habits, and absence of a case, a distinct connection with the Psychid larva in the arrangement of its tubercles—i and ii being placed as trapezoidals, iii as supraspiracular, iv and v approximating as sub-spiracular, a single vii in first instar, a double vi being present, in addition to these in later instars. All the tubercles in *Heterogynis* are simple and carry a single hair.

Psychid larvæ vary much in their food requirements. Those of the more generalised families are specially attached to lichens (but appear to have a strong tendency to become scavengers and to affect a carnivorous diet, if occasion offer), whilst the higher Psychids, although generally supposed to be attached to grasses and low plants, are sometimes more or less specialised to some particular food-plant. Some are reputed to be almost polyphagous, and Heylaerts asserts that many species, apparently specialised in a natural state to some particular food-plant, will eat many other foods in captivity—leaves of *Ranunculus bulbosus*, *R. repens*, leaves of sallows (preferably *Salix alba*), *Calluna vulgaris*, *Erica tetralix*, *Thymus vulgaris*, *T. serpyllum*, &c. He notes that all the species of *Oreopsyche* (*atra*, *plumistrella*, &c.) prefer grass, which others also eat. The same observer states that he has entirely reared larvæ of *Proutia betulina*, Zell., to maturity by feeding them on dead lepidopterous imagines, whilst details of the cannibalistic habits of the larvæ of *Taleporia tubulosa* (*pseudobombycella*) and *Diplodoma herminata* (*marginepunctella*) will be found in our account of the respective species. Psychid larvæ move freely in the sun, and withdraw into their cases at night. This manner of life tends to expose them to the attacks of hymenopterous parasites, whilst wasps and spiders are said to kill off large numbers in spite of the protection afforded by their cases. The larvæ of *Bacotia sepium* (*tabulella*) are stated by Bruand to be, among others, particularly liable to the attacks of ichneumons. Heylaerts says that the genera *Pezomachus*, *Pimpla*, *Hemiteles*, *Cremastus*, and the dipterous genus *Tachina*, are the most persistent enemies of Psychid larvæ. He further states that, in 1879, he received from Millière some female cases of *Hyalina resubiella*. As the perfect insects showed themselves at the free end of the cases, he opened the latter to blow the females, and was not a little surprised, when eviscerating a female, to observe a larva come out of its abdomen owing to the pressure. The larva was at once recognised as that of a Hymenopteron. Putting three living females into a small glass he obtained two hymenopterous pupæ from them, one of which produced an imago. Still one suspects that the larvæ must be more or less well-protected by their cases, for the slightest disturbance will cause those of most of the species to withdraw themselves immediately into the case and close the entrance against intruders.

Rouast says that whatever may be said to the contrary, the rearing of the higher Psychids from larvæ, if a few simple rules be observed, is very easy. The cases should be collected as soon as winter has set in, there being fewer deaths from parasites, and less risk of disturbance and injury than if they are collected when full-fed and already spun-up for pupation. The larvæ should be kept in boxes having a covering of wire-gauze of small mesh. At the bottom, a layer of peat earth should be placed, then a layer of moss, in order to preserve fresh the plants placed therein. An abundant supply of fresh food is absolutely necessary until the case is fixed, but as several species are polyphagous and content with *Poa annua* and other low-growing plants, these can easily be planted in the peat and watered occasionally. The boxes should always be kept in the open air and with an eastern aspect. The sun's rays are never too ardent for the larvæ, and sun is absolutely necessary for both larvæ and pupæ. Once also the cases are fixed for pupation they should never be disturbed, because the larvæ, having once turned round in their cases for pupation, the attempt to re-turn in order to spin down the case a second time often proves fatal. It is also important to keep a keen watch at the hour of emergence owing to the rapidity with which the males destroy themselves when kept within a limited space. The moths usually appear from 8 a.m.-10 a.m., a few species later, whilst *Apterona crenulella* (*helix*) is said to emerge only at dusk. Certainly *Pachythelia villosella* emerges most regularly about 6 p.m. and *Fumea roboricolella* almost as regularly between 2 p.m. and 4 p.m. Possibly there is much individual variation in this respect.

The larvæ of those Psychid families that live on the lichens of trees and walls—*Narycia monilifera* (*melanella*), *Luffia lapidella*, *Bacotia sepium*, &c., pupate on their feeding-places, but those that are ground-feeders, or that live principally on low plants, grasses, &c., rarely pupate on their food-plants but seek a solid body, large stone, rock, &c., or climb a tree or bush to which they fasten their cases before pupation.

The cases made by Psychid larvæ vary in shape, but each species forms a case peculiar to itself (although some modification may take place if the ordinary materials be not obtainable). Spun by the larvæ with grey or white silk, the cases of the lower Psychids are usually covered externally with particles of stone or lichen, whilst those of the higher Psychids are clothed with straws, stems, or even little twigs, arranged in a variety of ways—longitudinally, transversely, imbricated, or irregularly. But even among the higher Psychids, the mode of covering adopted by the more generalised families is often maintained, and we find some with cases clothed with particles of rock, others with lichen, or fragments of bark, moss, dead leaves, or herbaceous plants.

Some cases are smooth, hardened maybe by the powdered dust with which they are often covered, others are quite soft, even when solid in appearance. The cases of the Taleporiids and their nearest allies form a more or less triangular-based prism, drawn in towards the end, those of the Luffiids form a cone, those of the Fumeids and higher Psychids make usually a cylindrical tube of silk to which straws, &c., are attached, whilst the Apteronids have a case that is quite heliciform, and closely resembles a snail's shell. The case made by the male Psychid larva is usually smaller than that made by the female; this is markedly so in many of the Fumeids, Epichnopterygids, &c. One end of the case is usually kept open, and through this the larva thrusts its head and thoracic segments when walking or feeding. At the least danger it withdraws itself and closes its home by tightening certain silk filaments attached to the edge of the entrance, the other ends being fastened to the inner walls of the case; these normally hang loosely, but when tightened, the open end, being of a soft texture, is drawn into the case and the mouth is closed perfectly. At the other end of the case, in the *Psychinae*, is a longer or shorter silken tube, extending somewhat beyond the covered portion. This tube is often lengthened quite abnormally when the larva is ready for pupation, the work taking some hours, and its formation is a sure sign that the larva is full-fed. When this is made, the larva spins down the previously open end of its case to a rock, stem, twig, or trunk of a tree, turns itself round so that its head is towards the unfixed end, and awaits pupation. Standfuss states that after the larvæ of the higher Psychids have fixed their cases, and before turning round in them, they change their skin, doing so in the ordinary way, so as to push the *débris* out of the free end. After this moult these larvæ are said to be much changed; the new skin is very delicate, the markings have disappeared, the true legs are weaker and the body stouter and shorter, so that it is scarcely recognisable. In this condition, the larva turns itself round, and, without eating, remains yet another fifteen to twenty days before pupation. After it has pupated this last delicate larval skin is found inside at the fixed end of the case. One suspects that the whole of this statement can be true for only a very small number of species. Zeller had supposed, in 1847, that the male larva had a moult more than the female, as he observed the cast skin outside the cases that produced males of *Stenophanes* (*Psyche*) *apiformis* and the delicate larval skin in the case. Turati observed it in *Megalophanes* (*Psyche*) *turatii*, and Standfuss in *Stenophanes* (*Psyche*) *graslinella*, whilst Heylaerts has observed it in *S. graslinella*, *Pachythelia villosella*, *Sterrhopterix hirsutella*, and *Amicta ecksteini*, in which species the penultimate larval skin has been found outside the cases from which imagines have afterwards appeared. He states, however, most positively, that it happens in both sexes, and that the peculiarity is not confined to those species whose male larvæ make a very long silken "cap" to their cases. Heylaerts further observes that in some species the sexes take up a different position for pupation; in these, he asserts, the males frequently fix their cases near the ground, the females (of the same species) ascending much higher for this purpose. The same observer also makes the remarkable statement; "Pour nettoyer sa demeure, la chenille en ouvre la partie postérieure et, avec ses mandibules, elle éloigne par là ses excréments.

Plusieurs fois j'en ai fait l'observation." It is well-known that the larva uses the posterior end of the case for ordinary defecation, but the observation as to the use of the mandibles requires confirmation. The case of *Apterona crenulella* (*helix*), nearly as large as a small pea, resembles a sinistral snail shell, has three-and-a-half whorls, and is formed of a firm whitish silk, thickly coated externally with small particles of earth, the colour of the case being grey, red-brown, or black, varying according to the colour of the earth from which the larva draws its supply. The uppermost half-turn is very indistinct and generally appears as if it has collapsed. At the place where the second whorl commences there is a lateral opening, the margins of which usually conceal the entrance into the cavity of the whorl. The fæces are ejected from this aperture by the larva. Siebold says that the body of the larva of this species is also spirally curled, although in form and length it only corresponds with the lowermost whorl of the case. He further adds that the female of *A. crenulella* (like all other Macro-Psychid females) quits its case after oviposition is completed, making use of the lateral opening, which also permits of the act of copulation, which could only be effected through a low lateral aperture of this kind. He also notes that in all the cases of *A. crenulella* he had hitherto examined (more than 150 in seven years) he had only found female pupæ. Males have, however, since the time that Siebold's observations were made, been obtained freely.

The Psychid pupæ fall very distinctly into two classes, which we may call, for convenience, the Micro-Psychid or Taleporiid and the Macro-Psychid. The Taleporiid type of pupa is found in the genera *Narycia*, *Diplodoma*, *Solenobia*, *Bankesia*, *Taleporia*, *Luffia*, and *Bacotia*. The Psychid type of pupa occurs in the Fumeids, Epichnopterygids, Psychids, and Oiketicids. The former is characterised by its anterior band of dorsal hooks, the recurved hairs on abdominal segments 8-10, and the presence of two small dorso-anal spikes. The latter is distinguished by a supplementary posterior row of dorsal hooks on the abdominal segments, and by the two ventral hook-like modifications of the larval anal prolegs. These two forms of the pupa do not separate sharply the generalised from the specialised families in this superfamily, for the *Luffiidae* (*Luffia* and *Bacotia*), both in the imago and larva, belong to the higher Psychids, whilst the pupa shows that the family must have been derived almost directly from the Taleporiid branch, a mode of evolution that cannot be predicated with such certainty for the Fumeids and those families above the Fumeids on the same stem.

One knows beforehand, on examining the chrysalids of the true *Psychidae*, even superficially, and apart from the sexual organs, to what sex they belong, for whilst the male pupa is very like other pupæ-incompletæ, that of the female is obtuse at both extremities, with practically no trace of wings, and recalls the form of the pupæ of some Diptera. The pupa of the male moves up and down its silken tube with great activity. In the Psychid pupa the first free segment is the 3rd, the male pupa has the 3rd, 4th, 5th, 6th, and 7th abdominal segments free, the female has the 3rd, 4th, 5th, and 6th only free. Heylaerts says that the male pupa has the general form of those of the Bombycids, but that it is distinguished from them—

(1) By a ring of recurved hooks which is found on the dorsal face of the abdominal segments, above all, on the last three where they are most strong and

numerous. (The pupæ of *Fumea* and of *Apterona* have them but little developed, above all, those of the former genus, in which the hooks give place to rugosities. In the latter genus, the heliciform shape of the case renders it less necessary. The Cossid and Hepialid pupæ possess similar hooks.)

(2) By the shape of the anal segment, which ends in two very strong and very wide hooks, which curve ventrally forward. (In the genus *Fumea*—*F. sepium* is an exception*—they are curved backward and very much spread out. The front of the segment carries a double excrescence in the form of two tubercles in juxtaposition; in *Apterona* they do not exist at all. A longitudinal depression is found on each side of the abdomen.)

By means of the hooks on the abdominal segments the pupæ of the higher Psychids are able to wriggle rapidly up and down in their cases. One notices this movement readily when the sun is shining on a case of *Pachythelia villosella* near the point of emergence. The colour of most of the Psychid pupæ (including the generalised families) is yellowish-brown, *e.g.*, many species of *Psyche*, all those of *Epichnopteryx*, *Bijugis*, *Fumea* and *Apterona*, and these, some days before the emergence of the imago, become blackish, occasionally with a metallic reflection. In others, however, the pupa is black with the anterior and posterior areas red or reddish-brown. Sometimes the edges of the segments are darker, *e.g.*, *Stenophanes apiformis* (Heylaerts). The female pupa of the higher Psychids appears to make much less movement in its case. It is very soft and delicate, the headparts are ventral, the prothorax usually frontal (in some both the pro- and mesothorax incline to a ventral position). The abdominal segments are usually larger, the spiracles distinct, and scars, denoting the position of the larval prolegs, are also conspicuous, but these form a character observable in both sexes, and are found also in the lower Psychids. In both sexes, too, the external marks of the genital organs are evident, and there is generally some trace (sometimes very marked) of a lateral longitudinal depression, homologous with the well-developed lateral flange of the Psychid larvæ. Heylaerts states that the female pupæ of the *Oiketicidae*, *Animulidae*, *Psychidae*, *Apteronidae*, and *Epichnopterygidae* have no wing-cases, and only very rudimentary ones for the antennæ and legs, but that the genera *Bijugis* and *Fumea* possess wing-cases, although the female imagines are without wings. The pupæ of the lower Psychids with apterous (or almost apterous) females—*Solenobia*, *Bankesia*, *Taleporia*—as also those of the higher *Luffia* and *Bacotia*, have very distinct wings. It is stated that the pupa of *Apterona crenulella* (*helix*) is bent (conforming to the heliciform shape of the case), and that the female also takes the same shape.

The dehiscence of the Psychid pupa is interesting. In the lowest forms the head-parts are nearly (or actually) separate, having the legs attached loosely to the wings. In the more intermediate forms (*B. sepium*, &c.), the head-parts remain attached together, but the antennæ stand out free. In the highest subfamilies (*Whittleia reticella*, *P. villosella*) the whole front remains in one piece. It is quite an accident whether this piece remains in its place or is twisted aside, but even in the highest forms, *e.g.*, *C. unicolor*, the pieces separate as effectually as in *B. conspurcatella*, with very little interference (something a very long way short of violence). In none of them do the eye-pieces go with the dorsal headpiece.

**Bacotia sepium* is not a Fumeid, but a Luffiid. It has a pupa of the Taleporiid type, and the larva has highly specialised tubercles (in position).

The pupal life of most (? all) Psychids is comparatively short. Hybernation takes place in the larval stage and this, therefore, is the most lengthened. Sunshine appears to be almost an absolute necessity for emergence in some species, and almost all are active day-flying insects. In the higher Psychids (at least), the males, after emergence, mature very quickly and almost directly commence an active search for the newly-emerged females. They assemble readily, and appear to fly considerable distances. *Fumea roboricolella* will pair with two different females in an hour (copulation only lasting about four minutes) and the first occasion may take place within five minutes of the emergence of the male from the pupa-case, so rapidly do the wings expand, and the moths become active. Heylaerts notes that "a male may copulate with one, two, or three females before dying, the average life of a male Psychid not lasting more than two days, whilst in captivity it sometimes lives for only a few hours, its eagerness to find a female being such that it beats its wings on the walls of the breeding-cage until it falls exhausted." Each species has roughly a fixed time for the emergence of the imago. Some emerge in the morning, others in the evening. The former generally require the sun's rays to shine on them, for the latter this is not necessary, although, as a rule, if one wishes to rear Psychids, the cages in which they are kept should be placed out of doors summer and winter.

The male Psychids are variable in size, extending from the large *Oiketicus kirbii* measuring sometimes 45mm. in expanse, to the small Solenobiids, &c., which expand only 10-12mm. They are usually of dull coloration—black, grey and whitish are the usual tints—whilst some are transparent. A few exotic species of the *Oiketicidae* and *Animulidae* are less sombre in their tints. In the higher Psychids the head is more or less strong, is very hairy, the antennæ are bipectinated, plumose, or crenulated. There are ocelli in *Diplodoma*, *Bankesia* and *Taleporia*, but not in the higher families, the eyes are more or less large and naked, and there are no palpi. In the place of the palpi are two tubercles, each bearing a thick brush of longer or shorter, black or brown hairs, called by Heylaerts the "pseudopalpes." The tongue is entirely absent. The thorax is very hairy, the chitin beneath ivory-black, or -brown, in colour; the mesothorax is very wide, its scutellum very large and round; the metathorax, very narrow in the centre, widens on either side, its scutellum is very small. The abdomen normally does not extend beyond the anal angle of the forewings, but is able to be extended enormously in the males of those species that pair with the females whilst the latter are in their cases, sometimes for this purpose, increasing two or three times its normal length. The abdominal segments, which are very hairy, are usually (always in the higher Psychids) composed of very narrow rings of hard, dark, shiny chitin, joined by a very extensile membrane. The generative organs are corneous, very rudimentary, and do not carry the normal clasps. The feet usually are not very long, the anterior, as a rule, longer than the posterior (the genera *Diabasis*, *Epichnopteryx*, *Bijugis* and *Fumea* are exceptions). The shank, femur, and tibia are hairy, the tarsi covered with very short down. The *Oiketicidae*, *Psychidae*, and most of the *Epichnopterygidae* have a spine, or epiphysis, "spina tibialis," sometimes very long, on the anterior tibiæ. On the second pair of feet, some genera (*Epichnopteryx* and *Fumea*) have a pair of spurs. On the posterior tibiæ, *Psyche* has a pair of very small spurs, *Diabasis* a very well-developed pair, whilst *Fumea* and *Epichnopteryx* have two pairs. The stigmata are placed in normal position; the wings differ much in form and are covered with hair and scales, the latter often piliform are wide in the genus *Fumea*; the fringe is also long and piliform (Heylaerts).

The female in most of the Psychids is apterous, in fact, in all, except those genera that are at the base of the stirps and that have been already named—*Narycia*, *Diplodoma*, *Melasina*, *Psilothrix*, *Lypusa*, &c. Bruand lays much stress on the differences offered by the apterous females, which he divides into three groups—

(1) Araneiformes—represented by *Fumea*, *Luffia*, *Bacotia*, *Bankesia*, and *Solenobia*.
(2) Semivermiformes—*Taleporia*.
(3) Vermiformes—*Epichnopteryx*, *Apterona*, *Sterrhopterix*, and all the higher Psychids.

The "araneiform" and "semivermiform" females leave their cases immediately they have emerged and rest upon the extremity of the case whilst awaiting the male—the Fumeids with the ovipositor thrust into the case, the anal tuft closing up the entrance to the case, but the others quite exposed, with the ovipositor hanging downwards (the case also hanging downwards) in the Solenobiids, the Taleporiid females resting similarly. *Bacotia* and *Luffia*, however, rest on the case with extended ovipositor, until fertilisation takes place. We may here mention that Bruand placed *Luffia* ♀ with the "vermiform" group—an evident error. The Solenobiids and Taleporiids necessarily adopt a different egg-laying habit from the Fumeids. The empty pupa-skin of the female projecting from the larval case of the former groups, the eggs are placed in the latter, by means of the long ovipositor which is inserted between the edges of the larval case and the pupal-skin. The ovipositor in most of these is very elongated, composed of three cylindrical pieces, two of which are retractile, so that the female can deposit its eggs almost at the bottom of the case, lengthening or shortening the segments of the ovipositor like the tubes of a telescope, the ovipositor, when fully extended is often longer than the body of the female. Siebold, in his *Mémoire sur la reproduction de Psyche*, has given some interesting anatomical details of the internal structure of the ovipositor and of the generative organs. The deposition of eggs outside the case must be looked upon as abnormal in all those Psychids with apterous females. The "vermiform" females of Bruand—*Epichnopteryx*, *Apterona*, *Bijugis*, and all the higher Psychids—remain in the case, coming up the long silken tube to its entrance, the male inserting his extensile abdomen and pairing with the female whilst in this position. These females are very restless, often partly emerging and then retreating into the case, until a male has found them, and on this account Standfuss termed the group—*Pupifugae*. If a male should not find them they will often after two or three days, force their way completely out of the case when they soon perish. Copulation appears impossible if a female be removed from the case (at any rate we watched a male *P. villosella* most eagerly attempting to pair with an exposed female returning again and again for quite an hour, but utterly unable to do so or to place himself in a position that would allow of copulation, whilst the continuous vermiform movements of the ♀ increased the difficulty). On the other hand, copulation takes place in a few moments when the female is in the tube of the case. After fertilisation the female retires again into the pupa-skin, which remains at the bottom of the larval case, and fills this with the delicate eggs which are packed so closely that they often lose all shape and outline.

The female of the Psychids (except those that have winged females) bears no resemblance to the male, and Schrank's definition that it is "ein blosser Eiersack" is very nearly, though not quite literally, correct. The head is small, and carries articulated (Solenobiids, Taleporiids, Fumeids), or rudimentary (*Apterona* and higher Psychids) antennæ. The eyes are faceted in the more generalised, quite rudimentary in the more specialised, families. The mouth-parts are rudimentary (the mouth is said to be closed by a transparent membrane which stretches and contracts by the movements of respiration, although we have not observed it). The thoracic segments carry shiny, corneous dorsal plates, and, in many instances, these are present on some (or all) the abdominal segments, in others, the abdominal segments are soft and without protection of any kind. The spiracles are usually distinct, and the subcutaneous tracheæ are easily traceable in some females (*P. villosella*), as also are the renal tubes ventrally on the anterior abdominal segments. The nerve ganglia along the median line of the venter are also conspicuous in the higher groups, whilst the modification of the terminal segments to form an extensile ovipositor in Solenobiids, Taleporiids, Fumeids, &c., has already been noticed. This Fumeid ovipositor has been repeatedly spoken of as consisting of three segments, in reality, it would appear that there are but two, the apparent third (the middle) one, being probably only a special development of the membrane connecting the upper and lower segments, and allowing them to be withdrawn one within the other. In *Pachythelia villosella*, the ovipositor (?) consists of the fleshy 10th abdominal segment, whilst on the 9th, ventrally, are two soft fleshy flaps, which Heylaerts says guard the entrance to the vagina. The female may, or may not, possess an anal tuft of wavy hairs (with which the eggs are covered). Almost all the females of the generalised families show some trace of setæ which can often be homologised with those borne by the larval tubercles. The feet are exceedingly well formed in the lower, exceedingly rudimentary in the higher, Psychids. The abnormal development of the ovisacs has been already noted.

The general character of the Psychid antenna is to be scaled dorsally and to have very long hairs ventrally. The scales partake of the character of those on the rest of the insect, those of *Diplodoma herminata* (*marginepunctella*) and *Fumea* are very ordinary scales, those of the haired species, *e.g.*, *P. villosella*, are narrow and hair-like. The "sensory hairs" are very long, generally of a very uniform length, and exceed in length the thickness of the antenna. In the Taleporiid (lower) section of the Psychids, the antennæ are simple, the scales and hairs are in two rows (*D. herminata*, *T. tubulosa*), whilst sometimes one row of hairs seems rather smaller than the other and is on a less projecting knob. In some, the hairs are tolerably uniformly distributed (*Solenobia inconspicuella*). In the Macro-Psychids (higher section) the antennæ are pectinated, the scales are (as is usual in that case) not in definite rows, but evenly distributed, and usually clothe the pectinations to the tips. In a specimen of *P. villosella* examined, they appeared to be naked as also in *W. reticella*. The antennal structure shows *D. herminata* to be a good Psychid, that of *N. monilifera* suggests an alliance, in this direction, with certain Adelids (Chapman).

In the Psychids, the frenulum does not present any very remarkable features. It is present in all the ♂ specimens examined, but is in most cases, slender and rather weak. The retinaculum also is usually feebly developed. The apterous and ill-developed character of the females of almost all the British Psychids reduces the enquiry to an examination of the male sex only (except in *Narycia* and *Diplodoma*). In *Psychoides verhuella*, sometimes placed at the bottom of this stirps, the spina of the male is slender, the retinaculum consisting of a group of hairs and broad scales on the costal nervure. The female has two slender spinulæ locking into a slight fasciculus of scales on the median nervure. In *Narycia monilifera* the ♂ spina is slender and pale in colour, locking into an inconspicuous retinaculum whilst the ♀ has three slender spinulæ. The male of *Diplodoma* (*herminata*) has a slender spina, a bright transparent brown retinaculum, covered and concealed by an overlapping fringe of scales. *Solenobia* (*inconspicuella*) has the spina very slender and weak, the retinaculum a mere bunch of scales, whilst in *Taleporia* (*tubulosa*) the spina is long but slender, the retinaculum, also, simply a group of long scales. In *Bankesia* (*conspurcatella*) the spina is very slender, the retinaculum is bare, but stronger than in many allied species. Comparing this with the two preceding, one may say that in *T. tubulosa* the spina is slightly thicker and the retinaculum more strongly fringed with hairs, whilst in *S. inconspicuella* the spina is darker and the retinaculum is coated with thin straggling hairs, but decidedly weaker than in *B. conspurcatella*. In *Fumea*, the spina is slender, but whilst the retinaculum of *F. casta* is very weak and inconspicuous, that of *F. crassiorella* forms a small close-fitting pocket on the nervure, covered by a few long hairs, and that of *F. saxicolella* is rather conspicuous, bare of hairs, corneous and covered somewhat thickly with small scales, and larger than the retinaculum of *F. crassiorella*. In *Proutia* (*betulina*) the spina is very slender, the retinaculum very small and weak. In *Luffia* (*lapidella*) the spina is slender, the retinaculum small and closely curling into a tight tube for the spina, studded by a few long hairs, whilst in *Bacotia* (*sepium*) the spina is rather thicker and stronger than in the allied species, and the retinaculum is short and almost bare of scales. In *Whittleia* (*reticella*) the spina is slender and very glossy, the retinaculum small but effective. In *Epichnopteryx* (*pulla*) the spina is very slender, the retinaculum varies from a weak and slight bunch of scales to one that forms a very small sac or pocket on the nervure, almost bare of scales, and grips the spina closely. In *Sterrhopterix standfussi*, the spina is long but slender whilst the retinaculum forms a flattened pocket on the nervure, almost bare of scales. In *S. zermattensis* the spina is long and black and the retinaculum stands out boldly from the nervure curled over into a hook or ring. In *Pachythelia* (*villosella*) the spina is fairly strong, the retinaculum forming a pocket on the nervure almost bare of scales, whilst in *Canephora* (*unicolor*) the spina is well-developed, the tip received into a small pocket on the nervure almost bare of scales, but edged with a few broad scales (Griffiths).

As we have already stated, the males fly almost as soon as emergence has taken place, and are so active that many species are worn to shreds in an hour or two. They seek the females with great ardour and "assemble" freely; the Oiketicid males have been known to enter the pupa-case to the utter ruin of their wings. Armitage exhibited (*Proc. Ent. Soc. Lond.*, ser. 3, vol. ii., pp 103-104) a case of *Oiketicus kirbyi*, into the "cap" of which three males had, at the same time, inserted their abdomina, directly after its extremity had been opened by a newly-emerged female. Heylaerts states that he has often observed that, when a freshly emerged male recognises that a female is near him, he pairs immediately without waiting for the expansion of his wings.

The manner of copulation in the Macro-Psychids was described (*Stett. Ent. Zeitung*, 1844) by Mann. When a male has found a case which has the free end open, thus showing that the female has emerged, it fixes itself by means of its feet on the upper part of this end. Elongating its abdomen, it introduces it into the opening, pushes it beneath the venter of the female which presents its head to him, and introduces the penis into the vagina. After some minutes, copulation is finished, the male flies off to seek another female, whilst the first immediately commences to lay her eggs in the empty pupa-skin and in the case when the former is filled. The mode of copulation varies considerably, however, in the different groups as we have already shown, and whilst the vermiform females do not leave the case for this purpose, the araneiform females pair on the outside of the case, whither they crawl immediately on emergence. Bruand erroneously states that the vermiform females turn round in the pupa-case after emergence and expose the anal segments at the opening, adding that whilst the female is awaiting the male, she re-enters the case at the slightest disturbance. By the time that the female has laid her eggs she is reduced to the smallest conceivable dimensions, and most of the vermiform Psychids appear then to voluntarily leave the case. Bruand notices that if copulation does not take place in a few days, the female comes right out of the case, drops to the ground and dies, an observation which we have already affirmed. The fact that the females are apterous would lead one to conclude that the Psychid species may be very localised, and this is frequently so, whilst the tendency is often intensified by the fact that the larvæ walk slowly. Bruand, however, notes that if a larva be disturbed when walking, it falls, and is often carried by the wind to a considerable distance before reaching the ground; he observes that when he has been collecting cases of *Hyalina albida* and *Proutia salicolella*, he has seen the cases carried right away by a sudden gust of wind.

Dyar concludes that the family must be of great age, and the wide distribution of its members, which are found in all quarters of the globe, confirms this view. The generalised condition of the lower families of the stirps also supports this supposition and the suggested alliance with the earliest branches of the Tineid stirps accentuates it. It is practically the only superfamily of Lepidoptera in which the females of almost all the species are wingless, yet we should not look on this as evidence of generalisation, but rather as specialisation in its highest sense, the females having been developed until they are little more than huge bags of eggs. That the lowest members of the

Psychid phylum have a great antiquity is certain, and, whilst dealing with this point, one cannot help calling attention to the fact that Stephens twice (?thrice) described *Narycia monilifera* (*melanella*) and placed it on one occasion among the Lepidoptera, and on another among the Trichoptera, whilst Jordan remarked (*Ent. Mo. Mag.*, xx., p. 221) that, though the testimony of the rocks might be against him, he could not help indulging in the hypothesis that "the archaic form of lepidopterous life was almost a land Trichopteron," and that "the cases of these early Psychids might yet be found in the fossil state." If so, one would hardly expect to find the complicated structures resembling those of the higher Psychids of to-day, but rather simple structures, more closely allied to those woven by *Taleporia* and *Solenobia*.

In the *Agricultural Journal*, published by the Department of Agriculture of the Cape of Good Hope, February 16th, 1899, pp. 211-215, Lounsbury gave an account of a Psychid which he believed to have been indigenous on thorn trees, but which had transferred itself to the imported "wattle" trees, that it was reported to be injuring very severely, whilst another species was, at the same time, mentioned as doing much damage to the vine. So far as one can judge from the cases, the first is a Psychid, the second a Fumeid. Fallou gives (*Revue Sci. Nat. Appliq.*, xl., July, 1893, pp. 79-85) an account of the unprecedented abundance of *Hyalina atra*, L. (? *Psyche angustella*, H.-S.) in Auvergne, in 1892, when it committed considerable damage to the pastures of the mountain regions of that district, although usually not particularly abundant there.

The distribution of the higher Psychids is perhaps best learned from Kirby's *Catalogue*, pp. 500-524. From this we gather that the genus *Aconsmaticus* comes from Chili, *Oiketicus* from California, the southern United States, Central America, the West Indies and occurs in S. America to Patagonia; *Thyridopteryx* comes from N. America and the West Indies; *Dipyle* from Mexico, *Metura*, *Clania* and *Lomera* from Australia, *Liothula* from New Zealand, *Dappula* from Ceylon and Hongkong, *Metiser* and *Aprata* also from Ceylon, and *Deborrea* from Madagascar. The distribution of the two species of *Manatha*—one in Ceylon the other in Texas, and the distribution of *Eumeta*—Gambia, Delagoa Bay, Caffraria, Ceylon, East Indies, Australia, China, Japan, Surinam and Brazil—make one doubt whether the species are naturally allied that are included in these genera. *Anesina*, *Barandra*, *Dasaratha*, *Babula*, *Rasicota*, *Moffatia*, *Eurukuttarus*, *Kophene* and *Mahasena* are Indian genera; *Plateumeta* is Japanese; *Animula* extends from Australia and Sumatra to Venezuela and Brazil; whilst *Bombalina* is found in India and Natal. *Chalia* is undoubtedly a mixed genus (as used by Kirby) with several divergent elements, and its distribution would be misleading. *Canephora*, *Amicta*, *Fumaria*, *Oreopsyche*, *Sterrhopterix*, *Phalacropterix*, *Apterona*, *Stichobasis*, *Psychidia*, *Epichnopteryx*, and *Fumea* are (as used by Kirby) essentially Palæarctic genera, but *Psyche* is practically cosmopolitan and probably (with the exception of the Palæarctic and Nearctic elements) heterogeneous. *Platoeceticus*, *Œdonia*, *Sapinella*, *Thanatopsyche*, *Psychographa* and *Psychonoctua* are American; *Orophora* comes from New Zealand, and *Genduara* from Australia. Little is known of the distribution of the generalised families outside the Palæarctic region, but where this is known it is mentioned in our account of the family, subfamily, or genus, as the case may be.

CLASSIFICATION OF THE PSYCHIDES.

Réaumur tells us that the larvæ of the Psychids were known to Aristotle, who called them "Xylothoros," a name that has been translated into Latin as "Ligniperda," as if the insects lived on and digested wood instead of simply making their cases of it, although very many cover themselves with small pieces of grass, leaves, and lichen in preference. Pliny knew, however, that they were true lepidopterous larvæ, and Réaumur expresses the opinion that the cases are hardened by the solid particles for the protection of the larva, the silk being insufficiently firm, whilst he considers that grass is generally utilised, not because it represents the food-plants of the larva using it, but because it is more easily cut off and attached to the cases. The species noticed by Réaumur in the *Mémoires*, iii., pp. 143-204, are *Apterona crenulella*, *Fumea roboricolella*, *F. casta*, *F. crassiorella*, *? Acanthopsyche opacella*, *? Pachythelia villosella*, *Luffia lapidella*, *Bacotia sepium*, and *Solenobia triquetrella* (*? S. inconspicuella*), many of which appear to be fairly recognisable; in fact, Réaumur's description of *L. lapidella* is the only complete life-history of the insect known to us. Poda, in 1761, described (*Ins. Mus. Graec.*) a Psychid (which he considered to be a *Tenthredo*) as *Tenthredo hirsuta*, whilst Scopoli, in 1763, referred two species to the Phryganeids as *Phryganea pectinicornis* and *P. dubia*. In 1762, Geoffroy described (*Hist. des Insectes*) two species, one having a case covered with longitudinal straws, the other with a case composed of transverse straws (the former being named afterwards *palearis* in *Fourcroy's Ent. Paris*. He also described (*loc. cit.*) *Luffia lapidella* and a *Solenobia* (*? triquetrella*) which were named in the later work *lichenosa* and *lapidosa* respectively; as also *Narycia monilifera* and *Diplodoma herminata*, the species now bearing Geoffroy's (Fourcroy's) names, although generally spoken of as *N. melanella* and *D. marginepunctella*. Linné, in the *Systema Naturae*, xiith. ed., 1767, vaguely diagnosed a Scandinavian species among the *Phalenae-Bombyces* as: "*Bombyx atra*, elinguis, tota atra, magnitudo vix muscam carnariam superat." Scarcely one of the descriptions of the larger species, however, to which names were attached, can certainly be connected with a known species, and one of the first descriptions that can be thus applied is that of *Bombyx unicolor*, Hufnagel, *Berl. Mag.*, ii., p. 418, in 1766. In 1767, Pallas first drew attention to the phenomenon of parthenogenesis, and wrote (*Nova Acta Phys. Acad. Caes. Leop. Carol.*, p. 430): "Phalænarum biga, quarum alterius fæmina artubus prorsus destituta, nuda atque vermiformis, alterius, glabra quidem et impennis, attamen pedata est, atriusque vero, sine habito cum masculis commercio, fæcunda ova parit." He described and figured (*tom. cit.*, p. 435, pl. vii., figs. 1-5, 10) *Fumea casta* and *Canephora unicolor*, whilst in 1776, Denis and Schiffermüller (*Wien. Verzeichniss*) enumerated seven species—*Tinea graminella* (=*unicolor*), *T. viciella*, *T. hirsutella* (*? nec* Hb.), *T. muscella* (*? atra*, Esp.), *T. bombycella*, *T. pectinella*, and *T. plumella* (*? pulla*, Esp.). In their description of *T. viciella*, these authors assert (*loc. cit.*, pp. 292-293) that there is no female, and express the opinion that the eggs hatch directly from the pupa, without the intervention of a male, an error of observation that can readily be understood, when the egg-laying habits have once been noticed. Between 1781 and

1786 Brahm and Johann Hübner described and figured certain species in *Fuessly's Archiv der Insektengeschichte*, whilst Esper, between 1777-1794, and Fabricius, de Villers, Vieweg, Borkhausen, Jacob Hübner, and Thunberg described several species towards the end of the century, the larger Psychids being by some of these authors placed among the Bombyces, the smaller ones among the Tineids.

Schrank appears to be the first author who separated the Psychids as a distinct group, diagnosing the larger species under the generic title *Psyche*, as follows (*Fauna Boica*, p. 87)—

Federmotte, 211, *Psyche*.—Männchen: Fühlhörner; doppelkammförmig, Flügel; flach dachförmig, ansehnlich. Körper, schmal. Füsse, fast nackt. Weibchen: Ein blosser Eyersack. Lebensart: Die Raupen wohnen in Säcke aus zusammengesponnenen Blattstücke oder Blattribben, die bei einigen Arten sehr künstlich sind, und die sie allenthalben herumtragen. Aus den Eyern kommen, auch ohne Begattung, lebendige Jungen aus, die aber nicht fortwachsen.

Schrank had an unfortunate habit of changing specific names, *e.g.*, *graminella* is called *graminum*, *viciella* becomes *viciae*, *atra* is changed to *agrostides*, &c. In 1809, Latreille restricted the genus to *hieracii*, *viciella*, and *muscella* (*Gen. Crust.*, iv., p. 219), whilst Kirby, in 1892, makes (*Cat. Lep. Het.*, p. 515) *viciella* the type of the genus. As *viciella* is not congeneric with any British species, *Psyche* (as now restricted) is not represented in Britain. With Ochsenheimer, the history of the Psychid literature becomes more voluminous, but at the same time more exact, and the species more clearly defined. To trace this literature through the works of Germar, Duponchel, Boisduval, Zeller, and Herrich-Schäffer would occupy too much space, although the latter author's work in the *Sys. Bearbeitung*, vol. vi., is worthy of notice; it was, however, subsequent to, and probably inspired by, Bruand's *Monograph des Psychides*, published in 1853, which is deserving of all praise, and has practically formed the basis of almost all subsequent work on this superfamily, and his attempt to clear up the confusion, relating to the synonymy and life-histories of the species, was so far successful that a solid foundation for future work was produced by him. Siebold, Speyer, Hofmann, Standfuss, Heinemann, Millière, and Heylaerts have since paid special attention to the group.

We have already stated that Scopoli referred the Psychids to the *Phryganeidae*, and Curtis observes that, in more than one respect, the Psychids approach the Phryganeids, and he considers that they may be found to unite the two orders, not only on account of the remarkable resemblance between the economy of their larvæ and the form of the perfect insects, but the similarity of the cases with which they are clothed. Newman allies them also with *Phryganea*, but states (*Zool.*, viii., pp. c-ci) that whilst in *Sterrhopterix hirsutella* (*calvella*) the wings only produce scattered hairs, greatly resembling those possessed by many species of *Phryganea*, in *C. unicolor* (*graminella*) the wings are completely covered with true lepidopterous scales. It is rather remarkable that the question as to Psychids being Lepidoptera should have been thus raised at this late period. Stephens points out that the palpi are in a high state of development in the Trichoptera, and that, therefore, the *Psychidae* cannot, from their oral organs, belong to that order.

Linné seems to have been the earliest author to place the larger Micro-Psychids among the Bombycids, and the *Psychidae*, *Epich-*

nopterygidae and *Fumeidae* were so placed by Borkhausen, Brahm, Vieweg, and Ochsenheimer. The first real attempt to classify the Psychids, however, was made by Hübner. He includes the whole superfamily in the TINEIDES, and divides them (*Verzeichniss*, pp. 398-400) into "Canephoræ-veræ" and "Canephoræ-falsæ," the former representing the so-called Bombycid, and the latter the so-called Tineid, section. Guénée, too, was a strong supporter of the Tineid affinities of the Psychids, and insisted that they formed but one superfamily. In 1846, he criticised (*Ann. Soc. Ent. France*, 2, iv., pp. 6-7) the position of the Psychids, objected to their being placed near the Liparids, and pointed out how vital are the differences between the apterous female Orgyiids and Liparids on the one hand, and the wingless female Psychids on the other, both in their body-structure, antennæ, ovipositor (terebriform in Psychids), &c. He compares the larval habits of *Taleporia* with those of *Adela*, and concludes that the Psychid alliance is with *Adela*, *Incurvaria*, &c., and not with *Liparis* and *Orgyia*.

Stephens considered that the Psychids were Bombyces on the grounds of "the rudimentary oral apparatus, which is, in general, so slightly developed in the group, especially among the typical species, as to become nearly obsolete in some of the gigantic ones, and the same deficiency of trophi serves likewise to detach them from the *Tineae*, in which they are typically so highly developed as to exhibit all four palpi most distinctly without the aid of a lens." He allies them with: (1) The Crepuscularia (through *Heterogynis penella*). (2) The Tineids (through *Taleporia*). (3) The Bombyces (through *Oiketicus*). Horsfield places the Psychids with the Hepialids, uniting them by means of the singular genus, *Oiketicus*, Guilding.

Bruand, in 1853, criticised the superficial division of the Psychids into Macro-Psychid (Bombycid) and Micro-Psychid (Tineid) sections. Duponchel defined the Tineid section as having: "Les fourreaux nus ou unis, et non revêtus de pailles ou débris de feuilles commes ceux des Psyches," and then placed the modern genera *Epichnopteryx*, *Fumea*, *Proutia*, *Bacotia*, among them, whilst *Taleporia* was placed among the Macro-Psychids and later among the Micro-Psychids. Herrich-Schäffer places (*Sys. Bearb.*, ii., pp. 17-22) the Macro-Psychids between the Cocliopods and the Heterogynids, and observes that "the habitus of the Psychids is somewhat similar to the Cocliopods, the absence of the tongue and secondary eyes (ocelli) and the fact that the hind tibiæ possess only one pair of spurs, afford other points of resemblance. The two inner marginal nervures of the forewings that are present in the Cocliopods are united towards the base in Psychids, whilst the three inner marginal nervures of the hindwings are, in some Psychids, almost perfect, although in many the third is scarcely to be recognised, especially towards the base. The Psychids would accordingly connect the Cocliopods with the Tineids—*Canephora* (*Fumea*, *Epichnopteryx*) and *Taleporia*; on the other hand, they approach, through the Heterogynids, still nearer to the Zygænids (Anthrocerids). The relationship of this family with the Bombycids, &c., especially with *Liparis morio*, is only superficial." To this extent then Herrich-Schäffer follows Duponchel and carries over the Epichnopterygids and Fumeids to the Tineid stirps, whilst separating them from the Macro-Psychids (a method since followed by Meyrick). One need not be surprised that the superficial resemblance of the Fumeid and Taleporiid females misled Herrich-Schäffer, but one is somewhat astonished that the Epichnopterygid female did not point out the true position of this family. Here one may draw attention to the fact that in these higher Psychids, in particular, the ♀ is the most modified, and, therefore, although one may look to the male for the position of the superfamily among others, one must turn to the ♀ for the characters by which the members of the group must be arranged among themselves. Divisions (especially generic), therefore, based on female characters, are correctly founded, and are not to be put aside if unsupported by male characters, and should be retained, perhaps, even if contradicted by them. It is these groupings that are now wanted before we can get much further with the classification of the higher subfamilies and genera.

Stainton separated the Macro-Psychids from the Micro-Psychids, but included the Epichnopterygids and Fumeids in the former section, sandwiching the latter between the *Platypterygidae* and *Cochliopodidae*. Barrett follows Stainton in placing the larger Psychids (*Psyche*, *Epichnopteryx*, and *Fumea*) in a heterogeneous group called Bombycina—comprising such superfamilies as *Zeuzerides*, *Hepialides*, *Cochlidides*, *Nolides*, *Lithosiides*, *Arctiides*, and *Liparides*—and locates them next to the Liparids, because "their general structure is rather closely connected with the last genus (*Orgyia*) through *Penthophora morio*—a semi-transparent-winged, black species, with semiapterous female, of which the larva lives on grass, but is not a case-bearer." We are not quite clear in what way "the general structure" of Psychids "is closely connected" with Liparids. We doubt whether all Psychids are black, their females semiapterous, or that all their larvæ feed on grass.

Bruand concluded that, as a whole, the Psychids originated with the Tineids, and that they should be placed among the Tineina (as previously understood), immediately preceding the Tinéites. We have already stated that Bruand included almost the whole of the Psychids in one genus—*Psyche*—but his subdivisions of the genus make this a mere matter of terms, and his groups correspond almost exactly with the genera adopted today. He asserts that, taken as a whole, and in spite of the character of the inner nervure, the general system of the neuration is as analogous as that of other equally important groups, and he insists that closely allied species in other genera often differ more than does the *albida* division of *Psyche* (= *Oreopsyche*, Heyl.) from the *pulla* or *crassiorella* divisions (= *Epichnopteryx* and *Fumea*). He considers that his plate of the neuration is sufficient to convince one that this character justifies him in uniting the so-called Tineid and Bombycid sections in one group and placing them in the Tineids. On the various characters he enunciated, Bruand associated *Typhonia*, *Heterogynis*, *Psyche* and *Psychoides* in one superfamily, which he called a tribe. His genus *Psyche* comprised the genera *Psyche*, *Fumea*, *Epichnopteryx*, *Solenobia*, *Taleporia* (in part), as used by Staudinger and Wocke in their *Catalog*, 1871, as well as *Bankesia*, *Bacotia*, *Luffia* and *Proutia* (of our own definition), and Bruand considers the characters presented by these so homogeneous as not to permit the establishment of more than unimportant subdivisions.

With regard to the neuration it may be here mentioned that, according to Bruand, *Epichnopteryx bombycella*, *Fumea crassiorella*, *Proutia salicolella*, &c., have the internal nervure (parallel with the inner margin) of the forewings simple, as in *Taleporia politella*, *T. tubulosa*, *Solenobia clathrella* &c. This character appeared so important to Herrich-Schäffer that he founded his genus *Taleporia* upon it, including in the genus *Psyche* all those species that had the inner nervure bifurcate. Bruand considers that, without attaching too much importance to this character, it sufficiently indicates that the species exhibiting it should not be separated. It was practically on the character offered by this nervure, too, that Herrich-Schäffer placed the Macro-Psychids in the Bombycids, between the Cochlidids and Heterogynids, whilst the other group—comprising the Taleporiids, Solenobiids and *Typhonia* (*Melasina*)—were placed in the Tineids, Herrich-Schäffer, however, all the while avowing, that they have the strongest affinities with the Psychids proper, for, according to him, *Psyche* forms the passage from the Cochlidids to the Tineids.

Meyrick places the *Psychidae* (*Psyche*, *Sterrhopterix*) in the Psychina which contains also the *Zeuzeridae*, *Anthroceridae* (*Zygaenidae*), and *Cochlididae* (*Heterogeneidae*). He transfers all the other genera—*Epichnopteryx*, *Fumea*, *Solenobia*, *Taleporia*, *Narycia and Diplodoma*—to the *Tineidae*, these genera being sandwiched between *Arcrolepia*, Curt., on the one hand, and *Ochsenheimeria*, Hb., on the other. The separation of *Epichnopteryx* and *Fumea* from the larger Psychids had been suggested, as we have noticed, by Herrich-Schäffer and Duponchel. In our opinion Meyrick quite yields the position in making the separation because he says that he considers his *Psychidae* (also the *Zeuzeridae*, *Anthroceridae* and *Cochlididae*) as "correlative developments from a common ancestral form, which must have closely approached the typical *Tineidae* (group of *Epichnopteryx*)" (*Handbook*, &c., p. 443). This reminds one much of Herrich-Schäffer's statement that Psychids connect the Cocliopods with the Tineids, *Canephora* (*Fumea* and *Epichnopteryx*) and *Taleporia*, whilst, on the other hand, they approach through the Heterogynids still nearer to the Zygænids (Anthrocerids), &c. It appears to us, therefore, that Herrich-Schäffer and Meyrick widely separate the Micro-Psychids from the Macro-Psychids and then argue that they are in reality very closely allied.

Spüler followed Bruand in uniting the two sections, and states that in shape, and mode of life, the females of many species of *Fumea*, *Epichnopteryx* and *Taleporia* (including *Solenobia*) are much more nearly related to each other than are those of other species of *Fumea* and *Psyche*, the species of the latter genus, judging by the neuration, falling into two groups. These views as to the unity of the Psychids in one superfamily are confirmed by Chapman, who says that "the Psychids are, judging by the structure of the pupæ, a homogeneous group. *Whittleia reticella* (a Tineid according to Meyrick) and *Pachythelia villosella* (a true Psychid) come close together and have identical pupæ. If there be a subdivision it is between the plant-eating and lichen-eating groups, and they are only subdivisions of the same superfamily" (*in litt.*). Chapman further notes that Psychids are, speaking paradoxically, especially homogeneous, in exhibiting the most remarkable vagaries in their neuration—nervures present or absent, accessory nervures present or absent, &c., in all sorts of ways in otherwise closely allied genera. He considers that they might be divided in various ways on neurational characters that elsewhere might divide families. Why one neurational vagary, *viz.*, "hindwings with 7 and 8 united by a cross nervure" should separate one lot from another, one can hardly understand. *Oiketicus* wants the bar and so is a *Taleporia!*" (*in litt.*).*

Packard fully supports this view and writes (*Bombycine Moths of America*, pp. 67 *et seq.*): "The *Talaeporiidae* (*Solenobia* and *Talaeporia*) are the direct ancestors of the broad-winged *Psychidae*. . . . The imagines have, according to Stainton, no maxillary palpi, and the tongue is wanting, while the females are wingless. The head is broad, and we have, so to speak, in this group, Tineid-Bombyces. The neuration is generalised Tineid, and it is evident from a long abode in cases that the features which separate the family so widely from the *Tineidae* are the result of disuse and resulting adaptation. The family had diverged considerably from the Tineid source along a path which unmistakably ends in the *Psychidae*. . . . The pupa of *Talaeporia pseudobombycella* has a broad head with distinct paraclypeal pieces and glazed-eye sutures. The maxillary palpi are large and well-developed, extending under the eye from the antennæ to the labial palpi, which are large, but short and very broad. The maxillæ are present but small. The abdomen bears no cremaster, but there are two terminal small spines which may be the homologues of the anal leg hooks of the pupæ of *Psychidae*. The scars of the four pairs of anterior abdominal prolegs are present as in *Psychidae*. In *T. conspurcatella* the maxillæ are much more rudimentary, and, before exuviation, concealed by the long labial palpi; the maxillary palpi are large and triangular. In the pupa of *Solenobia walshella*, the maxillæ have undergone less reduction than in *Talaeporia*, as they are well-developed, but the European species, *S. pineti*, has outstripped the American one in the process of degeneration and modification, and the maxillæ are very much shorter and smaller, though the maxillary palpi are of the same shape and size. In this genus, the abdomen has no cremaster and no terminal hooked spines, the pupa, in exuviation, being fastened to the sides of the cocoon by numerous hooked setæ. The transition from the *Talaeporiidae* to the *Psychidae* is a most natural one, whether we compare the pupa or imago. In *Fumea*, the wingless females† have legs and antennæ, while in *Psyche* they are wanting and they never leave their case, or, when the female of *Fumea* 'escapes from the pupa, it emerges from the case and sits on the outside' (Stainton). . . . It is evident from this that the line of development from the narrow Tineid-winged *Talaeporiidae* to the broad-winged *Psychidae* was nearly direct. Perhaps the slight changes in neuration and much greater breadth of the wings and the pectinated antennæ are the result of adaptation to the stationary mode of life of the females, the males acquiring greater power of extended flight, and a more acute sense of smell in order to discover the presence of the females. In comparing the pupæ of different genera of *Psychidae* with those of the *Talaeporiidae*, the resemblance is most striking and naturally suggests the direct evolution of the Psychids from the latter group. The head is

* Since the above was written Chapman has argued out this subject at length in a paper entitled "On the Unity of the Psychidæ," *Ent Record*, xi., no. 8.

† There are traces of wings in ♀ *Fumea*, as also in *Luffia* (Bacot).

broad and has the same general shape as that of the *Talaeporiidae*, including the form of the eyes, of the clypeus, and of the labrum, which, however, in the *Psychidae*, is more distinct from the clypeus, though in *Solenobia walshella* it is nearly as separate. The shape of the cases of the maxillary palpi of *Psyche graminella*, *Œceticus abbotii*, and *Metrua elongata* is as in *Solenobia walshella* and *S. pineti*. The maxillæ, fairly well developed in the *Psychidae*, are much as in *S. walshella*. The labial palpi, though varying much in the different genera of *Psychidae*, are essentially as in the *Talaeporiidae* (compare those of *Psyche*, *Œceticus*, and *Entometa* with those of *Talaeporia pseudobombycella*). Those of *Platoeceticus* are longer than in the other *Psychidae*, but still more rudimentary than in *Solenobia*. In regard to the shape of the maxillary palpi, which unite, forming a continuous bar or piece in front of the labrum, *Thyridopteryx* differs from other *Psychidae* and approximates to certain *Hepialidae*. . . . In the *Psychidae* the paraclypeal pieces or tubercles, as we might call them, are always present. They are convex and very rugose. The labial or second maxillary piece, is, in the Australian *Eumetopa ignobilis*, of the same shape and sculpturing as in *Psyche graminella*, but the large, round, rugose pieces on each side, or 1st maxillary palpi, are single, not divided into two parts, unless the irregularly trapezoidal pieces between the maxillary palpi and the eyepiece be the homologue of the outer portion. In the Australian *Metrua elongata* the short reduced labial palpi are much as in *Psyche graminella*, but are more deeply divided. The two divisions I am inclined to consider as the second maxillary (labial) palpi. In this genus, the 1st maxillary palpi also are as in *Psyche graminella*. It will then be seen that in the pupa of this family the 1st and 2nd maxillary palpi vary very much in form, as they probably do in the imagines, being more or less atrophied in the latter, where they need to be carefully examined. On the other hand, the maxillæ themselves (for in their pupal condition in haustellate Lepidoptera, they have retained the separated condition of those of the laciniate Lepidoptera), though short, are quite persistent in form. The pupa of *Platoeceticus gloverii* differs from that of *Œceticus abbotii* in the undivided 1st maxillary palpus (eyepiece) and the elongated 2nd maxillæ as well as the narrower clypeal region, and the lack of a cocoon or case-opener. . . . The outer division of the eye-piece varies much in size. This is due to the varying width of the male antennæ, which, when wide, as in *Pinara* (*Entometa*), *Metrua*, *Thyridopteryx* and *Psyche*, overlap and nearly conceal it, while it is entirely hidden in *Platoeceticus*. On the other hand, in male pupæ of *Hepialus* and *Oncopera*, where the antennæ are small, narrow, and not pectinated, these pieces are large. The end of the body has no cremaster, but, what is unique, a hook arising from each vestigial anal leg. It will be seen that from an examination of the pupæ the views of Speyer, of Chapman, and of Comstock, as to the position of the *Psychidae*, are fully confirmed. They are more modified than the *Hepialidae* since the females are wingless and limbless. It is very plain that they are an offshoot from the Tineoids and especially from the *Talaeporiidae*, which have no tongue and whose females are wingless and sack-bearers."

We offer no apology for thus quoting Packard at length. It is necessary, when such a violent division of a superfamily is made as that of placing one portion of it among the Tineids, and the other portion (structurally identical) among the Bombycids, to examine carefully the characters on which the division is made. Our readers can now compare the reasons given by Stainton, Meyrick, and Barrett for separating, and those of Chapman and Packard for uniting, them.

There can be no doubt that all the Psychids are so closely related that they must represent one superfamily. The *Taleporiidae* differ somewhat from the *Psychidae*, being in many ways less specialised. Meyrick and Hampson both agree really that the two groups should follow each other closely in some way or other. Hampson notes (*Moths of India*, i., p. 289) that the Solenobiid section of the Tineids would follow the Psychids, if the Heterocera could be arranged in lineal series. Meyrick places *Fumea* with the Tineids, Hampson with the Psychids. Meyrick's division would tabulate thus :—

1. Hindwings, 8 connected by bar with upper margin of cell ; ♀ fertilised in the pupa-case = *Psychidae*.

2. Hindwings, 8 free from cell ; ♀ emerges and is fertilised on the outside of the case = *Taleporiidae* (including *Fumea*).

As has been stated before, however, there is great variation in the Psychid neuration, so that the latter goes for little. We are really unable to understand this division without making a fetish of the bar between 8 and the cell.

Bruand says that the Psychid position of rest is similar to that of the Bombycids. In *Fumea crassiorella*, *Proutia salicolella*, and even in *Psychoides verhuella* this character exists as strongly as in *Canephora unicolor* (*graminella*) and the allied species. At the same time, Bruand admits that " the wing-characters, antennæ, palpi, &c., of the Taleporias are nearer those of *Psyche*, strictly so-called, than those of the Heterogynids. He further asserts that the group included under the name *Taleporia* resembles more that of which *C. unicolor* (*graminella*) is the type, than that comprising *O. albida* and *O. plumifera*.

Having now indulged in a general criticism of the views adopted by various authors, it becomes necessary to state our own position :— With regard to the affinities of the superfamily as a whole, there are two possible positions in which it can be placed indicated in the " Phylogenetic tree " represented in vol i., pl. 1 of this work. These are on—(1) The Sphingo-Micropterygid stirps. (2) The Geometro-Eriocraniid stirps. Superficially, the imagines of the *Psychidae* and *Epichnopterygidae* approach the Bombycid section of the former stirps, those of the *Solenobiidae* and *Taleporiidae* approach the Tineid section of the latter. Really there appears little doubt that they originated at a point anterior to that at which the Tineids proper left the main stem, the two having had, far back in their phylogeny, a common ancestor with a generalised larva and case-bearing habit. Their general characters and affinities with the Sphingo-Micropterygid stirps have been previously discussed (*ante*, vol. i., pp. 117-118). We have little hesitation in placing the families with winged females as the more generalised members of the group, and those with the araneiform and vermiform females (which are in reality highly specialised) as the less generalised.

The relationship of the families to each other can only be determined by a due recognition of the characters offered in all the stages of the existence of an insect. As the lack of the imaginal tongue and the rudimentary maxillary palpi separate the superfamily sharply from the Tineids and allied superfamilies, so the peculiar nature of the larval case, the special (want of) development of the larval anal prolegs, the highly-developed third pair of true legs, the peculiar structure of the larval tubercles and their varied stages of evolution as indicated by their position, the remarkable pupal peculiarities—segments 3-7 movable (♂), 3-6 (♀)—the character of the dorsal spines, and the specialisation of the anal pupal hooks, intensify the distinction offered by the imaginal characters, and offer, at the same time, in their modifications, characters for its internal sub-division.

On comparing the families included in the group with which we are dealing, we find that the *Diplodomidae* and *Taleporiidae* (*Bankesia* and *Taleporia*) offer males with ocelli at the base of the antennæ; these are not found in the *Naryciidae* and *Solenobiidae*. Similarly, the *Diplodomidae* and *Taleporiidae* have large cases trigonal in section, the *Naryciidae* and *Solenobiidae* smaller cases and much more cylindrical in general appearance. On the other hand, the *Diplodomidae* and *Naryciidae* present us with winged females, with anal tuft; the *Taleporiidae* and the *Solenobiidae* with almost apterous females with anal tuft. In the larval stage of these families we find that the tubercles are somewhat similar both in structure and arrangement, i and ii being arranged in normal trapezoidal form (i nearer the mediodorsal line than ii), but that, in *Taleporia*, ii has already commenced to migrate, and is behind i. In the pupal stage, all the Micro-Psychids are structurally very similar, presenting a well-marked dorsal headpiece, a patch of dorsal spines on the front of the abdominal segments 3-7, several recurved hairs (modified tubercular setæ) on segments 8-10, and two small dorso-anal spikes. The eggs are moderately solid, not soft and delicate as in the higher Psychids (*e.g.*, *Pachythelia villosella*). The mode of egg-laying is similar in the *Diplodomidae* and *Naryciidae*, whose winged females appear to cover their eggs with a patch of silky hairs from the anal tuft, whilst the apterous females of *Solenobia*, *Taleporia*, &c., lay their eggs within the larval case (mixing the wool from the anal tuft among them), and not in the pupal-skin, which is drawn out as in the male.

We observe that *Taleporia* shows, in some respects, marked characters observed in *Diplodoma*, and that *Solenobia* exhibits others observed in *Narycia*. The question arises, since *Diplodoma* and *Narycia* may be assumed by the possession of wings in the females, and their general structure, to represent the more generalised genera, whether the similarities observed really betoken a close alliance between *Diplodoma* and *Taleporia* on the one hand, and *Narycia* and *Solenobia* on the other. We surmise that the true explanation is that the ancestral Psychid had ocelli and wings, that after *Narycia* (which still retains certain antennal Tineid or Lamproniid features) branched from the main stem it lost its ocelli, but the ♀ retained its wings, whilst the main stem itself was represented by Psychids that retained the ocelli, and gave off *Diplodoma*, that the main Psychid stem then developed forms that found it advisable to lay their eggs in the larval case, and had developed semi-apterous females. One of the first branches given off when the stem had reached this stage of specialisation was the Taleporiid, retaining the ocelli and large case, whilst almost simultaneously (or slightly earlier) the Solenobiid branch was separated, and retained some traces of wings in the females. Above the Solenobiid branch, another (the Luffiid) was given off, which, whilst retaining the characteristic Taleporiid ♂ pupa, became specialised with regard to—(1) its case (conical), (2) larva, which has the tubercles arranged quite in the form of the higher Psychids,

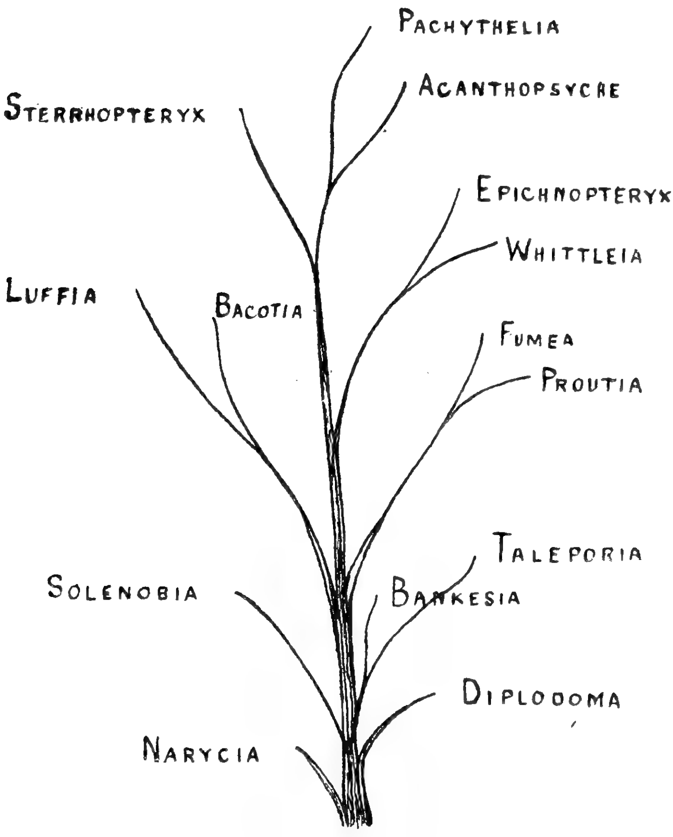

PLATE II.

Phylogenetic Tree illustrating the development of the Psychids from a hypothetical base.

(3) imaginal antennæ, and (4) the assumption of the higher Psychid character of the female pupa being retained within the larval case. From the main stem the Fumeids also arose, the larva with the posterior trapezoidals (ii) having migrated nearer to the mediodorsal

line than i, the female pupa-skin remaining within the case, whilst the ♀ imago emerges and remains on the outside of the case to oviposit, after the fashion of the Taleporiids, although its abdomen is partly inserted in the case during the operation. At the same time, the habit of covering the case with larger pieces of lichen, leaves, grass-stems, &c., was originated. Considerably above these the Epichnopterygids branched off, and these have, in almost all their characters, distinct suggestions of the higher Psychids. It may appear rather strange to say so, but one is compelled to conclude that the latter are almost unknown, so far as their relationships to each other are concerned. We do not wish to underestimate Heylaerts' subdivisions based on the neuration, but so far as our study of the life-histories of a few species has gone they are evidently quite inadequate. It is clear that our British species belong to different genera, whilst *unicolor*, *atra*, and others that have been carefully examined, belong equally to different genera, yet Heylaerts includes two species so widely different, structurally, as *unicolor* and *villosella* in a single genus. In speaking, then, of the higher Psychids (*i.e.*, Macro-Psychids) we are on safe ground, as it does not involve a theory of relationship of families to each other, and this is our reason for using the term so frequently in this chapter. The *Oiketicidae*, the *Psychidae*, the *Canephoridae* and *Apteronidae* of Heylaerts all represent, apparently, primary divisions of the higher Psychids, and it is only a matter of terms as to whether they be called families or subfamilies.

We may perhaps illustrate our idea of the relationship of the Psychid families occurring in Britain by means of a phylogenetic tree (Plate ii). Taking this tree as a basis of classification we have (1) the Micro-Psychids—consisting of the *Naryciidae*, *Diplodomidae*, *Taleporiidae*, and *Solenobiidae*, in which the ♂ and ♀ pupal skins are both left protruding from the larval case after emergence, the eggs laid in the larval case (not in the pupa-skin), the larva with the dorsal tubercles i and ii trapezoidal (i nearer median line), the pupa in both sexes with the two dorso-anal spikes, and the imago with generalised Tineid characters. (2) The Macro-Psychids—consisting of the *Fumeidae*, the *Epichnopterygidae*, and the *Psychidae*. These have the ♀ pupa-skin retained within the larval case on emergence; the eggs are laid within the pupa-skin, in a more or less agglomerated mass; the larva has the dorsal tubercles i and ii arranged so that ii is nearer median line than i; the pupa is without the dorso-anal spikes, but has two ventro-anal spikes (modified anal legs of larva), and there is a posterior row of intersegmental hooks on certain of the abdominal segments.

The *Luffiidae* are intermediate in their characters. The egg-laying habit, retention of ♀ pupa-skin within the larval case, and the arrangement of the larval tubercles i and ii, are Macro-Psychid, whilst the case and the general structure of the pupa are Micro-Psychid; the ♀ also has well-developed legs, leaves the case, pairing outside and laying her eggs with a highly specialised Taleporiid ovipositor. The *Fumeidae*, although showing absolute Macro-Psychid characters in the mode of egg-laying (within the pupa-skin), and in larval and pupal structure, have a female with powerful legs, that leaves the case and is provided with a Taleporiid ovipositor. These two families, therefore, show that there is no distinct break between the Macro- and Micro-Psychids, socalled, but that a slow process of evolution has taken place from the most generalised to the most specialised forms.

Group I: MICRO-PSYCHINA.

It may be well now to consider briefly the generalised section of the Psychides. As we have already pointed out, these consist of the *Naryciidae* (with Adelid or Lamproniid affinities), the *Diplodomidae*, *Lypusidae*, *Taleporiidae*, *Solenobiidae*, and, in some measure, the *Luffiidae*. These families have been treated by most systematists as genera, lumped together into one family (the *Taleporiidae*) and placed in the heterogeneous collection of generalised families, sometimes even now spoken of as Tineina. We have already pointed out that the Luffiids are, in many respects, Macro-Psychids, whilst the Fumeids have some Micro-Psychid characters but the ensemble of characters leads us to ally the Luffiids more particularly with the Micro-Psychids, and the Fumeids with the Macro-Psychids.

The Micro-Psychids, in reality, form Hübner's *Canephorae-falsae* and the relationship of the group has been discussed at length by various authors (*vide*, *ante*, pp. 119-124). Guénée, in 1846, insisted (*Ann. Soc. Ent. France*, 2nd ser., iv., pp. 5-9) that it formed a constituent part of the Psychids, a conclusion about which, modern research into the structure of the earlier stages leaves no room for doubt. Guénée pointed out that Duponchel's *Solenobia* (*Cat. Lép. Eur.*, p. 588) was synonymous with Zeller's *Taleporia*, and that his type *anderreggella* was really *tubulosa* (*pseudobombycella*), which Zeller had already, in 1839, adopted as the type of *Taleporia*. Guénée observes that the Taleporiids and Solenobiids pass from the Adelids to the higher Psychids by the most imperceptible gradations, differing chiefly from the former by having short, always (more or less) ciliated, antennæ, better developed palpi (slender and porrected), and a more thickly clothed abdomen. On the other hand, they differ from the latter (the higher Psychids) in their less pectinated antennæ, in their more opaque, more oblong, and smooth wings, in the palpi, in the length of the feet, and in their general aspect, which is not at all Bombyciform, and they do not attach themselves as the latter to grass stems, &c. He includes all the known Micro-Psychids in the one genus *Taleporia*, which, therefore, has an exceedingly comprehensive classificatory value. This genus he subdivides as follows:—

(1) Antennis visu filiformibus—*minorella*, *politella*, *pseudobombycella*, *murinella*, *clathrella*, and *triquetrella*.

(2) Antennis valde pectinatis—*lapidicella* (*pectinella*, Dup.), *petrella*, *tabulella*.

Duponchel appears to have had very little grip of the group. He refers *Taleporia tubulosa* (*pseudobombycella*) first of all to *Psyche* (*Cat. Lép. Eur.*, pp. 65-66), then he includes the same species, under the name of *anderreggella* (which Guénée saw and which was an undoubted *pseudobombycella*), in his genus *Solenobia*. This genus also practically included the whole of the then known Micro-Psychids—*clathrella*, *lichenella*, *lapidicella*, *pseudobombycella* (*anderreggella*), *minorella*, *pectinatella* and *undulella*. He places *Solenobia* between *Nemophora* and *Micropteryx*, although recognising the affinity of the group with the Psychids, in fact, he says that "it is analogous with the Psychids," and that "probably the major part of the species contained in section A (= the modern genera *Fumea* and *Epichnopteryx*) of the Psychids would be better placed in this." At the same time, he avers, that "although this is so, the Solenobiids differ from the Psychids, not only in their well-developed palpi, and their more elongated and non-transparent wings, but also in their food which consists of lichens, and in the character of their cases, which are smooth, instead of being covered with pieces of leaves or twigs as in the Psychids. The cases of the Solenobiids vary, he says, "according to the species; some are like hoods, others more elongated, some cylindrical, others trigonal, and yet others tetragonal."

We see by this that Guénée had rightly placed *Bacotia sepium* (= *tabulella*) with *Luffia lapidella*, and separated them from the Taleporiids and Solenobiids which make up his first section. He further noticed that the larvæ were lichen-feeders, that the cases were flat or ovoid, dry, and covered with particles of sand or wood, and not with straws, &c. Zeller referred the Micro-Psychids to the Tineids, and remarks (*Linn. Ent.*, vii., pp. 325 *et seq.*) that it is difficult to find characters that will separate them from all others. He was the first author to recognise the alliance of *Narycia*, *Diplodoma*, and *Lypusa* (which have winged females) with *Solenobia* and *Taleporia*; in other words, he first formulated the boundaries of what have since been known as the Micro-Psychids. He, too, like Guénée, allied them with *Adela* and *Nemotois*, and we have no doubt that these authors are so far correct that the Psychids, Adelids, and Tineids originated from a common stem and are closely related, as such relationships go, but that whilst the Psychids have retained many characters common to the Adelids, they have specialised in the larval, pupal, and imaginal states in a Bombycid direction. Zeller states that all these (Psychids, Adelids, Tineids) live in cases, some transportable, others fixed, those with the latter having to manufacture their food into dwelling-places, and he argues that, different as the two methods appear, the difference is really not important, and hence he designates the whole family as "case-bearers," whether they carry their cases or not. Yet he emphasises the gap between the Tineids and Coleophorids, and remarks that whilst the Tineid pupa partly emerges from its cocoon before the emergence of the imago, that of the Coleophorids remains within the cocoon. In our opinion, the difference is a fundamental one, as offering a distinct point of cleavage between the Psychids, the Adelids, and the Tineids. Having thus carried over the Taleporiids (and Solenobiids) to the Tineids, Zeller avers that a boundary-line between the latter and the Psychids does exist, and that the Psychids must remain among the Bombycids. He does not think that any special weight should be laid on the circumstance that the Psychids cover their cases with coarse material, "for *betulina* uses tolerably delicate leaves, which makes it probable that, with further discovery, the difference will be still more inappreciable in this direction." He considers that it is of more importance that whilst "in all Tineids the female pupa emerges from the cocoon as well as the male, in the Psychids, the female pupa stays in the case." This really remains one of the fundamental differences between the Macro- and Micro-Psychids, although it is by no means absolute. Zeller continues that, in the imagines, the Psychids have rounded, wide, Bombyciform wings, whilst those of the Tineids have elongated wings and a well-developed apical angle; but Speyer's *sepium*, he says, abolishes this difference, for, in spite of its elongated wings, the ♀ pupa-case and ♂ antennæ show it to be a true Psychid, yet Zeller failed to discover that the male pupa was essentially Taleporiid in structure and that it formed in reality by means of its pupa, as well as imago, an intermediate stage between the Micro- and Macro-Psychids. He further notes that the Micro-Psychids have only ciliated antennæ, whilst those of the Macro-Psychids are provided with fringed pectinations. In this respect *Dissoctena* is another interesting genus, presenting antennæ with long pectinations, the form of the wings and general characters being otherwise distinctly Solenobiid. Zeller considered that if these general rules which he had formulated concerning the Macro-Psychids held good, he should consider their Bombycid affinities to be proved. He then tabulated the sections dealt with as follows:

(1) Psychids: Casebearers whose ♀ pupa always remains in the larval case on emergence of imago.

(2) Tineids: Casebearers whose ♀ and ♂ pupæ protrude from the larval case on emergence of imago.

(3) Coleophorids: Casebearers whose ♂ and ♀ pupæ both remain in the larval cases on emergence of imagines.

Zeller further enters into a long discussion of the affinities of *Lypusa*, *Solenobia*, and *Taleporia*, comparing them with the Tineid genera, but the one point made is that these possess only rudimentary palpi, concealed in the long face-hairs, and that the other genera have more or less well-developed palpi, the absence of palpi being a distinct Psychid character.* He also notes that *Fumea* (*Psyche*) *nitidella* has a tendency to a Tineid (generalised) form of neuration. Zeller emphasises the fact that *Xysmatodoma* (*Narycia*) lives in a case, has an imago with undeveloped palpi, simple fringed male antennæ, and has a ♀ with an anal-tufted abdomen. *Diplodoma*, Zeller says, is very closely allied to *Xysmatodoma*, having, however, a case open at both ends, and the imago has ocelli. He then adds: "From here onwards, the line proceeds with definiteness to the Psychids." So that, after having separated the Taleporiids (and Solenobiids) from the Psychids, he proves that the genera *Xysmatodoma* and *Diplodoma* are in reality Psychids, and that the evolution of the Psychids from this point is evident. We have discussed Zeller's position at length, because his views are adopted by Stainton, and are practically those adopted by Herrich-Schäffer and Meyrick, and we wish to show that it was only ignorance of the general principles of evolution, and not a want of knowledge of the facts, that led the early authors to separate the Taleporiids and Psychids as branches of entirely different stirpes. Zeller, at least, saw that the evolution of the Psychids from *Xysmatodoma* and *Diplodoma* onwards was continuous. Following up the development of this "line," Zeller shows that the genus *Solenobia* has great affinity with *Xysmatodoma*, in the larval case and in the "habitus" of the male imagines, but he says that the Solenobiid ♀ is quite wingless (which is not quite the fact) and the male has quite short labial palpi concealed in the "face-hairs." The Taleporias are distinguishable from *Solenobia*, he says, by the greater skill with which they build their cases, by the ocelli, and by the well-developed nervure running into the apex of the forewings of the ♂. The genus *Lypusa* is, in Zeller's opinion, the final step to the Psychids, "agreeing with *Taleporia* in wing-build, but being without ocelli, with almost smooth head-hairs

* Zeller notes that *Tineola biselliella* has "quite undeveloped maxillary palpi," as also a species he calls *petrinella*, Heyd. = ? *Dysmasia petrinella*, but for this *see* Walter, *Morph. der Schmett.*, 1885, pl. ii., fig. 13, where the four-jointed maxillary palpi of *T. biselliella* are figured. Meyrick also refers to the maxillary palpi of *Tineola*.

and wanting the labial palpi." Here we see, then, that Zeller really comes to the conclusion that the Psychids and the Taleporiids are continuous, that they form, in reality, one evolutionary group, and yet he places the Micro-Psychids among the Tineids and the Macro-Psychids among the Bombycids.

Although Zeller indirectly came to this conclusion, Bruand arrived (*Mon. des Psychides*, 1853) at it, in a more direct manner, but his recognition of the unity of the group led him to state his views so forcibly that lepidopterists hesitated to follow him. He asserted that the Solenobiids, Luffiids, Fumeids, Epichnopterygids, and Psychids formed really only a single genus, and so included them all in his genus *Psyche*. He drew comparisons between such insects as *Psychoides verhuella* and *Canephora unicolor* that excited ridicule, and, at a time when more detail was being asked for in classification, he indulged in generalisations. The result was that although he had a more correct view of the relationships of the group than other lepidopterists of his time, his conclusions were put aside, whilst Zeller, Stainton, and Herrich-Schäffer disseminated the somewhat illogical conclusions of the first- and last-named, in their various works, and these authors have been, for a long time, followed by most European systematists.

Herrich-Schäffer also isolated the Taleporiids and Solenobiids from the Macro-Psychids (which latter he allied with the Cochlidids and Anthrocerids) and placed them among the Tineids. He criticised Boisduval for uniting the Micro- and Macro-Psychids, yet his criticism, from our modern point of view, really only amounts to a want of recognition that the more specialised forms of each group of Lepidoptera have arisen from more generalised ones along certain lines. He asserts that Boisduval's Psychids do not form a homogeneous family, that Zeller's Taleporiids are included therein, but that these are sharply differentiated therefrom by large secondary eyes (ocelli), distinct palpi and unpectinated antennæ. He then separates, "on account of the inner marginal nervure of the forewings, the two pairs of spurs on the hind tibiæ, and the presence of antennæ and legs in the females," the genus *Canephora* (*Fumea* and *Epichnopteryx*) from the Macro-Psychids, placing them in the Tineids, nearest to *Taleporia*. Herrich-Schäffer evidently did not know the Epichnopterygid female. He further distributes the Micro-Psychid genera among the Tineids in a somewhat erratic manner: Genus 22—*Solenobia*. Genus 23—*Xysmatodoma*. Genus 42—*Taleporia*, &c.

Structurally, of course, the Micro-Psychid genera—*Narycia*, *Diplodoma*, *Psilothrix*, *Melasina*, and *Lypusa*—differ from the remaining Micro-Psychids in having winged females, the Taleporiids, Solenobiids, and Luffiids agreeing, in this respect, with the Fumeids and Macro-Psychids. The Micro-Psychids, too, as a whole, differ from the Macro-Psychids in the structure of the male antennæ, yet in *Dissoctena*, the Luffiids, and the Fumeids, the characters overlap in a way that defies exact definition. In *Diplodoma*, *Bankesia*, and *Taleporia* the imagines are characterised by the presence of ocelli at the base of the antennæ. In all the Micro-Psychids, as Zeller long since pointed out, the male and female pupa-cases protrude from the cocoon, although *Luffia* and *Bacotia*, in this particular, agree with the Macro-Psychids, the female pupa-case being retained within the cocoon. In the Luffiids and

Fumeids, as in the Taleporiids and Solenobiids, the female emerges and awaits the male for copulation on the outside at the free end of the case, and whilst the Taleporiids and Solenobiids lay their eggs in the larval case, the Luffiids and Fumeids deposit theirs in the empty pupal-skin, all, however, covering their eggs with the wool from the anal tuft. Even the species of *Narycia* and *Diplodoma* that lay their eggs outside, so cover their eggs, but too few observations have been made with regard to the genera with winged females to enable us to indulge in any further generalisations. The habit of the Luffiids and Fumeids, whose females emerge from the case and yet lay their eggs in the empty pupa-skin which is left within the case, shows that any attempt to make an absolute line of division between the Micro- and Macro-Psychid sections is likely to result in failure.

Although not represented in Britain, the *Lypusidae*—containing the genera *Penestoglossa* (*Psilothrix*), *Melasina*, and *Lypusa (Typhonia)*—offer many interesting features. In *Lypusa*, Bruand determined *ciliarella*, Ochs., as living in a case found on the higher mountains of the Doubs dept., and further stated that *melas*, Dup., lives in a similar manner. Millière has since worked out the life-histories of *Lypusa (Typhonia) lugubris*, *Melasina ciliaris*, and *Penestoglossa (Psilothrix) dardouinella*, and states that the first-named goes through its metamorphoses distinctly in the manner of a Psychid. He further states that *M. ciliaris* lives in a tubular case carried in the manner of a Psychid, and that the larva of *Penestoglossa dardouinella* has all the habits of a Psychid or *Melasina*. These observations were of the greatest importance, for it provided proof of the unsatisfactory nature of the evidence of Lederer and Stentz, who reported that *lugubrosella*, Brd., fed after the manner of the Sesiids in the Ullreichsdorf woods in Styria. It was probably due to this report that Herrich-Schäffer separated the *Lypusidae* from the Psychids, asserting at the time that the larvæ did not live in cases, after the manner of those of the latter group. It is quite possible that some of the exotic genera at present placed among the *Lypusidae* are Diplodomids, but the authorities give us but little help. *Melasina* has ocelli, as *Diplodoma* and *Taleporia*. The winged exotic genera that apparently belong to the Micro-Psychids are:—Europe: *Penestoglossa*, F. v. R. (*Psilothrix*, Wk.), *Lypusa*, Zell. Africa: *Lasioctena*, Meyr., *Eccompsoctena*, Walsm., *Mesopolia*, Walsm., *Compsoctena*, Zell. (=*Tissa*, Walk., *Thapara*, Walk., *Galaria*, Walk.), *Gymnelema*, Heyl., *Didactica*, Walsm. India and Ceylon: *Alarona*, Walk. (=*Melasina*, *teste* Meyrick). America: *Anaphora*, Clem., *Acrolophus*, Poey.

The *eggs* of the Micro-Psychids are oval, sometimes inclining to spherical, the micropylar axis being, however, usually longer than the equatorial. They are pearly-white or pale yellow in colour, the shells apparently quite smooth and transparent. The apterous females lay their eggs within the larval case, the winged females outside, but the hairs from the anal tuft are always mixed with them. As soon as the young larvæ appear they form a case in which they dwell. The *cases* are usually covered outside with minute particles of sand, dirt, vegetable *débris*, &c., but so fine that the outer surface generally looks moderately smooth to the naked eye. The *larvæ*, taken from their cases, do not hold their abdominal segments high in the air, as in the Macro-Psychids, but attempt to crawl with their prolegs, which, however, are so short and unsuited for the purpose that they practically fail, although the strong hooks enable them to cling most tenaciously to the inside of the case. The true legs, on the other hand, are very strong and powerful. The thoracic segments are covered dorsally with corneous plates, the abdominal segments are soft, bulky, and with a well-developed lateral flange. The arrangement of the dorsal tubercles shows a complete system of evolution with regard to position, from the ordinary trapezoidal form with i nearer the median line than ii (*Narycia*, *Diplodoma*, *Solenobia*) to a form with ii directly behind i (*Bankesia*, *Taleporia*), thence ii passes much nearer to the median line than i (*Luffia*, *Bacotia*), and thus reaches the peculiar but normal Macro-Psychid arrangement for these tubercles; the other tubercles are characteristic, in position, of the other superfamilies of this stirps (except the Sphingids), *viz.*, iii supraspiracular, iv and v subspiracular (iv with strong, v with weak, seta), vi below these, and vii marginal, each tubercle consisting of a minute chitinous button with a single seta. The arrangement of the crochets of the prolegs are characteristic—horseshoe shaped (or an oval broken on the inner edge).

We are informed by the authorities, and it is probably true, that the larvæ of the Micro-Psychids live on lichens that grow on fences, trees, rocks, &c. In the case of some genera we are inclined to doubt whether this is the whole truth, and should not be surprised to find that the larvæ of *Taleporia* and *Diplodoma* are more or less scavengers on the ground, going to fences and tree-trunks only for the purposes of exuviation and pupation. This also is possibly to a certain extent true for some species of *Solenobia*. At any rate, in confinement, the larvæ of *T. tubulosa* (*pseudobombycella*) and *D. herminata* (*marginepunctella*) are well known to be carnivorous under certain conditions. It is, of course, possible, that larvæ, living on lichens growing on damp walls, fences, &c., require much moisture, and their confinement with a piece of food-plant liable to get out of condition, leads to an exhibition of carnivorous propensities. The enclosure in cramped quarters and the drying-up of food are known to develop cannibalistic tendencies in certain larvæ (*Asteroscopus sphinx*, &c.) and this may be a parallel instance.

The *pupa* of the Micro-Psychids is very characteristic. One peculiar feature is the arrangement and development of the various pupal mouthparts (especially in the females), and there is no doubt that a close study of these, the pupal antennæ, and the wings, would give some important facts bearing on the evolution of the helpless egg-sacs into which the females of the Macro-Psychids have been specialised. Other peculiarities are the presence of two minute dorso-anal points in both sexes (except the Luffiids, in the females of which they are absent), the modification of some (or all) of the setæ on abdominal segments 7-10 into long recurved hairs, the presence of a patch of short spiny hooks on the anterior portion of abdominal segments 3-7, the scars of the anal prolegs, and the reproduction in detail and position of the larval tubercles and setæ. That the dorso-anal hooks and recurved setæ function largely in restraining the pupa at the proper point of protrusion from the larval case for the emergence of the imago is obvious, but we doubt whether the former are homologous with the anal leg-hooks, as Packard says, although there can be no doubt that the ventro-anal hooks of the Macro-Psychids are to be so homologised.

The *imagines* are peculiar in many ways—the antennæ, mouthparts, the anal tuft of ♀, apterous condition of some females, presence of ocelli in some genera—all of which are fully dealt with elsewhere. As to their habits, the males are chiefly day flyers, loving the hot sun. *Narycia* and *Diplodoma* appear in late June and July (as also do the Luffiids, which, in this as in many other characters, show stronger affinities with the Macro-Psychids). *Taleporia*, too, emerges in early summer (June), but *Bankesia* follows *Solenobia* in appearing in early spring—March and April being the usual months of their appearance. That most of the species are much more widely distributed in the British Islands than our data at present suggest is certain, and our ignorance of the genus *Solenobia* is, in Britain, so profound that we have scarcely a clue as to the actual species inhabiting our islands. *Bankesia conspurcatella* is essentially a Mediterranean species, extending, however, into France and Belgium, and becoming localised on our south coast. *Solenobia inconspicuella* and *Taleporia tubulosa* are probably with *Diplodoma herminata* the most widely distributed British species. Why *T. politella* has not yet been recorded for Britain is altogether inexplicable, considering its range on the Continent.

As we have already pointed out, the characters presented by the early stages that separate the Micro-Psychids from the Macro-Psychids are those afforded by the eggs, the position of the dorsal larval tubercles, the position of the dorsal abdominal spines of the pupa, the absence of the intersegmental pupal spines, the modification of the pupal setæ on abdominal segments 7-10, the presence of the dorso-anal spikes, the absence of the ventro-anal spikes. We have already pointed out that these characters fail in part in the Luffiids. Snellen remarks that the general affinities of the genera *Epichnopteryx*, *Fumea*, *Taleporia*, and *Solenobia* show that they all belong to the Psychids, and can only be separated therefrom by artificial characters; they form a link, he considers, which connects the Micro-Psychids with *Diplodoma*, *Narycia* (*Xysmatodoma*), *Tineola*, and *Tinea*.

It appears to be quite impossible to group the Micro-Psychids satisfactorily. In many ways, as we have already pointed out, *Narycia* shows a stronger alliance with *Solenobia*, and *Diplodoma* with *Taleporia*. *Bankesia* has ocelli like the two latter, yet it has a distinct Solenobiid facies, although *Solenobia* is without the ocelli. Still, all of them show very marked differences (as is always the case in the more ancestral branches of a superfamily), and we see no logical way of dealing with them but as separate families, giving the details relating to each in its own proper place.

Family: NARYCIIDÆ.

As the Diplodomids show a distinct alliance with the Taleporiids so this family shows an equally marked tendency to approach the Solenobiids. Like the latter the imago has no ocelli, the larval case of *Narycia monilifera* is hardly to be distinguished from that of *Solenobia inconspicuella*, and the larvæ, too, with their generalised tubercles, i and ii placed in true trapezoidal fashion, present many striking resemblances. The females, of the Naryciids are winged, and hence the Solenobiids must have undergone considerable differentiation and specialisation (in the imaginal state particularly) since they left the Naryciids, to have reached their present form. There are, also, certain other characters in the early stages (which will be dealt with at length in considering the genus *Solenobia*), that separate this family very decidedly from the latter. The family, too, is important as being one of those that tend to unite the Psychids with the Tineids, not only in the female having wings, and the scaling thick (not flimsy and thin as in the Psychids), but also in the metallic lines which suggest in some measure the Tineids represented by *vinculella*, &c. But the greatest difference between the Naryciids and the remaining Micro-Psychids exists, perhaps, in the antennæ, for, like those of *Psychoides verhuella*, the antennæ of *Narycia monilifera* have two rows of scales completely encircling each segment in the ♀, and only have, in the male, hairs like other Psychids.

Subfamily: NARYCIINÆ.
Tribe: NARYCIIDI.
Genus: NARYCIA, Stephens.

SYNONYMY.—Genus: *Narycia*, St., "Nom. Br. Ins.," 2nd ed., p. 118 (1833); "Ill. Brit. Ent.," vi., p. 154 (1836); Crt., "Guide," 2nd ed., p. 172, no. 760*d* (1837); Westwd., "Syn. Gen. Br. Ins.," p. 51 (1840); Kol., "Gen. Sp. Trichop.," i., p. 102 (1848); Ibid., pt. ii., pp. 163, 181, 293 (1859); Hgn., "Stett. Ent. Zeit.," xiii., pp. 156, 233 (1852), xx., p. 203 (1859); "Ent. Ann.," 1859, p. 108 (1858); "Ver. z.-b. Ges. Wien," xiv., 851 (1864); Wkr., "Cat. Neur.," i., 135, 154 (1852); White, "List Br. An. B. Mus.," xiv., 15 (1853); Doug., "Ent. Wk. Int.," ii., p. 59 (1857); McLach., "Tr. Ent. Soc. Lond.," 3rd ser., v., 169 (1865); "Ent. Mo. Mag.," xxxiv., p. 186 (1898); Meyr., "Handbook," p. 776 (1895). [*Tinaea*, in part, Geoff., "Hist. Ins.," ii., 189-190, no. 18 (1762), reprint (1764), 2nd. ed. (1800); Wernebg., "Beitr.," i., 313, no. 18 (1864).] *Tinea*, in part, Geoff. (Fourc.), "Ent. Paris," ii., p. 325 (1785); Haw., "Lep. Brit.," pt. 4, p. 566 (1828); Sta., "Cat.," p. 6 (1849); "Supp. Cat.," p. 17 (1851); "Ent. Comp.," pp. 10, 30, 36, 39 (1852); Doug., "Zool.," 1851, p. 3184; Brd., "Lép. Doubs," iii., livr. 5-6, p. 31 (1850); Fré, "Ann. Soc. Ent. Belg.," ii., p. 110 (1858); Now., "Enum. Lep. Hal. Or.," pp. 169-170 (1860). *Lampronia*, in part, Stphs., "Cat.," p. 227 (1829); "Nom. Br. Ins.," p, 51 (1829); "Ill. Brit. Ent.," iv., p. 358 (1835); Crt., "Guide," p. 187 (1831), 2nd ed., p. 215 (1835); Wood, "Ind. Ent.," p. 230 (1839); Humph. and Westd., "Brit. Moths," ii., p. 252 (1851), 2nd ed. (1854); Hdrch., "Eur. Lep. Cat.," p. 78 (1851); Koch, "Schmett. Deutsch.," iii., 373 (1856). *Adela*, in part, F. von R., "Abbild. Ber. Schmett.," 5. 156 (1834). *Xysmatodoma*, Zell., "Linn. Ent.," vii., pp. 332, 362 (1852); Frey, "Die Tineen," &c., p. 14 (1856); "Lep. der Schweiz," p. 335 (1880); H.-Sch., "Sys. Bearb.," v., p. 26, pl. xi., 7 (1853); p. 89 (1854); Sta., "Ins. Brit.," p. 21, pl. i., 7*a-c* (1854); "List Br. An. Br. Mus.," xvi., p. 6 (1854); "Man.," ii., p. 287 (1859); Staud. and Wocke, "Cat.," p. 105 (1861), p. 267 (1871); Hein., "Schmett. Deutsch. Tin.," p. 34 (1870); "Tin.," 2, Tab. 3 (1876); Mill., "Cat. Lép. Alp.-Mar.," p. 98 (1875); Bang-Haas, "Nat. Tids." (3), x., p. 2 (1875); Hrtm., "Mitt. Mün. Ent. Ver.," iii., p. 197 (1879); Sand, "Cat. Lép. Auv.," p. 154 (1879); Snell., "De Vlind.," pp. 416, 450 (1882); Pey., "Cat. Lép. Als.," p. 84 (1882); Curò, "Bull. Soc. Ent. It.," xv., p. 5 (1883); Sorh., "Die Kleinsch. Brandbg.," p. 142 (1886); Meyr., "Pr. Linn. Soc. N. S. Wales," vii., p. 490 (1893). *Conoeca*, Scott, "Aust. Lep.," i., 26 (1865); Wkr., "Cat.," xxxv., 1925 (1866); F. and R., "Reise Nov. Lep.," v., expl. pl. 138 (1875); Rsnstk., "Ann. and Mag. N. Hist.," xvi., 440 (1885), *vide* Meyr., "Pr. Linn. Soc. N. S. Wales," vii., p. 490 (1893). *Œcobia*, Scott, "Aust. Lep.," i., p. 27 (1865); Wkr., "Cat.," xxxv., 1924 (1866), *vide* Meyr., "Pr. Linn. Soc. N. S. Wales," vii., p. 490 (1893).

Stephens diagnosed (*Illustrations of British Lepidoptera*, vi., p. 154) this genus as follows:—

"Antennæ with the basal joint pilose and much incrassated, the remainder furnished (♂) on each side with long hairs; maxillary palpi drooping, very pilose, rather short; head transverse-ovate, pilose in front; eyes moderate, lateral, scarcely prominent; thorax ovate; wings strongly deflexed during repose; anterior elongate-elliptic, obtusely rounded at the apex, which is furnished with short scaly cilia;

nervures very indistinct; posterior smaller, somewhat ovate, furnished with longer cilia; abdomen shortish, stout, somewhat cylindric; legs stoutish, anterior tibiæ with a single spur at the inner apex, intermediate with a pair, and posterior with a pair at the apex, and a second pair in the middle." He then adds: "The distinctly pectinated filiform antennae of this genus at once serve to distinguish it from the other Trichoptera, from which, like *Acentropus*, they also differ in having the wings clothed with scale-like hairs; but, unlike that genus, their legs are provided with ample spurs, and the sides of the thorax are not furnished with tippets."

The only species cited by Stephens under this genus is *elegans* (= *monilifera*) which, therefore, is the type of the genus. The chief characters of the genus may be summarised as follows:—

Ovum.—Oval in outline, almost circular in transverse section, surface very smooth, unsculptured.

Case.—Somewhat flattened, neck slightly constricted, faintly trigonal in section, lateral flanges moderately developed, upper surface convex, covered with lichen (minute pieces).

Larva.—Head small, retractile; thorax slender; abdomen bulky; largest segments 3-6 abdominals; pro-, meso-, and metathorax with dark brown corneous dorsal plates; anal segment with black-brown plate; slight constriction between pro- and mesothorax; true legs strong (especially 3rd pair); prolegs short (same type as in higher Psychids, but oval of crochets more broken on inner margin); dorsal tubercles trapezoidal; setæ, with basal plates, ii stronger than i, iii strong, iv strong and v weak near each other; lateral longitudinal flanges distinct.

Pupa.—Dorsal head-piece moderate; labrum well developed, two bristles at base, hooked; mandibles very large; maxillæ triangular, well-developed; maxillary palpus well marked; labial palpi, two flaps between maxillæ; tubercles as in larva; patch of dorsal spines anterior to i; long recurved hairs on abdominal segments 9-10; two dorso-anal spikes on 10; spiracles on well-developed cones; two rounded bosses ventrally on 9 (♂) marking the genital organs.

Imago.—Head rough; tongue and maxillary palpi obsolete; labial palpi, porrected, short, hairy; eyes compound; *no ocelli*; antennæ with two rows of scales completely encircling each segment in ♀, replaced ventrally in ♂ by two sets of hairs, which project laterally, basal joint with pecten; posterior tibiæ hairy; both sexes winged; female with anal tuft.

Neuration.—Forewings—1b furcate, 7 absent, 8 and 9 sometimes short-stalked. Hindwings—Nervures all separate (Meyrick).

There appears to be only the Palæarctic genus *Narycia* in this family since Meyrick has sunk the Australian genera *Conoeca* and *Œcobia* as synonymous therewith. Most authorities agree in placing it very near the genus *Diplodoma* which is correct so far as both have retained many of the generalised characters of the earlier forms from which the Psychids have originated. Both genera, too, have winged females. Whereas, however, the larval case and larva of *Narycia* are particularly Solenobiid, those of *Diplodoma* are more especially Taleporiid. In antennal structure, as has already been mentioned, the female *Narycia* is rather Adelid than Psychid, whilst the male has antennæ of distinct Psychid structure. There appear to be only two known Palæarctic species in this genus—*monilifera*, Geoff. (*melanella*, Haw.) and *astrella*, H.-Sch.—the first-named generally distributed from Dalmatia and Hungary to Britain, the latter confined, so far as we know at present, to Bohemia and Silesia. Meyrick asserts, however, "that the genus is very numerously represented in Australia, some species attaining a considerable size." He himself described 29 Australian species in 1893 (*Proc. Linn. Soc. New S. Wales*, vii., 490-506). It is possible, therefore, that when thoroughly worked out, the subfamily may be found to contain a long series of allied genera.

Hagen discovered, in 1857, that *Narycia elegans* of the Stephensian collection, which had been described and placed as a neuropterous insect, was, in fact, the well-known *Xysmatodoma melanella*, also known in England as *Tinea atrella*. Although referred to by other neuropterists, the name *Narycia* was not properly applied to this genus until 1895, when it appeared in Meyrick's *Handbook*, p. 776. Zeller diagnosed the genus under the name of *Xysmatodoma*. He notes that "the lack of ocelli, the five simple, hind-marginal nervures of the forewings, and the simple larval-case, separate this genus from the preceding (*Diplodoma*)." He says it "agrees largely with the division E of *Tinea*, and the lack of maxillary palpi would not be sufficient ground against their union, but it is more important that there is combined therewith the peculiarity, not occurring in *Tinea*, that the ♀ has a woolly anus as in *Diplodoma*, and, compared with the ♂, smaller, narrower wings. The forewings of *X. melanella* have five nervures running into the hindmargin which come from the distinct transverse nervure; the nervure that shuts off the supplementary cell, unites with the last of the nervures that branches off to the costa, &c." Frey notes (*Die Tineen*, p. 14) the genus as "agreeing with *Solenobia* in the absence of ocelli and in the circumstance that five nervures run out to the hind margin; it differs, however, from *Solenobia* in having labial palpi, and from this genus and *Taleporia* in the smallwinged females."

Narycia monilifera, Geoffroy.

Synonymy.—Species: *Monilifera*, Geoff. (Fourc.), "Ent. Paris," ii., p. 325, no. 18 (1785). *Melanella*, Haw., "Lep. Brit.," p. 566 (1828); Stphs., "Nom. Br. Ins.," p. 51 (1829); "Cat.," no. 7570 (1829); "Illus.," iv., p. 358 (1835); Crt., "Guide," p. 187 (1831), 2nd ed., p. 215 (1835); "Brit. Ent.," xiv., expl. pl. 639 (1837); Wood, "Ind. Ent.," p. 230, no. 1,589 (1839); Humph. and Westd., "Brit. Moths," ii., p. 252, pl. 120, fig. 6 (1851), 2nd ed. (1854); Zell., "Linn. Ent.," vii., p. 363 (1852); Reutti, "Lep. Bad.," 1st ed., p. 180 (1853), 2nd ed., p. 304 (1898); Sta., "Cat.," p. 6 (1849); "Supp. Cat.," p. 17 (1851); "Entom. Comp.," pp. 10, 30, 36, 39 (1852), 2nd ed., pp. 8, 30, 71, 73 (1854); "Ins. Brit.," p. 21, pl. i., figs. 7a-c (1854); "List Br. An. B.M.," xvi., 6 (1854); "Man.," ii., p. 287 (1859); "Tin. S. Eur.," p. 90 (1869); "Ent. Ann.," 1870, p. 2 (1869); Doug., "Zool.," ix., p. 3184 (1851); H.-Sch., "Sys. Bearb.," v., p. 89 (1854); Frey, "Die Tineen," &c., p. 15 (1856); "Lep. der Schweiz," p. 335 (1880); Now., "Enum. Lep. Hal. Orient," pp. 169-70 (1860); Hardg., "E. M. M.," vi., pp. 91-3 (1869); Ibid., xii., pp. 208-9 (1875); Hein., "Schmett. Deutsch. Tin.," p. 35 (1870); Morr., "Br. Moths," iv., 14 (1870); Jdhlle., "Ann. Soc. Ent. Fr.," 4th ser., x., 115 (1870); Staud. and Wocke, "Cat.," p. 267, no. 1,351 (1871); Boyd, "E. M. M.," xii., p. 163 (1875); Mill., "Cat. Lép. Alp.-Mar.," p. 98 (1875); "Nat. Sic.," v., 130 (1886); "Bang-Haas, "Nat. Tids.," 3, x., p. 2 (1875); Sand, "Cat. Lép. Auv.," p. 154 (1879); Hrtmn., "Mitt. Mün. Ent. Ver.," iii., p. 197 (1879); Ross., "J. B. Ver. Nass.," p. 228 (1881); Snell., "De Vlind.," p. 450 (1882); Pey., "Cat. Lép. Als.," p. 84 (1882); Rou., "Cat. Chen. Eur.," 142 (1883); Curò, "Bull. Soc. Ent. It.," xv., p. 5 (1883); Sorh., "Die Kleinsch. Brandbg.," p. 142 (1886); Meyr., "Handbook," p. 776 (1895). *? Sequella*, Haw., "Lep. Brit.," pp. 566-7 (*teste* Stainton) (1828). *Atrella*, St., "Sys. Cat. Br. Ins.," ii., 227 (1829); "Nom. Br. Ins.," 51 (1829); "Ill.," iv., p. 359 (1835); Crt., "Guide," 187 (1831), 2nd ed., 215 (1835); Wd., "Ind. Ent.," p. 230, pl. 50, fig. 1,590 (1839); Humph. and Westd., "Br. Moths," ii., 252, pl. 120, fig. 7 (1851), 2nd ed. (1854). *Elegans*, Stphs., "Nom. Br. Ins.," 2nd ed., 118 (1833); "Ill.," vi., p. 154, pl. 32, fig. 4 (1836); Curt., "Guide," 2nd ed., 172 (1837); Walk., "Cat. Neurop.," i., 135, 154 (1852); White, "List. Br. An. B Mus.," xiv., 15 (1853); Doug., "Ent. Week. Int.," ii., 59 (1857); Hgn., "Ent. Ann.," 1859, 108 (1858); "Stett. Ent. Zeit.," xx., 203 (1859); "Ver. z.-b. Ges. Wien.," xiv., 851 (1864); Kol., "Gen. Sp. Trichop.," pt. ii. ["N. Mem. Soc. Imp. Nat. Mosc.," xvii (xi)], 181, 293-296, pl. v., 62 (1859); McLach., "Tr. Ent. Soc. Lond.," 3rd ser., v., p. 169 (1865). *Stelliferella*, F. v. Rös., "Abbild. Ber. Schm.," p. 156, pl. 59 (1834); Brd., "Lép. Doubs," iii., livr. 5-6, p. 31 (1850); "Mon. des Psych.," p. 40 (1853); Hdrch., "Eur. Lep. Cat.," 78 (1851); Koch, "Schmett. Deutsch.," iii., p. 373 (1856); Fré, "Ann. Soc. Ent. Belg.," ii., 110 (1858).

[This is *monilifera*, Geoffroy (not Fourcroy), *vide* Halliday and Dohrn, *Stett. Ent. Zeit.*, xii., 132 (1851), and Hagen, *Bibl. Ent.*, 246. In both it is stated that Geoffroy wrote the book, *Ent. Paris.*, and that Fourcroy was only the editor. Geoffroy always cited his authors in *Hist. abr. Insectes*, and it should be noted that, in his supplement, he credits to *Ent. Paris.*, new species not mentioned in the previous parts of *Hist. abr. Insectes*, but he does not cite an author for these *new species* and *new names*. Had Fourcroy been the author Geoffroy would certainly have cited the work as his, but his silence in this respect certainly suggests a very modest "mihi" (*Durrant*).]

Original description.—*Tinea monilifera*. La Teigne à deux rangs de points blancs. Long. $1\frac{1}{4}$ lig. *Tinea* alis atris, punctorum alborum lineâ duplici transversâ (Geoffroy, *Ent. Paris.*, ii., p. 325). [This insect is Geoffroy's, no. 18, *Hist. des Ins.*, pp. 189-190, which he there describes as: "*Tinaea* alis atris, punctorum alborum linea duplici transversa. La teigne noire à deux rangs de points blancs. Longueur $1\frac{1}{4}$ ligne. Elle est partout d'un noir matte et nullement brillant; elle a seulement deux bandes transverses blanches, formées par des petits points de cette couleur, l'une à la moitié de l'aîle supérieure, l'autre aux trois quarts de la même aîle en descendant.]

Werneburg refers this description without hesitation to *stelliferella*, F. v. R. As Wocke apparently knew nothing of Geoffroy's *Ent. Paris.* he adopted Haworth's name *melanella*, by which the species has been generally known.

Imago.—Anterior wings 9mm.-10mm. in expanse; black with a fine white slender oblique basal line, a fine angulated white line (usually broken) beyond the centre, and two or three white points at apex; fringes unicolorous with the ground colour of the wing. Posterior wings and fringes unicolorous grey.

Sexual dimorphism.—The female is as a rule rather smaller than the male, and is generally better marked, the white dots sharper and clearer. It may be at once distinguished by the woolly anal tuft. Zeller says that the forewings of the female are usually shorter, narrower, and with whiter spots than those of the male. The white dots are, in the ♀, collected in a blotch before the centre of the costa, with a blotch beyond the centre which is much elongated downwards, a pair of white dots at the apex. Fischer von Röslerstamm strangely notes that most of the females lack the fringes on the inner half of the hind-margin of the hindwings and that this is at once noticed even in freshly emerged specimens. Frey, Millière, Curò and others note that the ♀ is dimorphic, with a winged and wingless form. This error, Rössler says, originated with Harding (*Ent. Mo. Mag.*, vi., p. 92).

Variation.—Some examples have scarcely any trace of the white spots and markings of the forewings and intermediate forms occur. The presence of the apical dots is very rare. Stephens notices that some examples have a few minute white dots scattered over the surface of the anterior wings, especially towards the hinder margin. Zeller notes it as a variable species, the Brunswick examples large and with yellow markings, the Frankfort-on-Oder specimens also large, with strongly-developed white markings and very distinct from the Vienna examples. He further suggests that *N. astrella* may be a form of so variable an insect.

a. var. *atrella*, Stephs., "Illus.," iv., p. 359 (*teste* Stainton) (1835); Wood, "Ind. Ent.," fig. 1590 (1839).—Alis anticis atris, fasciâ obsoletissimâ ante medium, punctisque marginalibus albidis. Exp. al. 4-5 lin. Anterior wings deep black, with a very obscure whitish fascia a little before the middle, and some minute dots of similar hue on the costa and inner margin. Posterior wings fuscous, immaculate. Metropolitan district in June, not common (Stephens).

β. ab. *ochracea*, n. ab.—The spots on the forewings ochreous instead of white. This is Zeller's var. *b*, diagnosed (*Linn. Ent.*, vii., p. 363) as: "Signis al. ant. ochraceis ♂." He writes of it: "Two males from Brunswick are noticeable for their somewhat larger size ($2\frac{1}{4}'''$ in length of forewings), for the clear ochreous-yellow of the rather sharp markings of the forewings and legs, for the yellower colour of the antennæ, and for the black palpi which are only whitish at the extreme tip."

Comparison of Narycia monilifera with N. astrella.—*N. astrella* has not yet been described as British. So little is known of it that it may perhaps be advisable to give the original description of it:—

Narycia astrella, H.-Sch., "Sys. Bearb.," v., fig. 320 (1851); p. 89 (1854); Zell. "Linn. Ent.," vii., p. 365 (1852); Hein., "Schmett. Deutsch.," p. 35 (1870); Staud. and Wocke, "Cat.," p. 267 (1871).—*Xysmatodoma astrella*, m., Sppl. pl. xlvi., fig. 320; Zell., "Linn. Ent.," vii., p. 365. Cinereo-fusca, albo-irrorata, fasciis duabus obsoletis albidis, ciliis basi albopunctatis, apice albo quadrisectis. Grösser als *melanella*, die Vorderflügel gegen die Wurzel etwas schmaler, die Stirne und das erste Fühlerglied immer weissgrau, die Grundfarbe der Vorderflügel nicht so dunkel, mehr grau als schwarzbraun, die weissen Punkte zahlreicher und daher zwei deutlichere Binden bildend. Die Endhälfte der Franzen mit vier sehr bestimmten weissen Flecken. Die Stirne und das erste Fühlerglied innen sind deutlich weissgrau behaart. Von Fischer-R., aus Reichstadt in Böhmen (Herrich-Schäffer, *Sys. Bearb.*, v., p. 89, pl. 46, fig. 320). Heinemann adds: "Reinerz, end of June."

N. monilifera specially differs from *N. astrella* in the black-haired head, the yellow-ringed antennæ, the smaller and less elongated forewings, as well as in the markings, which, only in the ♀, sometimes form two transverse lines, but which do not, as in *N. astrella*, form two broad shades ("cloudbands") (Zeller).

Ovum.—The egg is ·46mm. in length and rather over ·33mm. in width, almost circular in transverse section; a well-rounded oval in outline, full yellow in colour, surface very smooth, regular and unsculptured. Laid by an unfertilised ♀, a few woolly hairs amongst them, June 16th, 1899.

Case.—The cases (full-grown) average about 5·5mm. in length and 2mm. in width, somewhat rounded dorsally, but with a flat face resting on the surface; some cases circular, others almost trigonal in section; one end almost pointed, the other end blunter and rounded; composed of whitish silk, thickly covered with minute particles of sand and yellow lichen, which give the cases a yellow colour. [Described June 15th, 1899, from cases from the Cheddar Rocks]. Not quite full-grown cases measure about 5mm. in length and 1·5mm. in width; they taper to a rather narrow pointed anal end, the mouth slightly constricted and lipped; opening almost ventral; made of whitish silk: much curved dorsally, rather flat ventrally, but with a nearly cylindrical section. Covered with fragments of lichen (Bacot. Cases from Cheddar Rocks). Bacot further notes of cases from Tarrington, "the lateral ridges well-marked, and slightly developed mediodorsal ridge, but the cases are not regular in shape and vary somewhat *inter se*. These cases are covered with fine, rather bright green, tree algæ" (April 26th, 1899). Triangular, with somewhat rounded edges, pointed at both ends, grey in colour, covered with small grains of sand; one sent by Heinemann variegated with yellow particles of lichen (Zeller). The case grey, with particles of dust worked into a dense coating of silk; bluntly triangular, almost like that of *S. triquetrella* (Fischer). Bruand notes the case as "so similar to that of *S. tabulella* (=*sepium*) that it is easy to confound them at first sight." That of *N. monilifera*, he says, is "only a little constricted at the anterior end which makes it slightly pyriform." [This want of appreciation of marked differences throws light on some of Bruand's other comparisons.] Koch says that the case is two-edged, somewhat vaulted above, 2‴ long, made of particles of lichen unmixed with other materials."

Habits of larva.—The larva is found less on fences than on tree-trunks; it is most difficult to breed, being restless in confinement, and trying its utmost to escape. When short of food the larvæ will eat each other's cases completely (Koch). Bacot observes that the larvæ were noticed to come out of the posterior end of the case, and considered it to be due to the shaking up that they had received in the post. The larva drops on a thread readily, so that one might suppose the habit of leaving the case a not unusual one. Griffiths notes that the close similarity of the larva-cases to the patches of lichen (arising, of course, from small particles of the latter being worked into the fabric of the cases), made the larvæ difficult of detection, especially as none of them seemed to be in motion. A very favourite resting-place appeared to be some narrow crack or crevice in the limestone; in this the larva-case hangs pendent. He considers that this sluggish habit, however, "may have been caused by the boisterous east wind sweeping down the Cheddar gorge" on the occasion of his first visit (May 6th, 1899), which frequently bore away into space the cases as he loosened them from their attachment to the rock. Griffiths further notes that although he did not see the larvæ on the move during the daylight in a state of nature, yet, in captivity, they seemed to wander round the box in which they were confined, both at night and in the early morning.

Larva.—The larva is grub-like with a large bulky abdomen and small weak head and thorax. Head and prothorax black and glossy, meso- and metathorax with dark brown corneous dorsal plates. Abdomen bright yellow; anal segment with a dark brown corneous plate. Head rounded, black, glossy, not large, carried rather flat (horizontal), retractile to a considerable extent, the loose whitish skin in front of prothorax conspicuous. The prothorax rather long and rounded (with somewhat of a neck or constriction between it and mesothorax), dark brown, chitinous, and glazed, the chitinous plate not so completely covering the segment as in the higher Psychids. The mesothorax has a dorsal corneous plate, two lateral plates, one on either side, the colour of plates paler brown than that on prothorax; a narrow white mediodorsal line commences at head and is continued over pro- and mesothorax; the metathorax (scarcely so well armed as the 1st abdominal of *Pachythelia villosella*) has a small anterior dorsal plate, and a larger and darker posterior one, on either side of mediodorsal area, a rather small lateral plate is also present on this segment. The segments increase gradually in size from the prothorax to the 6th abdominal segment, and decrease more rapidly from the 6th to the anus. The abdomen is large, soft, and bulky; the prolegs small and weak; the hooks being arranged on short stumps as in the higher Psychids, but the oval (horseshoe) arrangement of hooks on prolegs 1-4 is less complete, having a larger gap on the inner side; there appears to be no pit in the centre of foot. A row of dark spots are present on ventral area, apparently the nervous ganglia. The position of the large dorsal vessel can also be distinctly made out. The hairs are weak and faint (especially on abdomen), and are either very transparent or of the same colour as the skin; on the thorax they are stronger and white. The tubercular setæ on abdominal segments and metathorax are arranged in trapezoidal form, the tubercles on abdominal segments with fairly large basal plates, but proportionately not quite so large as in the higher Psychids. On the metathorax the plate bearing i is small, and the hair small; the plate bearing ii is very large as a plate and carries a larger hair; this plate (ii) is brown, that carrying i and those on abdominal segments are of the skin colour. On the abdominal segments the plate at base of i is smaller than that at base of ii; seta on ii fairly long and easily seen, that on i very small and inconspicuous; i is nearer to median line of dorsum, ii more remote (in this it agrees with Tineids, Zeuzerids, &c.). The lateral flanges are well developed, and, though conspicuous, do not bulge very much. The spiracles are situated above the lateral ridge, small, nearly circular, with a raised chitinous ring. A supraspiracular tubercle, iii, and seta, are present, the hair fairly long, about equal in length to that on ii; iv and v are rather far below the spiracle and at about equal distances from it, they are placed near each other as in true Psychid larvæ, the anterior, v, is very small, the posterior, iv, larger, nearly equal to iii in size. True legs (like the thorax) are weaker in relation to size of abdomen than in Macro-Psychids. The larva is restless, wriggles much when being examined, but the abdomen is too bulky for it to be very active; some of its movements are very suggestive of the backward wriggle usually associated with Tortricid larvæ [Bacot. Described April 30th, 1899, larvæ from Dr. J. H. Wood]. Larvæ from the Cheddar Rocks are described as "short, stout, with large bulky abdomen and slender thorax, the head and thorax making up quite one-third of the total length, although these parts of the body are probably less than one-fifth in bulk. The anal segment, brown-black and chitinous, the plates on abdominal segments 8-9 dark-coloured, brown, and hence prominent. The head small, black, and glossy, a few hairs present, the antennæ rather conspicuous." Fischer notes the larva as "pale brown in colour, the thoracic segments dorsally dark brown; the head and anal segment black; the tubercles widely distant, brownish." The larva was well studied and figured by Mann, the drawings being reproduced by Fischer von Röslerstamm.

Comparison of the larvæ of Narycia monilifera and Solenobia (?) lichenella.—The larva is larger, and in some more respects Psychid-like than that of *S. lichenella*. The abdomen has, however, not become very markedly Psychid, whilst the head, thorax, and legs are relatively larger and stronger. The lateral ridges are more regular and better marked than in the larva of *S. lichenella*, and, although the hairs appear to be of about equal length, those of *N. monilifera* show up more clearly, perhaps because rather thicker or darker-coloured. The chitinous plates at the base of the hairs are large and well-marked, whilst no plates are noticeable in the larva of *S. lichenella* (Bacot). [The *S. lichenella* here compared, is the parthenogenetic form from Wellington College.]

Pupa.—The pupa is pale brown in colour, and the intersegmental folds of the movable incisions only somewhat darker. *Laterally:* The dorsal head-piece stands out frontally, the prothorax depressed, the front of the mesothorax rises suddenly, but is not markedly developed medially, the metathorax and all the abdominal segments form a somewhat regular convex line along the dorsum, rising most at the 3rd and 4th abdominal segments, the metathorax scarcely falling below the line of this curve. The wings stand out prominently laterally, owing to depression on metathorax at base of wings, eyes bulging; antenna rising at point where dorsal head-piece meets prothorax laterally. The spiracles exceedingly minute, placed towards the front of each segment, the scar on 8 especially well-developed. The strongly-developed setæ, iii and iv, on chitinous buttons, the dorso-anal spikes very prominent. The wings reach to the end of the 6th abdominal, the 3rd pair of legs to the end of the 7th. The genital organs marked by prominence on anterior part of the 9th abdominal segment. *Dorsally:* The prothorax frontal, but not so far forward as the dorsal head-piece. The mesothorax moderately well-developed. The 1st abdominal narrow (front to back), the 2nd and 3rd depressed transversely across the middle of the segments. The 4th-7th covered with small rough points towards the front margin, more thickly placed towards the anterior edge. The intersegmental membranes between 2-3, 3-4, 4-5, 5-6, 6-7, 7-8 distinct and smooth; abdominal segments 8-10 united into a single mass. The spiracular (iii) and subspiracular (iv) setæ stand out conspicuously; the dorsal tubercles i and ii with chitinous bases. The 10th abdominal segment rounded, with two dorso-anal spikes, a long recurved hair just outside the base of each. The anus practically dorsal. The wings have a less prominent appearance than in lateral view. *Ventrally:* The dorsal head-piece prominent (placed frontally and not ventrally). The eyes darker (facets of imaginal eye showing through the skin); distinct lunular glazed eye at base of antenna, and outside the true ocellar area. The labrum with two hairs on either side; the labium, labial palpi, maxillæ and maxillary palpi well-developed. The 1st pair of legs and somewhat slender antennæ end together (at a point that appears to be the costal commencement of Poulton's line, but may be the edge of hindwing showing through), the 2nd pair ends at the apex of the forewings, whilst the 3rd pair reaches to the end of the 7th abdominal. The ends of the wings and legs quite free from the abdominal segments. The male genital organs very conspicuous, forming a swollen boss on the front part of the 9th abdominal. [Described June 14th, 1899, from pupæ sent by Mr. Griffiths and collected at the Cheddar Rocks.] The square dorsal head-piece more than twice as large as prothorax, the wing-cases to the end of the 6th abdominal segments (7th in the male if shrivelled and in the ♀ to end of 5th); antennæ to end of 1st pair of legs (about the 4th abdominal segment); the 2nd pair to end of wings; the 3rd pair extends the width of a segment beyond the wings. (In the ♀ the 2nd pair goes to end of wings and the 3rd pair a segment and a half beyond, the 1st pair and antennæ reaching to the end of the 2nd abdominal. There is no ventral impression for the legs beyond the 5th segment in the ♀).

The two bristles at base of labrum finely hooked, the mandibles very large; the maxillæ well-developed, triangular, sharp-pointed, well-marked maxillary palpus at each exterior angle; the labial palpi (as in most other Taleporiids) form two large flaps between maxillæ, not divided at base; the tubercles as in larva—i and ii trapezoidal, iii large, iv (large) and v (weak) in line longitudinally below spiracle, vi, vii, and viii all single-haired; ii nearer to i on abdominal segments 5-8 than on 1-4; the setæ occur as recurved hooked hairs on abdominal segments 9-10 (4 ordinary tubercular hairs on 8, and 2 on 9); two dorsal anal spikes on abdominal segment 10. The dorsal spines form a patch (3 or 4 transverse rows) anterior to tubercles i on abdominal segments 5-8, the spines look small and sparse. The spiracles stand out as well-developed cones. Two rounded bosses in front of venter of 9th abdominal segment mark the genital organs. The eye goes with the faceparts and antennæ, on dehiscence, as in Psychids, but legs are separate (Chapman). The anal segments of the pupa are figured by Fischer.

Food-plants.—Lichens on trees and in hedges (Zeller), green confervoid growth on tree-trunks (Warren), *Parmelia* (Rössler).

Habits and Habitat.—Stephens says that it occurs among elms in the vicinity of the metropolis, but is not very abundant. Barrett notes that at Haslemere imagines occurred on an old fence from which cases had been obtained earlier in the year. Wood says that at Tarrington it is occasionally met with on the wing, or at rest on tree-trunks. Bower notes that in Kent, the larvæ are not confined to any particular tree, but the cases are generally well hidden in crevices of bark. The imagines are generally captured at rest or flying in the morning sun. Hudd and Harding found the cases on the trunks of various fruit-trees in their gardens, near Bristol. Atmore has taken a few imagines at King's Lynn, always flying in the sunshine. Warren notes the larvæ as occurring on old fences at Brandon, and Farren, near Cambridge, has captured specimens on the trunks of an old tree on the banks of the Cam. Bankes beat an imago from Scotch fir at Ringwood, whilst Digby captured others at rest on lichen-covered beech trunks, on which empty cases of the species were noticed at the same time, in the New Forest. The imago is often found sitting on the tree-trunks, but the males fly briskly in the afternoon. Griffiths says that the larvæ were found most abundantly feeding on patches of yellow lichen growing near the bases of the limestone cliffs of the Cheddar Gorge, some distance up the road beyond the entrance to the caves, shortly after passing the highest of the great bastioned rocks, the most picturesque part of this wonderful defile. Douglas notes larvæ on the fence in Addington Road, near Shirley. Durrant found cases in "countless thousands" on fences at Southill, Beds., on Oct. 15th, 1884, also on lichen-covered fences in 1891, and trunks of *Pinus sylvestris* in 1897 at Merton; Bacot found a single case on an old oak-trunk at Broxbourne in 1899. Mann found cases on the trunks of *Robinia pseudacacia* near Vienna, and states that the larvæ fed on the bark lichens. The imagines, he asserts, emerge 14 days after pupation, and are to be found on the acacia trunks and on fences near, being difficult to find, so well are they protected by their colour. Zeller found specimens on a willow-trunk on the borders of an alder thicket at Glogau. Reutti notes the cases in Baden on tree-trunks, fences, and lichen-covered walls, whilst Sorhagen states that in Brandenburg the imago is to be found resting on the tree-trunks in woods and gardens. Snellen notes it as common in the drier parts of the Netherlands, generally on oak-trunks, whilst Peyerimhoff states that, in Alsace, it prefers tree-trunks, especially hornbeam and apple, in woods, gardens, shady lanes, &c., the imago emerging from 7-8 a.m. [Millière observes that the imago flies usually in July in oak woods in the Alpes-Maritimes, and that the larva is to be found in spring dragging a conical hood (? *lapidella*) on the bark of *Quercus robur*, on lichens growing on which it feeds. He adds: "The female is apterous." We suspect that there may be an error as to the species referred to in this record.] Rössler says that the case is found on all kinds of tree-trunks in Nassau, and is often brought in from the forest with firewood, in consequence of which the imago is sometimes found flying about the houses. Larvæ often abundant at Falster on beech-trunks after hybernation (Bang-Haas). Hofmann finds it in orchards in Würtemburg.

Time of appearance.—From the end of May until July. In June near London (Stephens); in the middle of June at Haslemere (Barrett); June and July at Richmond Park (Warren); June 6th 1850 at Lewisham, flying along hedges, and beaten out between 7 and 8. 30 p.m., June 2nd, 1850, bred from cases off fences near West Wickham, June 5th, 1850, bred from cases obtained on Dartford Heath fence (Stainton); imagines captured at Leicester July 10th, 1875, (Sang *teste* Gardner); bred July 3rd 1885, captured June 27th, 1892, at Tarrington (Wood); imagines June 22nd, 1887, on tree-trunks at Lee, July 24th, 1888, worn, on fence at Bexley, a few cases end of March, 1889, on tree-trunks, apparently feeding upon a very fine lichen, at Eltham, Greenhithe, and Lee, bred the imagines from May 3rd-June 16th, 1889, imagines captured, June 27th, 1890 (worn), June 30th, 1891, June 22nd, 1898, at Bexley, 4 cases on tree-trunks at Eltham, April 6th, 1893, one imago only emerged, May 31st, 1893 (Bower); July 3rd, 1890, at Ringwood, June 12th-14th, 1889, in the New Forest (Bankes); bred June 16th, 1899, from Cheddar Gorge pupæ (Chapman). Pupation in most instances entered upon before June 12th, 1899, at this time many pupa-cases in the Cheddar Gorge were already empty, the first moth appeared in confinement on June 20th (Griffiths); July 3rd, 1887, at Chequers Court, Bucks, July 3rd, 1888, at Brandon (Walsingham); examples bred July 3rd, July 17th, July 18th, 1891, from cases on fences, others bred July 29th, 1897, from cases on *Pinus sylvestris*, also captured July 10th, 1885, July 15th, 1886, June 21st-June 29th, 1896—all at Merton (Durrant). Imago captured on May 25th, in Brunswick (Heinemann); at the end of May and throughout June around Vienna, and in May, 1853, on the trunks of poplars at Fiume (Mann); larvæ in the early spring, imagines at end of May and in June at Brandenburg (Sorhagen); in May and early June in Alsace (Peyerimhoff); in May and early June in south-west Germany (Koch); Müller on May 24th at Frankfort; Christoph, June 4th, 1859, at Sarepta (Zeller coll.).

Localities.—Beds: Southill (Durrant). Berks: Reading, Wokingham, near Wellington College Station (Hamm). Bucks: Chequers Court (Walsingham). Cambridge: Cambridge (Farren). Cheshire: Very rare (Ellis), Birkenhead (Stainton), Bowdon (Threlfall), Eastham Wood (Brockholes), Prenton Wood, near

Birkenhead (Gregson). Derby: Burton-on-Trent (Mason). Essex: Colchester (Harwood). Gloucester: Bristol, Durdham Down, Stapleton, Almondsbury (Hudd). Hants: Ringwood, New Forest (Bankes), Basingstoke (Hamm). Hereford: Tarrington (Wood). Hertford: Cheshunt (Boyd), Broxbourne (Bacot). Kent: Local and uncommon, Eltham, Lee, Chislehurst, Bexley, Greenhithe (Bower), Dartford Heath (Stainton). Lancashire: Manchester (Stainton). Leicester: Leicester (Sang). Middlesex: near Hampstead Road Station (Healy). Norfolk: King's Lynn (Atmore), Merton (Durrant). Somerset: Cheddar Gorge (Griffiths). Suffolk: Brandon (Walsingham). Surrey: Addington, near Shirley (Douglas), Haslemere (Barrett), South Lambeth (Stephens), West Wickham (Stainton), Ripley (Westwood), Richmond Park (Warren). Sussex: Bersted, Bognor (Fletcher). Yorks: York (Stainton).

Distribution.—Austria: Vienna, Fiume (Mann), Prague (Frey coll.), Brünn (Gartner), Lavantthal (Höfner). Belgium: Brussels (Lambillion), Louvain (Fré). Denmark: North Zealand, Falster (Bang-Haas). France: North France (Constant coll.), St. Florent, Nohant (Sand), Aube (Jourdheuille), Douai (Foncart), Doubs (Bruand), (?) Alpes-Maritimes (Millière). Germany: Generally distributed in woods and on fences (Heinemann), near Dantzig (Tiedemann), Glogau (Zeller), Brandenburg, Frankfort-on-Oder, Brunswick (Heinemann), Ueberlingen, Heiligenberg, Freiburg, Lahr, Karlsruhe, Spires, Wertheim (Reutti), Alsace (Peyerimhoff), Bonn (Frey), general in Brandenburg, Finkenkrug, Potsdam, Friedland, Stettin (Sorhagen), Munich (Hartmann), Rhine Palatinate (Bertram), Frankfort-on-Main (Koch), Waldeck and Arolsen (Speyer), Nassau (Rössler), Wurtemberg (Hofmann), Ratisbon (Schmid), Silesia, generally distributed (Assmann), Dessau (Richter), Krefeld (Jordan), Hanover (Glitz), Pomerania (Büttner), Frankfort-on-Oder (Kretschmer). Italy: ? Alps of the Valtellina (Curò). Netherlands: Not rare in drier parts, South Holland, Utrecht, Arnhem in Gelderland, Venlo in Limburg, Breda in North Brabant (Snellen). Russia: Sarepta (Christoph). Switzerland: Up to 5,000ft. (Frey), Bremgarten (Boll), Upper Engadine, Samaden (Pfaffenzeller), Pontresina (Killias).

Family: DIPLODOMIDAE.

This family is probably (with the last) the most generalised of those that undoubtedly belong to the Psychides. Both sexes are winged, and the imago has distinct ocelli at the base of the antennæ, a character that is maintained by the Taleporias, which originate some distance above the genus *Diplodoma*, on the Psychid stem. The family seems to be restricted to the Palæarctic area, only two species at present being known to represent this stranded remnant of the early Psychids. It is quite possible, however, that some of the genera mentioned *ante*, p. 132, belong to this family.

Subfam.: DIPLODOMINAE.
Tribe: DIPLODOMIDI.
Genus: DIPLODOMA, Zeller.

Synonymy.—Genus: *Diplodoma*, Zell., "Linnaea Entomologica," vii., pp. 332, 359 (1852); Sta., "Insecta Britannica," p. 20, pl. i., figs. 6*a-d* (1854); "List Br. An. B. M.," xvi., Lp., p. 6 (1854); "Ent. Ann.," 1856, p. 49 (1855); "Man.," ii., p. 286 (1859); "Ent. Ann.," 1861, p. 103 (1860); H.-Sch., "Sys. Bearb.," v., pp. 30, 96 (1853); Hein., "Schmett. Deutsch. Tin.," p. 33 (1870); Ibid., 2, Tab. 2 (1876); Nolck., "Lep. Fn. Estl.," p. 469 (1871); Staud. and Wocke, "Cat.," p. 267 (1871); Bang-Haas, "Nat. Tids." (3), x., p. 2 (1875); Wallgrn., "Bih. Vet.-Ak. Handl.," iii., p. 33 (1875); Sand, "Cat. Lép. Auv.," p. 154 (1879); Snell., "Tijd. v. Ent.," xxii., p. 129 (1879), "De Vlinders, &c.," pp. 416, 448 (1882); "Tijd. v. Ent.," xxxvii., p. 13 (1894); Hart., "Mitt. Münch. Ent. Ver.," iii., 196 (1879); Frey, "Lep. der Schweiz," p. 335 (1880); Röss., "J.-B. Ver. Nass.," xxxiii-iv., p. 228 (1881); Peyer., "Cat. Lép. Als.," 2nd ed., p. 84 (1882); Curò, "Bull. Soc. Ent. It.," xv., p. 5 (1883); Rou., "Cat. Chen. Eur.," 142 (1883); Sorh., "Die Kleinschmett. Brand.," p. 142 (1886); Heyl., "Tijd. v. Ent.," xxxiv., p. xxvi (1891); Meyr., "Handbook," &c., p. 776 (1895); Reutti, "Lep. Bad.," 2nd ed., p. 304 (1898). [*Tinaea*, Geoff., "Hist. Ins.," ii., p. 198, no. 41 (1762); Wer., "Beitr.," 2, p. 315 (1864).] *Tinea*, Geoff., "Ent. Paris.," ii., p. 332 (1785); Zell., "Isis," 1839, p. 183; "Ber. Schles. Tausch. Schmett.," iv., p. 15 (1843); vi., p. 11 (1845); viii., p. 13 (1846); Zell. (and Lienig), "Isis," 1846, p. 270; Sta., "Cat.," p. 6 (1849); "Ent. Comp.," 1st ed., pp. 10, 39, 49 (1852). *Lampronia*, Stphs., "Sys. Cat.," no. 7569, p. 227 (1829); "Illus.," iv., p. 358 (1835); Curtis, "Guide," 1st ed., p. 187 (1831), 2nd ed., p. 215 (1837); Wood, "Ind. Ent.," p. 229 (?1839); Tgstr., "Bidr.," p. 107 (1847); Fologne, "Ann. Soc. Ent. Belg.," iii., p, 143 (1859). *Incurvaria*, Dup., "Cat.," p. 355 (1846).

Zeller's diagnosis of this genus reads (*Linn. Ent.*, vii., p. 332) as follows:

Caput superne et in fronte hirsutum. Palpi maxillares nulli; labiales cylindrici pilosi. Ocelli distincti pone oculos. Antennæ setaceæ. ♂ ciliatæ, ♀ subdentatæ. Alæ anteriores oblongæ, mediocriter ciliatæ, anteriorum cellula discoidalis venas in marginem posticum sex emittit, supremam simplicem, subapicalem. ♀ alata, ano lanato. Larva saccophora, sacco in indusium incluso.

In this genus Zeller places only one species—*marginepunctella*, St. (*herminata*, Geoff.), which, therefore, becomes the type.

The chief characters of the genus (based on *D. herminata*) may be summarised as follows:

Ovum.—Oval in outline, long axis horizontal, surface smooth, covered with hairs from body of female.

Case.—Trigonal in section, three distinct lips at opening, covered with sand, enveloped in a loose outside sac covered with insect *débris*, &c.

Larva.—Head retractile; thoracic segments with corneous plates; tubercles with simple setæ; i and ii trapezoidal (ii, however, but little outside i), iii well-developed, iv and v subspiracular (iv the stronger), vi single, vii consisting of two separate tubercles; the prolegs short on the abdominal segments 3-6, anal ones larger and stronger, the hooks arranged in oval form (broken on inner margin); pupates within larval case.

Pupa.—♀. Large dorsal headpiece (twice as large as prothorax); small eye-collar (maxillary palpus); labrum and labial palpi well-developed; apex of wings to end of 4th abdominal segment; 3rd pair of legs beyond 5th abdominal segment; antennæ not quite as long as wings; tubercles and setæ as in larva; transverse band of dorsal spines on front edge of abdominal segments 3-7; recurved hairs on abdominal segments, 7-10; two dorso-anal spikes; movable incisions, 2-3 (dorsally), 3-4, 4-5, 5-6, 6-7 (male, 7-8 also).

Imago.—Head rough; tongue obsolete; maxillary palpi obsolete; labial palpi, cylindrical, drooping, loosely-scaled; eyes compound; ocelli, one at base of each antenna; antennæ ♂ ciliated, ♀ subdentate, basal joint without pecten; posterior tibiæ smooth-scaled; both sexes winged; ♀ with anal tuft.

Neuration.—Forewings, 1b furcate, 7 to termen. Hindwings, 6 and 7 sometimes short-stalked (Meyrick).

This genus is particularly Taleporiid in its affinities. It has the characteristic female anal tuft, and also ocelli; the pupa has the two dorso-anal spikes that are noticeable in the generalised Psychids, the long recurved hairs on abdominal segments 7-10, the anterior pad of hooks on the abdominal segments 3-7. The larva is generalised so far as its tubercles are concerned, but the abdominal prolegs are typically Psychid. The winged female covers her eggs with hairs from the anal tuft, whilst the Taleporiids have the same habit, except that their eggs are laid in the case. The case itself is peculiar, the trigonal Taleporiid-looking case being enveloped in an outer covering which is ornamented with insect *dêbris*. Zeller notes the peculiarity that the larval case stands in an outer one that allows the first to project at both ends, and considers that the presence of ocelli in both sexes prevents the union of this genus with *Xysmatodoma* (*Narycia*). He further notes that "the discoidal cell of the forewing has the longitudinal 'foldline' thickened posteriorly, and that this bifurcates exteriorly, the branches meeting the distinct transverse nervure; the fork is so sharp and peculiar that it appears to be a real nervure. Six nervures run to the outer margin of the forewing in this genus, whilst only five do so in *Xysmatodoma*. The supplementary cell is distinct and the fork of the subdorsal nervure complete." We have already stated (*ante*, p. 114) that whereas the antennal structure of *D. herminata* is that of a true Psychid, that of the ♀ *N. monilifera* suggests an alliance with the Adelids, whilst later (p. 135) we describe the suggested Adelid arrangement of the scales on the antenna of female *Narycia*. The antennæ of *Narycia* and *Diplodoma* are interesting from the point of view of illustrating the evolution of the Micro-Psychid antenna, that of the latter genus being more specialised (especially in the ♀) than the former. The following comparison may be interesting :

N. monilifera.—♂. The dorsum clothed with two rows of scales of nearly equal size and in fairly accurate alignment; the basal black, the distal white or yellow; ventrally there is a group of four or five black tubercles towards the base and a transverse row of them near the extremity; each of these somewhat raised black points carries a long black hair, which are thus arranged in two groups. ♀. The two rows of scales completely encircle the antenna, and are in accurate alignment. They are appressed to the antenna all round. One short hair makes its way between the scales ventrally, about middle of segment. This is not evident except about middle of antenna, where, on a few segments, there seems a slight interval between two scales of the yellow row, where the hair comes through.

D. herminata.—♂. Scaled above with brownish-yellow scales, two rows to a segment, the first row of scales being much shorter than the second, and with a slight irregularity in both rows, *i.e.*, the ends of the scales of each row are not in accurate transverse alignment. The under side has long hairs, irregularly placed, more numerous towards end of segment, but not collected into groups. ♀. The scales (a shorter and longer row) encircle each segment and, as in the ♂, are not in accurate alignment, inferiorly the long second row (in dried specimens) is not applied flatly to the segment as dorsally, but stands off at an angle, so as to give a serrate outline in profile; this arrangement appears to be to give room to sundry hairs towards the end of each segment, shorter and less numerous than in the male, and partially hidden by these porrected scales.

There appear to be only two Palæarctic species in the genus—*herminata*, Geoff., and *adspersella*, Hein., the former of general distribution from Asia Minor to Britain, the latter confined to the Bavarian Alps.

Diplodoma herminata, Geoffroy.

Synonymy.—Species: *Herminata*, Geoff., "Ent. Paris.," ii., p. 332 [with ref. to "Hist. Ins.," p. 198, no. 41] (1785). *Marginepunctella*, Stphs., "Sys. Cat.," ii., 227 (1829); "Nom. Br. Ins.," 51 (1829); "Illus.," iv., p. 358 (1835); Curtis "Guide," 1st ed., 187 (1831); 2nd ed., 215 (1837); Wood, "Ind. Ent.," fig. 1588, p. 229 (? 1839); Sta., "Cat.," p. 6 (1849); "Ent. Comp.," 1st ed., pp. 10, 39, 49 (1852); 2nd ed., pp. 8, 30, 36 (1854); "Ins. Brit.," p. 20, pl. i., fig. 6 *a-d* (1854); "List Br. An. B.M.," xvi., Lp., p. 6 (1854); "Ent. Ann.," 1856, p. 49 (1855); 1861, p. 103 (1860); Humph. and West., "Brit. Moths," ii., p. 252, pl. 120, fig. 5 (1851); Zell., "Linn. Ent.," vii., p. 360 (1852); H-Sch., "Sys. Bearb.," v., pp. 30, 39, 96 (1854); Fré., "Ann. Soc. Ent. Belg.," ii., p. 110 (1858); Fologne, Ibid., iii., p. 143 (1859); "Ent. W. Int.," vi., p. 127 (1859); Edleston, Ibid., p. 132; Ibid., viii., p. 149 (1860); Healy, Ibid., pp. 44, 156; Staud. and Wocke, "Cat.," p. 105 (1861); p. 267 (1871); Hein., "Schmett. Deutsch. Tin.," p. 33 (1870); Ibid., 2, Tab. 13 (1876); Nolck., "Lep. Fn. Estl.," p. 469 (1871); Wallgrn., "Bih. Vet.-Ak. Handl.," iii., p. 33 (1875); Bang-Haas, "Nat. Tids.," 3,x., p. 2 (1875); Staud., "Hor. Soc. Ent. Ross.," xv., p. 270 (1879); Sand, "Cat. Lép. Auv.," p. 154 (1879); Snell., "Tijd. v. Ent.," xxii., p. 129 (1879); "De Vlinders," &c., pp. 416, 449 (1882); "Tijd. v. Ent.," xxxvii., p. 13 (1894); Hart., "Mitt. Münch Ent. Ver.," iii., 196 (1879); Frey, "Lep. der Schweiz," p. 335 (1880); Röss., "J.-B. Ver. Nass.," xxxiii-iv., p. 228 (1881); Peyer., "Cat. Lép. Als.," 2nd ed., p. 84 (1882); Curò, "Bull. Soc. Ent. It.," xv., p. 5 (1883); Rou., "Cat. Chen. Eur.," 142 (1883); Sorh., "Die Kleinschmett. Brand.," p. 142 (1886); Heyl., "Tijd. v. Ent.," xxxiv., p. xxvi (1891); Meyr., "Handbook," &c., p. 777 (1895); Reutti, "Lep. Bad.," 2nd ed., p. 304 (1898). *Siderella*, Zell., "Isis," 1839, p. 183; "Ber. Schles. Tausch. Schmett.," iv., p. 15 (1843); vi., p. 11 (1845); viii., p. 13 (1846); Zell. (and Lienig), "Isis," 1846, p. 270; Dup., "Cat.," p. 355 (1844); Tgstr., "Bidr.," p. 107 (1847); Heydrch., "Lep. Eur. Cat. Meth.," ed. 3, p. 78, no. 31 (1851); H.-Sch., "Sys. Bearb.," v., pl. xlvi., fig. 319 (1851); Koch, "Schm. S.-W. Deutsch.," p. 373 (1856). *Marginipunctella*, Sta., "Man.," ii., p. 286 (1859); Morris, "Brit. Moths," iv., 13, pl. 98, fig. 2 (1870); Jourd., "Ann. Soc. Ent. Fr.," 4 ser., x., 115 (1870).

Original Description.—*Tinea herminata.* La Teigne à bordure herminée. Long. 2 lig. *Tinea* fusca, lineâ duplici transversâ flavâ, margine alarum undique flavo intersecto. Loc: Larva habitat lichenum scriptum (Geoffroy*, *Ent. Paris.*, ii., p. 332). [This insect is Geoffroy's No. 41 (*Hist. des Ins.*, p. 198), which is unnamed, but the description reads as follows:—"*Tinaea* fusca, linea duplici transversa flava, margine alarum undique flavo intersecto. La teigne à bordure herminée. Longueur 2 lignes. Sa couleur est toute brune en-dessus et en-dessous; mais en-dessus il y a deux lignes ou bandes jaunâtres qui parcourent les aîles transversalement, l'une plus haut, l'autre plus bas, et de plus les bords, tant extérieurs qu'inférieurs des aîles, sont entrecoupés de brun et de jaune. La chenille de cette teigne mange un petit *lichen* imitant une poussiere noire, qui vient sur les arbres et les treillages, et son fourreau noir paroît formé de cette même poussiere."]

Imago.—Head yellow. Anterior wings 10-14mm., glossy golden-brown (tinged with purplish); spaces between nervures with small yellow dots especially well marked on costa and outer margin, one very large spot on the inner margin rather more than one-third from the base; fringes latticed with yellow and ground colour. Posterior wings and fringes unicolorous, dark grey, tinged with purplish.

Sexual dimorphism.—The males and females both appear to be subjected to similar size and colour variations. The female is, however, at once distinguishable from the male by the woolly anal tuft. Zeller says that the females have the head hairs of a deeper rust-yellow and that the wings are more distinctly spotted than are those of the male, especially on the costa.

Variation.—The males vary from 10·5mm.-14mm., the females from 10mm.-14mm. Some males are almost unicolorous golden-brown with only a trace of the normally large yellow spot on the inner margin, and two or three minute yellow costal spots towards the apex visible; others have a yellow inner marginal spot and one towards the base of costa well developed, which apparently tend to form a transverse yellow basal band; others, again, have this band and a second broken band beyond the middle of the wing, extending from the costa to the anal angle, whilst occasionally there is a series of yellow points forming a curved line enclosing the apex of the wing. The more usual form is for the yellow spots to be arranged irregularly between the nervures, and then their resemblance to the pale patches of *Taleporia*, *Solenobia*, &c., is very evident. One form of the insect was named by the early authors, and treated by them as a distinct species. This is:

a. var. *siderella*, H.-Sch., "Sys. Bearb.," pl. xlvi., fig. 319, *teste* Zeller (1851); Koch, "Schmett. Deutsch.," p. 373 (1856). *Marginepunctella* var. *b.*, Zell., "Linn. Ent.," vii., p. 360-1 (1852).—Al. ant. costæ maculis duabus, priore maculæ dorsali opposita, posteriore in strigam continuata. ♀ (Zeller).

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* This work is generally cited to Fourcroy, who only edited it, the work itself being written by Geoffroy, and is a *précis* of his *Hist. des Insectes*, the insects being numbered to correspond therewith, and every word in the abbreviated description is copied therefrom.

Of this aberration Zeller notes: "One large ♀ has a large yellow spot before, and one behind, the middle of the costa, the former is of an irregular form, is sprinkled with some brown dots, and lies over against the enlarged inner-marginal spot which is deeply hollowed out inwards. The hind costal spot is triangular, marked on the costa itself in the middle with a brown spot, and forms with some larger pale yellow spots a weak curve reaching to the inner angle; otherwise the costa has no further spots." Nolcken records a female of this form from Pichtendahl, and states that he has a male, sent from the Alps by Mann, agreeing with this female in size, clearer brown in colour and so richly sprinkled with yellow spots that it differs strikingly from the rest of the males. The male from Pichtendahl stands, as regards markings and colour, almost midway between the Alpine and German examples, in which the yellow spots are restricted almost to vanishing point, so that they are almost entirely dark brown. Koch notes *siderella* from near Cassel (probably, however, only as typical *herminata*).

ORIGINAL DESCRIPTION OF THE ALLIED DIPLODOMA ADSPERSELLA.—So little is known of this, the only species yet described, congeneric with *D. herminata*, that it may be well to give the original description thereof. This reads as follows:

Adspersella.—Vorderflügel braungrau, gelblich glänzend, mit kleinen bleichgelben Punkten, eine unbestimmte breite Binde vor der Mitte und ein grosser Vörderrandsfleck vor der Spitze bleichgelb, dunkel gesprenkelt, die Kopfhaare gelbgrau. $3\frac{1}{3}$ L. . . . . Der Sack grösser $7\frac{1}{3}'''$ lang und $1\frac{1}{2}'''$ breit, mit Erdkörnern bedeckt, scharfkantig, braun, er besteht nur aus einfachen Hülle, ohne den Mantel der vorigen Art (*D. marginepunctella*). Auf der Kaiseralp, von Herrn Hofmann (Heinemann, *Schmett. Deutsch.*, iii., p. 34).

EGG-LAYING AND EGG.—The female covers her eggs with a thick coating of fur in a similar manner to *Liparis auriflua* (Edleston). This was afterwards confirmed by Healy. Heylaerts describes the eggs as "small, round, and yellow," and says that they hatch in ten days.

CASE.—The full-grown case measures some 10mm.-11mm. in length, and 4mm.-4·5mm. in width. It is very trigonal in section and presents very distinct lips at the opening for emergence of pupa. It is made of white silk covered externally with sand, and enveloped in a loose outer case (standing at some little distance from it) covered with insect *débris*, minute particles of vegetable matter, the outer case being attached to the inner case by loose threads of silk (Chapman). The case is triangular, its underside flat, the mouth turned rather down, the whole covered with a loose toga composed of all sorts of odds and ends (Stainton, case from Stockton, received from Scott, Oct. 7th, 1855). The larval case is double, and reaches $6\frac{1}{2}'''$ in length ($9'''$ in the *Isis*, 1846, p. 270, is a misprint). It is three-sided with sharp edges, thinning off more to a point posteriorly than anteriorly. At the lower edge of the front end is an opening from which the larva protrudes its thoracic segments. It is light grey in colour, clothed with small grains of sand, brownish particles of earth, and minute pieces of the hard portions of beetles. This case is enclosed in another, more bulging, from which it projects at both ends and to which it is fastened by single threads on the margins; the outer case is more thickly clothed with particles of dirt and remains of beetles than the inner (Zeller). Fologne notes that the case of this species is often composed entirely of the remains of coleoptera, diptera, and even of larvæ mixed with the silk. This made him suppose the larva to be carnivorous, a habit which he proved by giving one a weevil which was devoured by the next morning and its remains attached to the larval case. Healy notes the larva as readily repairing a case that had been damaged. Rössler notes the case as extremely like that of *Tinea parietariella*, covered with pieces of insects. With regard to the loose outer covering of the case of *D. herminata*, Wood suggests that its value is evidently protective, due to its likeness to those small collections of insect remains entangled in the remnants of a spider's web, that one occasionally finds hanging in just those places where *D. herminata* cases might be expected (*in litt.*).

Larva.—Larva albida pubescens, maculis corneis melleis sparsa, capite melleo, prothoracis cornei margine antico albido, mesothoracis brunnei margine albido latiore, metathorace pallidius fusco-maculato. The head honey-yellow, the prothorax paler yellow, with whitish margins, the mesothorax browner with a fine whitish median longitudinal line and broader whitish margins; the metathorax has broad whitish margins, is corneous and brown centrally with a whitish cross, the cross arms being concave anteriorly. The true legs light brownish-yellow. The first three abdominal segments (which the larva sometimes puts out of the case) are similar to the metathorax, only the corneous plates are more separate, they are also bright and shiny. The yellowish-white pubescence is more marked on the head and thoracic segments (Zeller, *Isis*, 1846, p. 273). Dull whitish; head pale brown; 2nd segment darker brown behind, divided in the middle by a whitish line; 3rd and 4th segments with a faint brownish tinge on each side, in which are two brown spots; legs pale brown. Larvæ from Scott, October 7th, 1855, Stockton [Stainton, *vide*, *Ent. Ann.*, 1856, p. 49 (Durrant)]. The larva is dirty yellowish-white, with a somewhat fleshy tint; head shining brownish-yellow with somewhat darker spots; the ocelli and mouth-parts dark brown, while the antennæ are much lighter. The thoracic segments are provided dorsally with shining brownish-yellow shields, that on the prothorax broad and unmarked, those on the meso- and metathorax narrower and with a triangular mark in the middle, on the anal segment is a similarly-coloured shiny anal plate, the other segments are soft, the usual tubercles brownish, as also the stigmata. The legs are brownish-yellow, somewhat darker at the articulations and strongly built; the prolegs are small and coloured like the body (Heylaerts).

Habits of Larva.—The larva is generally found on the trunks of old trees, on the lichens growing on which it is reputed to feed. It lives for at least two years, and probably often for three. Heylaerts says that as soon as the larvæ hatch they immediately make cases, which are enlarged at each subsequent moult; the life-cycle extends over two years, and the larvæ feed entirely on "dust moss." They refused to touch dead insects, and starved in preference. Snellen and Haar, however, in a discussion that followed, confirmed the carnivorous tendencies of the species. Edleston is inclined to think that they resort to the trees for rest and forage on the ground for prey, but his observations that they will eat the lichen on such trees, and that they feed on hawthorn voraciously, suggest that the carnivorous habit is an incidental and not a normal one. They spin down their cases for hybernation in November, setting them free in April and May of the next year, and commencing to feed again. Those that emerge in June and July appear not to feed much (if any) again in the spring. Wood notes that "the larva takes at least two years to feed up, being seldom seen in the first year;" but he notes that he has "once or twice in the autumn found the half-grown case attached low down to the trunk of a tree, almost at the ground level. The full-sized or adult case is more often met with, on palings usually, but also on tree-trunks, from 1ft. to 3ft. above the ground. The earliest date noted for an adult case is June 5th, and the latest July 19th. The majority found have contained larvæ that still required to be fed, but this necessity never extended beyond the middle of July, or thereabouts; they remain active, however, at intervals, through the autumn and following spring, until they finally settle down for pupation at the end of April or beginning of May." To feed them he places "in the vessel in which they are kept strips of cork or wood, on which freshly killed insects, usually flies, are pinned, and these they soon discover if hungry. They should be wintered out of doors, and under this treatment there is no difficulty in rearing them. As I have never found the cases when laid-up for pupation in the spring, it would appear that after it has finished feeding the larva again becomes as secretive as in the first year of its life" (*in. litt.*, April 20th, 1899). Snellen found a larva at Hilversum in autumn; it ate green "stofmos," dead flies, and spiders, till late in autumn, then it fixed its case by some threads and hybernated. After hybernation it secured its case more firmly, and pupated therein. Sorhagen notes that it has been recorded as hybernating under stones. Healy notes larvæ as becoming dormant at any time between August and early November, becoming active again towards the end of December. One observed crawled about, stretched its body out of the case when crawling, and fed on young leaves of lilac (December 2nd, 1860), not by eating through the leaf, but by nibbling the under-surface all round the edges of the leaf.

Pupa.—The ♀ pupa has a large dorsal head-piece (twice as large as the prothorax), triangular in outline. There are two bristles at base of labrum; a portion of the eye-collar (maxillary palpus) appears to be present, the labial palpi are well-developed, as also is the labrum. The tips of the wings extend to the end of the 4th abdominal segment, the third pair of legs, beyond wings to the 6th abdominal, the antennæ not quite as long as wings, the wings are soldered ventrally as far as the end of 2nd abdominal, free beyond. The leg-scars faint; each of the spiracles forms a circular opening with thickened border, the 2nd abdominal pair pushed back by wings. The dorsal spines form a transverse band (several spines deep but not arranged in regular rows) placed in front of anterior trapezoidals on abdominal segments 3-7 (on 3 only faintly). The tubercles are arranged as in the larva—i and ii trapezoidal (i just internal), iii large, iv (large) and v (small) both subspiracular, vi (with large hair reaching to front of segment), vii (two separate setæ), viii single and somewhat posterior. The characteristic recurved hairs (modified tubercular hairs) occur on 7 (one each side), 8 (three each side), 9 (four each side), and 10 (two each side); the two dorso-anal spikes conspicuous. The movable incisions are 2-3 (dorsally), 3-4, 4-5, 5-6, 6-7 (and, ♂, 7-8). On dehiscence the eye goes with face-parts and antennæ as in Psychids (♀ pupa). Chapman notes of the pupa as follows: The pupa has very long rounded prominent jaws with distinct articulation against the cheek-piece, whether these be paraclypeal tubercles or not it is impossible to doubt that they are the jaws. The maxillæ are triangles, outside the labial palpi, obscuring them, or rather the labium, only a little basally. They are but little larger than would make them equilateral triangles, the base at the cheek, the apices at about half the length of the labial palpi. They have a very distinct palpus at their external angle. It is clearly continuous with them, yet is connected with them by a non-superficial portion, so that they form an "eye-collar" as they hardly do in other Psychids. The abdominal spiracles—4, 5, 6, 7 (8 obsolete), are on high prominences towards the anterior margin of the segments. Zeller says: "The pupa is light yellowish-brown, somewhat shiny, the last pair of legs extend beyond the apices of the wings in a somewhat sharp point. The rounded anus is pale, shiny, smooth, without spines; on the dorsum is a small, sharp, light-brown point, in the medio-dorsal line and on the segment some short bristles." The pupa-case is much protruded before the emergence of the imago.

Food-plants.—According to Gartner the food of the larva consists of *Parmelia pulverulenta* which grows at the foot of the trees, in whose bark crevices the larva hides, whilst Schmid gives *Physcia pulverulenta*, possibly the same plant. Powdery lichens found on old trees, hawthorn, &c. (Edleston). Fologne found larvæ, in 1859, at Brussels, on oak-trunks, and discovered that though they would not eat lichen they cleared out the contents of a half-killed weevil, house-fly, *Tortrix ocellana*,&c.; and adorned their cases with the *débris*. Edleston notes that on April 9th, May 14th, 28th, and July 9th, 1859, he found many larvæ on and near two poplar trees covered with lichen, some of the larvæ one, others two years old, but no imagines appeared. On reading Fologne's observation he fed them on bruised beetles (*Pterostichus*), houseflies, hawthorn, &c., on which they flourished until November, 1859, when they spun up for the winter. At the end of June, he bred 2 ♂ and 2 ♀ and some 20 or 30 other imagines during July. Those that did not pupate he continued to feed on bruised beetles, and earwigs as well as hawthorn, and he further notes that they also devoured the bodies of Noctuid moths and of a specimen of *Arctia villica*. The specimens bred were much larger than those captured wild. Healy notes that a larva of *D. herminata*, found on an oak-trunk in May, 1860 at West Wickham, was fed on houseflies and small moths, which it devoured greedily, it had no green food and it progressed favourably until its hybernation in August. He further notes that the larvæ never attempt to attack each other although they will eat the scraps with which the outside of another case is ornamented. We suspect that Zeller, in 1853, had already reached an almost correct result as to the food-plant. He asserted that he did not believe the larva fed on lichen, that its case was clothed with grains of sand and minute portions of beetles, &c., which it could find on the ground, but not on a perpendicular or very inclined surface. Wood has successfully reared the larvæ on freshly-killed insects, principally flies. A larva captured at Witherslack, by Threlfall, fed up on larvæ of *Solenobia* (?) *triquetrella*, and emerged June 20th, 1878.

Time of Appearance.—The imago, in June and July, at Pembury (Weir); four bred the last week of April (Healy); June 25th, 1852, flying along hedges between 7 and 8 p.m., and July 1st, 1852, beaten out of a hedge, at Lewisham (Stainton); beginning of July at Almondsbury (Hill); ten specimens on boles of oak and fir in July, 1856, at Bowdon, and bred some 30 examples at the end of June and during early July, 1860 (Edleston); June 22nd, 1856, at Darenth (Miller); June 27th, 1857, at Alkham (Beale); June 19th and 21st, 1897, at Bexley (Bower). Wood notes that the best catch he ever made was in 1894, when he collected, between July 3rd and 19th, nine cases from an open flight of palings and from these eight moths emerged the following year, between the end of May and the first week of June. He further states that he has only once captured the imago at large, and that it was then on the wing, in the afternoon of June 27th, 1892; a case on May 18th, 1868, imagines on July 2nd, 1872, and June 8th, 1877, at Witherslack (Hodgkinson); a larva on April 30th, 1878, at Witherslack, emerged on June 20th (Threlfall). Larvæ, found in August, 1855, at Exeter (Parfitt); and in September, 1855, at Stockton (Scott); July 13th, 1888, June 10th, 1893, July 4th, 1894, June 25th, 1897, in the Isle of Purbeck (Bankes); June 24th, 1892, in Purbeck (Digby); June 8th, 1865, June 24th, 1870, June 22nd, 1875, at Glanvilles Wootton (Dale); July 10th-27th, 1892, at Aldeburgh (Cruttwell); bred June 22nd, 1899, larva from Sandown, I. of W. (Chapman); imagines emerged June 7th, 13th, 14th, and 24th, 1897, from cases sent by Salvage from Derry (Durrant). The imago flies in June in the neighbourhood of Glogau, and cases may be found spun up the preceding May on old walls and tree-trunks (Zeller); June 22nd, 1859, at Gross Glogau, June 27th, 1875, at Bergün (Zeller coll.). April 20th, at St. Florent (Sand); a large case taken in the autumn, at Hilversum, the imago emerged July 21st, (Snellen); June 27th, 1866, July 4th, 1867, are mentioned as dates of capture at Pichtendahl, by Nolcken. Sorhagen notes May for the larva, June and commencement of July for the imago, at Brandenburg; Peyerimhoff also gives June to the end of July, in Alsace. Mann found the species at Brussa, in May, 1851, and captured a single specimen at Amasia on May 3rd, 1860. Bang-Haas says that although the larvæ are full-fed in July the imagines do not emerge until the following June. Heylaerts bred 24 imagines between July 11th-19th, 1890.

Habits and Habitat.—Stainton has captured the imago flying along hedges between 7-8 p.m., at Lewisham, and also beaten them out of hedges at the same hour. Edleston found imagines at rest on the boles of oak and fir, at Bowdon, and Hill notes them as flying in the evening along hedgerows in dry pastures, at Almondsbury. Bankes beat them out of a hedge composed of living and dead wood and old gorse bushes, during the daytime, and others flying naturally, about 7.30p.m., in the Isle of Purbeck, whilst Bower captured the species flying along a hedge-bottom in the morning sun, at Bexley, and another at rest on a fence two days later. Two larvæ were found by Fletcher on a gatepost, on a bank parting the fields from the saltmarshes, at commencement of July, 1898, at Hayling, and were then full-fed; Sang found two larvæ on a tree-trunk, at Baydale, near Darlington; and Gregson has taken them on old posts at Simonswood moss. Digby says that the imago is readily recognised when captured by the odd way it has of buzzing head downwards at the bottom of the net. Hodgkinson netted two males flying softly under a shady nut-bush, at Witherslack, in the early morning. Cruttwell observed the species on the heathy land just inside the marshes at Aldeburgh. Prout found a larval case spun up (so securely that he thought it was a cocoon) on April 11th, 1899, among rootlets of ivy, pieces of lichen, &c., on an old trunk in Rowdown Copse, near Sandown. After a few weeks it was observed moving about, and it apparently freed itself for pupation towards the end of May, suspending the cocoon by a few threads from the box in which it was confined. The larva, in May, is to be found on tree-trunks, walls and rocks, in Brandenburg (Sorhagen), and also on fences and rocks in Baden, the imago flying in the forenoon (Reutti). At Garz, Büttner found the cases spun-up in the outer chamber of an ice-cellar. Rössler notes that in Nassau the case has been found in several hilly districts, in autumn, under stones. Zeller found a case on a rotten beech stump at Raibl, the larva in which lived all the winter and died in spring.

Localities.—Berks: Sonning (Digby). Cheshire: Birkenhead (Stainton), Bowdon (Edleston), Rock Ferry (Brockholes). Cumberland: Lake District (Stainton). Derby: Burton-on-Trent (Mason). Devon: Exeter (Parfitt). Dorset: Purbeck (Bankes), Glanvilles Wootton (Dale), Bloxworth (Cambridge). Dublin: Howth (Hodgkinson). Durham: Stockton (Scott), Baydale near Darlington (Sang *teste* Gardner). Hants: I. of Wight, Sandown (Prout). Hereford: Tarrington (Wood), Ledbury (Warren). Gloucester: Stapleton (Harding), Almondsbury (Hill). Kent: Bexley (Bower), Alkham (Beale), Pembury (Weir), Darenth (Miller), Plumstead (Butterfield). Lancashire: Grange, local and not common (Ellis), Preston (Hodgkinson), Manchester (Stainton), Cleveleys (Threlfall), near Simonswood Moss (Gregson). Londonderry: Benone (Salvage). Middlesex: Neasdon (Warren). Norfolk: (Digby). Stafford: Cannock Chase (Barrett), Wirksworth (Baker). Suffolk: Aldeburgh (Cruttwell). Surrey: West Wickham (Healy), near Croydon (Douglas), Ripley (Stephens), Oxshott (Warren). Sussex: Guestling (Bloomfield), Abbotts Wood, Hayling (Fletcher). Westmorland: Witherslack (Threlfall). Wicklow: Wicklow mountains (Birchall). Yorkshire: York (Stainton), Huddersfield (Inchbald).

Distribution.—Asia Minor: Brussa, Amasia (Mann), Bithynia, Pontus (Wocke). Austria: Lavantthal (Höfner), Bohemia, Hungary (H.-Schäffer), Carinthia—Raibl (Zeller), Glockner, Mehadia, Tyrol—Montepiano (Mann). Belgium: near Brussels (Fologne), Liége (Fré). Denmark: Geel's Wood and Naestoed in Zealand, Haldin Jylland (Bang-Haas). France: St. Florent, Cher (Sand), Saone-et-Loire—Montjeu near Autun (Constant), Venançon, near S. Martin Lantosque (Millière). Germany: Generally distributed but not common in woods (Heinemann), near Dantzig (Tiedemann), Munich (Hartmann), Wiesbaden (Nolcken), Silesia, near Frankfort-on-Oder, near Glogau, on the Probsthainer peak (Zeller), Gross Glogau, Bergün (Zell. coll.), the province of Glatz (Zebe), Bavaria (H.-Schäffer), Ueberlingen, Heiligenberg, Freiburg, Karlsruhe, Durlach, Spires, the Palatinate, near Neustadt-on-Hardt (Reutti), widely distributed in Brandenburg, occurs in North Germany but rare, Garz, Friedland (Sorhagen), Alsace, Trois-Epis, pinewoods of Altenberg, La Vancelle (Peyerimhoff), Brunswick (Frey coll.), Burgundy (Constant coll.), Hanover (Glitz), Pomerania (Büttner), Lichtenau near Lauban (Moeschler), Cassel (Koch), Waldeck (Speyer), Nassau (Rössler), Wurtemberg, Urech, Kapfenburg (Hofmann), Wörth, Kelheim, Ratisbon (Schmid), Breslau (Assmann). Italy: Italian Tyrol (Mann), ? Valtellina (Curò). Netherlands: Rare, only found in a few localities in south and south-eastern parts of Holland, Hilversum, Arnhem (Snellen). Russia: Caucasus (Seebold), Baltic Provinces (Sintenis), Dubbeln, Kemmern (Teich), Livonia (Lienig), near Åbo (Tengström), Pichtendahl (Nolcken). Scandinavia: Sweden (Boheman), Scania, Småland, Oland, Gothland, West Gothland, Jemtland (Wallengren). Switzerland: near Bergün (Zeller), Bergell (Bazziger), Upper Engadine, Soglio (Killias), Valais (Anderregg).

Family: SOLENOBIIDAE.*

Probably this is the least known of the families included in the

* We are informed that the correct way to spell this is *Solenobiadae*, and that the "i i" is inadmissible. As a matter of uniformity we prefer to retain the same spelling throughout our chapter on the Psychids.

Micro-Psychids, as it certainly is the one in which the greatest confusion prevails as to the species described by various authors. No real critical attention has been paid to the family in Britain, although with the "Zeller," "Frey," and "Stainton" collections, one would surmise that the material for such a study is available; yet, in the two last-named collections, at least, one is not always quite able to follow the species as there named, nor to agree that the insects bearing different names are always really distinct species. Details, however, bearing on this, will be considered at length when dealing with the various species.

Subfam: SOLENOBIINAE.
Tribe: SOLENOBIIDI.
Genus: SOLENOBIA, Duponchel.

SYNONYMY.—Genus: *Solenobia*, Dup., in part, "Hist. Nat.," supp. iv., pp. 197, 201, 428-430, 512 (1842); "Cat. Mét.," p. 358 (1846); Zell., "Linn. Ent.," vii., pp. 332, 343 (1852); H.-Sch., "Sys. Bearb.," v., p. 26, pl. xi., 5-6 (1853), p. 88 (1854); Frey, "Die Tineen," &c., p. 13 (1856); "Lep. der Schweiz," p. 335 (1880); Sta., "List Br. An. B. M.," xvi., 5 (1854); "Ins. Brit.," p. 19, pl. i., 5*a-c* (1854); "Man.," ii., p. 285 (1859); ? "Tin. N. Amer.," 181 (1872); Hofm., "Berl. Ent. Zeits.," iv., pp. 35-40 (1860); ? Clemens, "Pr. Ent. Soc. Phil.," i., p. 132 (1862); Wocke, "Stett. Ent. Zeit.," xxiii., p. 68 (1862); Hein., "Schmett. Deutsch. Tin.," p. 21 (1870); "Tin.," 2, Tab. p. 1 (1876); Nolck., "Lep. Fn. Est.," p. 467 (1871); Staud. and Wocke, "Cat.," p. 266 (1871); Mill., "Cat. Lép. Alp.-Mar.," p. 295 (1875); Wallgrn., "Bih. Vet.-Ak. Handl.," iii., p. 32 (1875); ? Chamb., "Bull. U. S. G. Surv.," iv., p. 162 (1878); Sand, "Cat. Lép. Auv.," p. 154 (1879); ? Pack., "Guide," 7th ed., pp. 345-6 (1880); Snell., "De Vlind.," pp. 416, 444-5 (1882); Pey., "Cat. Lép. Als.," 2nd ed., p. 83 (1882); Sorh., "Die Kleinschmett. Brand.," p. 140 (1886); ? Riley, "Smith's List Lep. Bor. Am.," p. 95 (1891); Meyr., "Handbook," p. 774 (1895); Barr., "Ent. Mo. Mag.," xxxi., p. 163 (1895); xxxiii., p. 125 (1897); Chapmn., Ibid., xxxii., p. 79 (1896); Drnt., Ibid., xxxiii., p. 220 (1897); Reutti, "Lep. Bad.," 2nd ed., p. 305 (1898). *Taleporia*, in part, Hb., "Verz.," p. 400 (1826). *Talaeporia*, in part, Zell., "Isis," 1839, p. 182; Pritt., "Ber. Schles. Tauschver. Schmett.," iv., p. 15 (1843); Hoyell, Ibid., viii., p. 13 (1846); Sta., "Cat.," p. 6 (1849); "Ent. Comp.," pp. 10, 16, 27, 28 (1852); "Zool.," 1849, p. lxi; 1850, p. 2788. *Taloeporia*, Gn., "Ann. Soc. Ent. Fr.," 2nd ser., iv., p. 12 (1846). *Psyche*, in part, Brd., "Mon. des Psych.," p. 107 (1853).

This genus was named by Duponchel, who diagnosed it as follows:

Solenobia, Dup. (*Psyche* et *Fumea*, Steph. *Psyche*, Curt., Ochs., Treits. *Talaeporia*, Zell.). Antennes des mâles très finement ciliées ou pectinées; antennes des femelles filiformes. Palpes droits, longs, velus. Trompe nulle. Les quatre ailes non transparentes, et brièvement frangées; les supérieures en ovale allongé; les inférieures plus courtes. Femelles absolument aptères." He then goes on to say: "This genus is analogous with that of the Psychids (p. 65), and perhaps the greater part of the species contained in section A (*pulla*, *plumella*, *nitidella*, *radiella*, *bombycella*, *pectinella*, *calvella*, *nudella*, *pseudobombycella*, *politella*, *murinella*) of this last genus would be better placed in this than in the one in which they find themselves. Although this is so, the Solenobias differ from the (Macro-) Psychids, not only by their well-developed palpi and their more elongated and non-transparent wings, but also by the food-plant of the larvæ, which consists of lichen, and by the appearance of their cases which are smooth in place of the clothing of pieces of leaves or stems as in the Psyches. On the other hand the cases vary *inter se*, some form capuchons, others are elongated, some cylindrical, others trigonal, and some tetragonal" [Duponchel, *Cat. Mét.*, p. 358 (1846)].

The species included by Duponchel in the genus are: "*clathrella*, Tr., *lichenella*, Linn. (*triquetrella*, Hb.), *lapidicella*, Zell. (*lichenum*, Schrank), *pseudobombycella*, Hb. (*glabrella*, Ochs.), *anderreggella*, D., *lefebvriella*, D., *minorella*, D., *pectinatella*, D., *undulella*, F. v. R." Although not diagnosed until 1846, Duponchel used the name at least four years previously. Thus we find that he describes (*Hist. Nat.*,

p. 197) the "Solenobée de Anderregg (*Solenobia anderreggella*), and figures the same. This insect is *T. tubulosa* (*pseudobombycella*). In a footnote to the generic name he writes: "Nouveau genre établi par moi, et dont je donnerai les caractères dans mon *Catalogue Méthodique* a la fin de ce volume." On p. 198 of the same work he has a *Solenobia lefebvriella*, which he also figures, and which appears to be a paler form of *T. tubulosa* than his *S. anderreggella*. On p. 428 he has *Solenobia lichenella*, and on p. 430 *S. clathrella*. These also are figured, and undoubtedly represent the males of two species of the restricted genus now known as *Solenobia*. On p. 512 there is a *Solenobia pectinella*, which appears to be *Luffia lapidella*.

As the *Taleporia* of Hübner was created for *tubulosa* (*pseudobombycella*) and *triquetrella*, and Zeller restricted (*Isis*, 1839, p. 182) the name to the former species, it follows that the insect first included by Duponchel under the generic name *Solenobia* (*viz.*, *anderreggella*=*lefebvriella*=*tubulosa*) is not available as the type of the genus. This leaves *lichenella*, Dup. (*nec lichenella*, L.), and *clathrella*, Dup., as typifying the genus. Since the species of *lichenella*, Dup., is not absolutely certain one prefers to name *clathrella*, Dup., as the type of the genus. The genus, thus restricted, was diagnosed (*Linn. Ent.*, vii., p. 343) by Zeller, as follows:

Caput superne et in fronte hirsutum. Os pilosum palpis subnullis. Ocellis nulli. Antennæ ♂ setaceæ ciliatæ. Alæ oblongæ, mediocriter ciliatæ; anteriorum cellula discoidalis venas in marginem posticum quinque emittit, simplices; ♀ aptera, ano lanato. Larva saccophora, sacco breviusculo, granulato, anum versus attenuato.

The chief characters of the genus may be summarised as follows:

Ovum.—Oval in outline; shining, pearly-white in colour; laid in case.

Case.—Flattened; convex above (sometimes slightly trigonal); lateral ridges slightly angular; soft; mouth ventral, covered with sand and *débris*.

Larva.—Head small, retractile; pro- and mesothorax with chitinous plates; tendency to constriction between pro- and mesothorax; thorax slender; abdomen bulky; the anal segment with black chitinous plates; dorsal tubercles i very minute, ii larger (ii just outside i and some distance behind); iii large; iv (strong) and v (weak), both subspiracular; true legs strong; prolegs very weak; crochets arranged in oval broken on inner edge; spiracles inconspicuous with slightly raised rim.

Pupa.—Dorsal headpiece rather small; two hairs at base of labrum (sometimes 2 or 1 other above); incisions 2-3 (dorsally only), 3-4, 4-5, 5-6, 6-7 (7-8 male) movable; the anterior patch of dorsal spines wide, including i; i and ii trapezoidal; recurved hairs on abdominal segments 8-10 specially well-developed; dorso-anal spikes in both sexes; proleg scars distinct; spiracles with projecting rim.

Imago.—Head rough; tongue and maxillary palpi obsolete; labial palpi short; eyes compound; *no ocelli;* antennæ ♂ ciliated; basal joint with pecten; posterior tibiæ hairy; ♀ apterous, with anal tuft.

Neuration.—Forewings—1b furcate, 7 and 8 or 8 and 9 sometimes short-stalked; 7 to apex, 10 absent. Hindwings 4 and 5 or 6 and 7 sometimes short-stalked (Meyrick).

The Solenobiids differ from the Taleporiids in at least one important character, *viz.*, the absence of the imaginal ocelli. The pupæ of both families are structurally very similar to each other, as also are they to those of the Naryciids and Diplodomids, except that the latter, having winged females, show considerable difference in respect to those organs in the pupa, compared with the Solenobiid and Taleporiid pupæ. We have already stated that the larval cases of *Narycia* and *Solenobia* are very similar, as also their larvæ, but the winged female of the former separates the families very sharply. Zeller separates the Solenobiids from the Taleporiids on three grounds: (1) The absence of ocelli and palpi (in the former); (2) The single nervures of the forewings; (3) The loose larval case. He states that "only five nervures of the forewings run into the outer margin in *Solenobia*," adding that "the one that lies directly above them, and runs into the costa, is identical, however, with the sixth in *Talaeporia*, while it also joins the nervure which separates a part of the discoidal as a supplementary cell in *S. clathrella*." He notes that this supplementary cell is "wanting in *S. pineti*, and, consequently, also the nervure." Zeller further considers that *Solenobia*, owing to its delicacy and fragility, approaches nearer to the Psychids (*nitidella*, *sepium*, &c.).

The species of *Solenobia* are ill-defined, little known, and hence difficult to distinguish correctly. In Britain, owing to the isolation of those who have attempted to work at the group, each seems to have left the species in worse confusion than before, and this has been increased by an attempt to attach the names of European species to British specimens (chiefly of *S. inconspicuella*) that have happened to differ slightly from others. At present we are quite certain only that we possess one British species—*S. inconspicuella*. We also appear to have the parthenogenetic *S. lichenella*; *douglasii* apparently belongs to *Bankesia*, and Barrett says that we possess *S. wockii* (a conclusion with which, after examination of the specimens on which the opinion was founded, we are forced to disagree). At the same time, we may observe that some continental lepidopterists do not allow *S. wockii* to be distinct from *S. inconspicuella*. The parthenogenetic form obtained by Hamm (Wellington College), ? Fletcher (Horsham) and others, is possibly *S. lichenella*, although to us the case appears indistinguishable from that of *S. inconspicuella*, and larvæ and living females of the latter from a locality where winged males occur have not been sufficiently well-described to enable us to make a critical comparison. The dark dorsum of the pupa may be differential, but if so, the *S. lichenella* of the "Stainton" collection are possibly incorrectly named, and Snellen van Vollenhoven's *triquetrella* would appear to be *lichenella*. We have discussed (*Ent. Record*, xi., p. 173) this British parthenogenetic *Solenobia* from near Wellington College, on certain characters which Barrett and Chapman considered (*Ent. Mo. Mag.*, xxxiii., p. 127) to distinguish it from *S. inconspicuella*. Although we were able to show that these characters did not hold good, and although Chapman on further examination could not differentiate these females from others called *S. inconspicuella*, we have not yet been able to prove that the insect is *S. inconspicuella*, and unless there be a parthenogenetic form of the latter species, it is more logical to assume it to be *S. lichenella*. Still, authors have referred parthenogenetic forms to various species, and the subject is an exceedingly difficult one.

Possibly this phenomenon of parthenogenesis is one of the most remarkable features in the economy of the Solenobiids. It would appear to be beyond question that the females of some of the species at least have the power to produce parthenogenetic progeny for many successive generations. Siebold observes that during 1850, 1851, and 1852, he collected in Berlin several hundred cases of *Solenobia lichenella* and *S. triquetrella*, and bred nothing but females, although one locality gave him two males of *S. triquetrella*. The females "clung firmly to the outside of their cases, in the same way as do the females of *Fumea nitidella*, and filled their cases with eggs by pushing in their ovipositors. The Solenobiid females, however, when emerging, drag the pupa-skin out of the larval case, the pupa-skin at first hanging loosely from the free end of the case and afterwards falling down,* so that the female lays her eggs directly in the case; the eggs are laid almost as soon as the ♀ is excluded," and Siebold says that "they possess such a violent impulse to lay their eggs that, when removed from their cases, they let their eggs fall openly." He further states that "all the eggs of these husbandless Solenobias, of whose virgin state he was most positively convinced, gave birth to larvæ." On the other hand Siebold states that the females of *Fumea* put off their egg-laying until copulation takes place, and that when this does not happen they die without laying their eggs. Bacot has obtained undoubted parthenogenetic progeny from the *Solenobia* that Hamm obtains near Wellington College, and Chapman observes that as soon as females from that locality emerge, they begin almost at once to thrust the ovipositor between the pupa-shell and the larval case to oviposit in the latter. He notes that as the process of laying is going on, the body of the female does not shrink in size, but is distended with air so as practically to maintain its original volume. This gives it a greater purchase, and enables it more readily to lay its eggs within the case. When, however, the egg-laying is finished the body speedily collapses. The question here arises whether there be but one parthenogenetic form—rightly called *lichenella*—and whether the so-called parthenogenetic forms of *triquetrella*, *pineti*, &c., are referable to this same species. In connection with this it must be borne in mind that Hofmann asserts that he has had a male *S. triquetrella* pair with one of these parthenogenetic females, and concludes that the parthenogenetic form also is *S. triquetrella*. It is possible, of course, that each species has its own parthenogenetic form, and that the various observers are correct as to their references to the different species.

This, one of the most difficult matters connected with the parthenogenesis of the Solenobiid species, was first raised by Hofmann, who surmised that insects he bred were respectively "parthenogenetic" and "sexuated" forms of the same species—*S. triquetrella* and *S. pineti*. Have any of the species of *Solenobia* two forms—sexuated and parthenogenetic? The evidence offered by Hofmann as to *S. triquetrella* is not conclusive, but is so interesting that we offer the following summary. Hofmann notes that he has found cases (of what he considers to be *S. triquetrella*) over large districts in the neighbourhood of Ratisbon (on fir-trunks and pear trees) and Erlangen (on fir- and oak-trunks), but never in numbers, appearing to be more common on the margins of woods, and usually on old trees, whilst single cases are found on grass culms, low plants (such as *Spartium scoparium*); all the cases are flattened anteriorly, so that the ventral surface lies flat on its resting-place, the cases producing (at the end of March and commencement of April) only female specimens. He observes that after emergence they remain only about a quarter of an hour with raised abdomen, and then begin (by inserting the ovipositor between the pupal skin and larval case) to fill the empty case with eggs, which are mixed with

* This does not happen until the ♀ has finished laying her eggs, and not then without some external interference (at least in *S. lichenella*, &c.).

the wool from the anal tuft, the egg-laying occupying some 6-8 hours, when they generally fall from the case. Larvæ emerged in from 5-6 weeks, but refused to feed on lichens gathered from the rocks, and died. The same observer then recounts how he obtained cases (of *S. triquetrella*) from Ratisbon, put each one in a separate box, but obtained only females, from the eggs laid by which, however, numbers of larvæ hatched. These latter made cases from the maternal cases and sand, fed on nearly dry leaves of various low plants, a fact that led him to surmise that in nature the larvæ probably lived near the ground and only crawled upon lichen-covered tree-trunks and rocks to pupate. During moulting (four moults observed) the cases were spun down firmly, and by the commencement of September the larvæ were full grown, and hid under bark and stones, and remained quiet during the winter, coming from their winter retreats in March, at the end of which month they pupated, emerging again in April—entirely females. One would suspect from this account that these broods (bred *ab ovo*) which produced only parthenogenetic females, belong to the species we have later described as *S. lichenella*. In April, 1858, in the Reichswald, at Erlangen, Hofmann found several cases about 1-2ft. from the ground on pine-trunks, specially well covered with plant *débris*, in a place where *Spartium*, heather and grass were growing in abundance, but the imagines had emerged. However, on April (? March) 15th, 1859, he found 16 cases containing pupæ, and from April 8th-12th, 6 ♂ and 4 ♀ emerged, the latter differing vastly in their habits from those just previously observed, for these remained seated on the cases as if awaiting copulation, and those that were not allowed to copulate laid no eggs, although they remained 14 days seated on their cases before dropping off, whilst one which was allowed to pair began to oviposit a few minutes later. The different behaviour of the parthenogenetic and sexuated females led to the supposition that they must be different species, but a number of females—obtained from pupæ reared from unfertilised eggs and coming partly from Ratisbon and partly from Erlangen—being available, Hofmann placed a freshly emerged male with two parthenogenetic females then laying, but although the male fluttered round them they took no notice and continued to lay; but when he placed the male with a newly emerged parthenogenetic female, that still sat on its case with raised abdomen, there was an immediate copulation. This, as well as the fact that no difference could be detected between freshly emerged sexuated and parthenogenetic females, confirmed Hofmann in the opinion that the females, though differing in their manner of reproduction, were one species (*viz.*, *S. triquetrella*, F. v. R.), with whose description the male entirely agrees. The thick covering of the cases from the Reichswald is considered to be of no importance, because at Ratisbon, and elsewhere at Erlangen, similar cases had been found; the different behaviour of the females agrees with the observations of others on this species—some to the effect that males and females occur in equal numbers, which are reproduced by copulation [Fischer von Röslerstamm at Dresden (*Abbild.*, &c., p. 87), Reutti at Baden, Leukart at Freiburg], whereas others have only observed females which reproduced parthenogenetically (Wocke at Breslau, Speyer at Wildungen in Waldeck, Reutti at Lahr). From this Hofmann concludes that *S. triquetrella* appears under two forms, a sexuated and parthenogenetic form—a supposition which he owns, however, wants confirmation.* He adds that, in the sexual forms, males and females occur in about equal numbers, the latter only laying eggs after copulation, from which male and female imagines are produced ; in the parthenogenetic form females only occur, which, from their structure, are capable of copulation, yet, as a rule, lay fertile eggs without copulation, the eggs producing only female offspring. What the offspring of a parthenogenetic female paired with a sexual male would be—whether entirely males or males and females, and whether such females are parthenogenetic—has not been ascertained. It does not appear that the parthenogenetic females must be paired at certain intervals, but that, every spring, they can be paired, and hence accident plays an important part. The parthenogenetic form of *S. triquetrella* seems to be widely distributed whereas the sexual is local and confined to small areas; at Erlangen both have been observed, but at places widely separated from each other. Time will show whether the observations made on *S. triquetrella* females are peculiar, or occur in all *Solenobia* species (*Berl. Ent. Zeits.*, 1860, pp. 40-46). The evidence here offered is not convincing and we are not prepared to accept as sufficient proof of the parthenogenetic race being *S. triquetrella* the facts that (1) a male *S. triquetrella* paired with a parthenogenetic female, (2) the parthenogenetic females being inseparable from the sexuated females. It appears to be beyond question that the female Solenobiids are almost exactly similar—we have already shown (*Ent. Record*, xi., p. 173) that a number of small differences relied upon to separate what are probably ♀ *S. lichenella* from ♀ *S. inconspicuella* would not hold when living examples were examined, and hence we still feel inclined to suspect that Hofmann was here dealing with two physiologically distinct species—the parthenogenetic *S. lichenella* and the sexuated *S. triquetrella*. It would, indeed, be remarkable if *S. lichenella* were a parthenogenetic form of *S. pineti* (as generally considered on the Continent) and the sexuated *S. triquetrella* also had a parthenogenetic form. Really we know nothing yet of the subject and every student must take the facts as he finds them. Besides the evidence offered by Hofmann as to the possible existence of two female forms of *S. triquetrella*, he suggests that there are two forms of *S. pineti*, but the actual evidence offered (*Berl. Ent. Zeits.*, 1860, pp. 48-50) is no more satisfactory than the suggestion made by Zeller (*Linn. Ent.*, vii., p. 354). He states that for six years he found, in April, on the lichen-covered trunk of an old isolated pear tree, in the neighbourhood of Ratisbon, cases that were very like those of *S. pineti*, rather smaller, brighter coloured, and with rather more prominent angles; whilst the contained larvæ appeared to be exactly similar to those of *S. pineti*. From these only females were reared, and these laid eggs, the larvæ hatching after five or six weeks. The young larvæ were reared on lichen-covered pieces of bark from pear and oak trees, and from these only parthenogenetic females were reared. These females were scarcely distinguishable from those of *S. pineti*, but, under the microscope, the

* With regard to the absolute necessity for confirmation, we may call attention to the fact that many good observers have considered the parthenogenetic *Luffia ferschaultella* (*pomonae*) to be a female form of *N. monilifera* (*vide*, *E.M.M.*, vi., pp. 91-93; xi., p. 208), whilst others again have considered *S. lichenella* and *N. monilifera* to be interchangeable.

antennæ were found to be shorter than those of the latter, thinner, and with longer segments (15), the last segment exhibiting a lateral constriction, suggesting that it might be formed of two segments, whilst at the extremity is a very small blunt-pointed knob, although this difference could not be considered sufficiently constant to separate it as a distinct species. Hofmann considered that probably the parthenogenetic females of several species of *Solenobia* were lumped together under the name *lichenella*, and he surmised that the parthenogenetic insect obtained at Ratisbon might be a form of *S. pineti*. He adds that Reutti sent him cases (as *lichenella*) from fences and stone posts, very like those of *pineti*, but with more prominent and projecting angles. Zeller's statement (*Linn. Ent.*, vii., p. 351) and the resemblance of some of the Ratisbon cases of *lichenella* to those of *S. pineti*, led Hofmann to suggest that they might be the same species, but further evidence is distinctly wanted. The same author notes a case like that of *S. pineti* the larva found feeding on an *Agaricus*, growing on an old willow tree, at Ratisbon, which produced a parthenogenetic female on April 25th, 1859, exactly like those reared from the pear tree mentioned above. Hartmann observes [*Kleinschmett. Münchens*, p. 10 (1871)] that the cases of *S. triquetrella* are found on the northern wall of the park and other walls and fences round Munich. Those from walls are notably rougher than those from wooden fences, the former having more sand and particles of stone, the latter fine particles of wood and lichen, covering them. All the cases produce wingless females, and a male is unknown from the district. He noticed young larvæ in a breeding cage that had contained cases that had produced only females, and fed them on lichens, dead flies, &c., moistened occasionally. He hibernated the larvæ successfully, and bred the following April only females. He carried on the same race through five years, 1863-1867, when this particular strain died out. Then he started another . . . . In order to further test the question he obtained, in 1868, from E. Hofmann, at Nuremberg, *triquetrella* larvæ, from a place where, strangely, only males and no females had emerged from collected larvæ. From these cases seven males emerged, and, as Hartmann was breeding parthenogenetic females at the time, he paired a male with one in an empty glass. The male died next morning, the female laid her eggs in the case, and died the second day. After fourteen days the young larvæ appeared, made themselves cases, and the following February (1869) 25 examples pupated. On the morning of March 19th, the first imago, a ♀, appeared. On March 20th this had left its case for some distance without laying any eggs, probably in expectation of a male; several other females appeared during the succeeding days, but no male appeared. From fresh cases sent by Hofmann only males again emerged, which he attempted to pair with fresh parthenogenetic females, but failed. In March, 1869, Siebold also sent him cases of *S. triquetrella* which he had received from Wocke at Breslau. From these cases only ♀s appeared, and although they were kept for breeding no results were obtained. Hartmann further (*loc. cit.*, p. 12) states that he had inbred parthenogenetic *lichenella* from the same stock for eight years, and that males of *S. inconspicuella*, bred from Breslau cases, would not pair with these *lichenella*.

Referring to the imagines of the Solenobiid species we find that the males are characterised by a peculiar speckling—pale grey or whitish—on a dark ground. Hofmann states that "the bend of the costal margin, the size and shape of the wing, as well as the size and number of the spots forming the speckling, undergo numerous, though small, modifications. With age, examples tend to become yellowish. The antennæ and tarsi are sometimes distinctly ringed, at others not ringed at all. The neuration varies to a great extent in the same species, sometimes even the neuration of the two hind-wings of the same specimen is quite different." With regard to the females, Hofmann observes that "those of the different species are very similar, and only show slight variations of size, colour, and the genital organs. The antennæ and legs offer considerable irregularity in the number and form of the segments, and one notices occasionally that a segment is divided into two in one specimen, whilst there is no trace of the constriction in another." He considers, however, that certain characters of the antennæ and legs, only to be made out by the aid of the microscope, are of value in their discrimination. The habits of the apterous females are very similar. They are provided with well-developed legs, emerge from the case, and after copulation (and without re-entering the puparium) lay their eggs in the larval case (by means of the long, jointed, telescopic ovipositor), and cover them with the silky wool from the anal tuft. The pupæ of both sexes emerge from the cocoon for a considerable distance before the emergence of the imago. In common with that of the Taleporiids, the pupa has an anterior patch of dorsal spines on abdominal segments 3-8, the tubercles placed as in the larva, long recurved hairs (replacing the ordinary setæ) on abdominal segments 8-10, and two small dorso-anal spikes. Although the females have very aborted wings, their pupæ have the wing-cases well-marked. The larvæ are all very similar, the tubercles generalised, except that ii tends to shift slightly behind i; the prolegs short, and the third pair of true legs strong, as is the case in all Psychids. The most constant characters, Hofmann asserts, are to be "found in the form and size of the cases—the colours and material used, of course, vary with the locality, whilst the form and size are variable only in agreement with the differences in the manner of life and their environment"—and are, therefore, we presume, considered to be specific.

The female *Solenobia* is very similar in general appearance to those of *Taleporia* and *Fumea*. The head and prothorax are retractile, and all three thoracic segments have shiny dorsal corneous plates. The feet are distinctly segmented, and the terminal joints of the tarsi bear hooked claws. The eyes are large, round, black, and distinctly faceted (but there are no ocelli). The antennæ are threadlike, formed of cylindrical segments bearing single hairs, and the segments increase in size so as to form a slight swelling just before the apex.

This appears to be a purely Palæarctic genus, almost entirely confined to Europe, and consisting of about eleven closely allied species—*clathrella*, *pallida*, *mannii*, *cembrella* (*pineti*), *triquetrella*, *fumosella*, *suifunella*, *wockii*, *inconspicuella*, *nickerlii*, and *lichenella*. So little known are they that it is quite possible that most of the species may occur in Britain. We have, therefore, given brief summarised descriptions of all the species. The perfect insects emerge in the spring, the males appearing on the wing from March to May, specimens very rarely extending their time of emergence beyond the latter month.

SOLENOBIA INCONSPICUELLA, Stainton.

SYNONYMY.—Species: *Inconspicuella*, Sta., "Cat.," p. 6 (1843); "Zool.," 1849, p. lxi; 1850, p. 2788; "Ent. Comp.," 1st ed , pp. 10, 26, 27, 28 (1852), 2nd ed., pp. 8, 24, 69, 70, 114, 141 (1854); "Ins. Brit.," p. 19, pl. i., figs. *5a-c* (1854); "List Br. An. B. M.," xvi., Lp. 5 (1854); "Man.," ii., p. 286 (1859); Zell., "Linn. Ent.," vii., p. 354 (1852); Bruand, "Mon. des Psych.," p. 107, pl. ii., figs. *80a-b* (1853); "Ann. Soc. Ent. Fr.," 3rd ser., vi., p. 608 (1858); H.-Sch , "Sys. Bearb.," v., p. 89 (1854); Edl., "Ent. W. Int.," v., 146-7 (1859); "Zool.," xvii., 6462-3 (1859); Hofm., "Berl. Ent. Zeits.," iv., p. 50, pl. ii., fig. 9 (1860); Spey., "Nat. Ver. Preuss. Rhein.," xxiv., p. 266 (1867); Hein., "Schmett. Deutsch. Tin.," p. 25 (1870); Staud. and Wocke, "Cat.," p. 267 (1871); Boyd, "Proc. Ent. Soc. Lond.," 1874, p. xi; ? Frey, "Lep. der Schweiz," p. 335 (1880); Snell., "De Vlind.," pp. 445-6 (1882); Pey., "Cat. Lép. Als.," p. 84 (1882); Meyr., "Handbook," p. 775 (1895); Barr., "Ent. Mo. Mag.," xxxi., p. 164 (1895); xxxiii., pp. 125-6 (1897); Bankes, Ibid., xxxi., p. 220 (1895); Chapmn., Ibid., xxxii., p. 79 (1896); Walsm., Ibid., xxxiii., p. 129 (1897); Reutti, "Lep. Bad.," 2nd ed., p. 306 (1898). *Cembrella*, Dgl., "Pr. Ent. Soc. Lond.," v., p. xii (1847). *? Triquetrella*, Brd., "Mon. des Psych.," pp. 106-7 (1853) *teste* Sta., "Ent. W. Int.," v., p. 147 (1859); "Zool.," xvii., p. 6463 (1859). *Triquetrella*, Edl., "Ent. W. Int.," v., pp. 146-7 (1859); "Zool.," xvii., pp. 6462-3 (1859) *teste* Walsm., "Ent. Mo. Mag.," xxxiii., p. 129 (1897).

ORIGINAL DESCRIPTION.—*Talaeporia inconspicuella*, n. sp. Exp. 5 lines (the Continental *lichenella** expands 8 lines). Anterior wings pale grey, with darker reticulations and nervures; head black; ♀ black. Case 3 lines long, conical (the case of *lichenella** is above $3\frac{3}{4}$ lines long). This is the *cembrella* of many of our cabinets (Stainton, *Sys. Cat. Brit. Tin.*, p. 6).

IMAGO.—Anterior wings 8mm.-12·5mm. in expanse; dark grey in colour, freely sprinkled with paler spots, irregular in size and position, but chiefly between the nervures; cilia pale grey, faintly streaked with darker. Posterior wings and cilia unicolorous pale grey.

SEXUAL DIMORPHISM.—As in all the members of this genus the male is fully winged, the female with minute cellular wing-expansions only, *i.e.*, almost apterous. Hofmann notes that "the ♀ with extended ovipositor is nearly two lines long, dirty yellow in colour, sometimes reddish-yellow with dark brown head and large prominent black eyes; the antennæ are black-brown (hardly differing from those of *S. triquetrella*), 16-jointed, with a short, pear-shaped, terminal joint; legs black, with 4-jointed, yellow-brown tarsi; the three thoracic segments bear shiny dark brown plates, the dorsal spots and the double spots on the underside of each abdominal segment are brown; the spiracles appear as red-brown spots; the sides of the abdomen are covered with fairly thick brown-grey hair; the ovipositor is shiny black; the abdominal tuft white, mixed with grey." Reutti notes the females from Lahr as "pale yellow, with darker grey dorsal spots and a white anal tuft."

VARIATION.—Our British examples are exceedingly variable, even from the same locality, if a long series be examined. In our own series, principally from Surrey (Coverdale's coll.) and Brentwood (Burrows), some have the costa of the forewings slightly convex towards the apex, whilst others are quite straight. One observes, further, that some examples have a strongly-marked patch of dark scales at the end of the discoidal cell, whilst others have not the faintest trace of it. In all, the colour is rather dark grey, but whilst some are coarsely

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* This *lichenella* of Stainton refers to the *clathrella* (or *triquetrella*) of our present lists.

speckled with fairly large pale grey patches (especially about the discoidal lunule), in others these are reduced to fine dots, whilst in others, again, the wings are unicolorous, and there is scarcely a trace of them. In the "Frey" collection, the *inconspicuella* from Ratisbon are almost unicolorous dark grey, with the pale specklings minute and round (rarely blotched as in the greater number of British examples), with the discoidal lunule faint, and the hindwings unicolorous, yet, in their generally larger size and the tendency for the forewings to be elongated, they appear to be identical with the specimens captured by Bradley and Martineau in Wyre Forest, the latter, however, having fairly abundant pale grey speckling, as in the more mottled of our British examples. The *S. wockii* in the "Frey" and "Stainton" collections closely resemble typical *S. inconspicuella*, but the forewings appear to be a shade wider and the colour slightly more ochreous. Hofmann says that *S. inconspicuella* shows "a great deal of variation in wing-neuration. Generally nervures 4 and 5 spring separately from the discoidal cell, the inner and outer portions of which are of equal length. This is the case in eleven specimens from the neighbourhood of Ratisbon, whereas in two others from the same locality these nervures spring from the same point, and the inner portion of the discoidal cell is somewhat longer than the outer." Hofmann further notes that Stainton informed him that the Ratisbon examples agreed in every particular with those obtained from near London. Boyd exhibited, at the meeting of the Entomological Society of London, May 4th, 1874, a specimen of *S. inconspicuella* taken in St. Leonard's Forest, with others of the typical form, of a remarkably pale colour, which was considered to be an albino aberration, but had a very different appearance from the ordinary form. Barrett notes that Edleston's specimens from the Brushes (Manchester), differ considerably *inter se*, and states that there are two or three specimens in the series in which the purplish-grey colouring of the nervures and reticulations is so spread over the forewings that the pale spaces are obscured, and in one of them quite lost.

a. ? var. *triquetrella*, Edl., "Ent. Weekly Int.," v., p. 146 (1859).—Herewith I send seven males of my *triquetrella* (partly bred) and three females and cases. I think if you will refer to Bruand's work you will satisfy yourself that these are really identical with the species he describes as *triquetrella* . . . . The cases are found on large millstone-grit stones on the moors (occasionally on stone walls). In order to get them it is necessary to turn over these stones, as they prefer the sides nearest the ground. These insects appear in the perfect state from the 1st to the 20th of May, and are very active on the wing, and what is very singular in this genus, one rarely gets a female. The female chrysalis is seen projecting from the case—the insect is missing. What females I possess are chiefly bred. The anal aperture in the female is considerably less woolly than in *inconspicuella* . . . . If my insect is not the true *triquetrella*, depend upon it, it is a new species.

In the above note Edleston introduced a species that he considered to be the *triquetrella* of Bruand. In an "editorial" to this note, Stainton states that he had come to the conclusion that *triquetrella*, Bruand = *inconspicuella*, Sta., and adds that he cannot distinguish Edleston's *triquetrella* (from the moors) from the same lepidopterist's *inconspicuella* (from beech woods), individual specimens of the former differing more from one another than from *inconspicuella*. Stainton again refers (*Man.*, ii., p. 286) to this form in the following words: "Mr. Edleston believes we have a third species occurring near Manchester, the larvæ under stones on the moors." Barrett refers (*Ent. Mo. Mag.*, xxxi., p. 163) one of Edleston's so-called *triquetrella* in the "Stainton" collection to *S. wockii* (*i.e.*, *wockii*, Barr. *nec* Hein.). Sidebotham, who has Edleston's collection, considers (*Ibid.*, xxxiii., pp. 125-6) all the forms actually collected by Edleston to be identical and to represent *S. inconspicuella*, whilst Barrett goes on to say that they are even identical in the character of the anal tuft, Edleston having previously noted them as differing in this particular. Walsingham (*Ibid.*, p. 129) considers the *triquetrella* and *inconspicuella* of Edleston to be identical and not to be separated from true *inconspicuella*. Barrett notes (*Ibid.*, p. 128) two examples in the "Doubleday" collection under the name of *triquetrella*, larger than ordinary *inconspicuella*. These Durrant considers (*Ibid.*, p. 220) to be either a strongly-marked form of *S. wockii*, or more probably to represent a species intermediate between *S. wockii* and *S. inconspicuella*, having the facies of the latter and the coloration of the former, but with a more distinct pattern.

β. ? var. *wockii*, Barr. (*nec* Hein.), "Ent. Mo. Mag.," xxxi., pp. 163-4 (1895).—When at Birmingham I noticed in the collection of Mr. R. C. Bradley a specimen of the male of a species of *Solenobia* unknown to me . . . . Of other specimens captured April 15th-17th, 1895, three were forwarded to me . . . . and quite recently I found, in the collection of the late Professor Frey, of Zurich, specimens agreeing most accurately with them under the name of *wockii*, Hein., and labelled "Silesia," hence probably from Dr. Wocke . . . . As may be expected, the yellowish colouring (of *S. wockii*) is exceedingly indistinct in the British specimens, and the dark flecks and latticing more pronounced, but the proportionately large whitish spots, or interstices, agree well, and I think that there is no doubt of the correctness of this identification. That Mr. Bradley's specimens agree with Frey's types is beyond question. In Mr. Stainton's collection I find a single specimen of the same species among his specimens of *inconspicuella*, and from its being labelled "Edleston," I have little doubt that the present species is that which was alluded to by Mr. Edleston in the *Intelligencer*, vol. v., p. 146, as either *triquetrella* or a new species (Barrett).

Mr. Bradley has allowed us to examine two of the examples of the *Solenobia* that Barrett has referred to *S. wockii*. These specimens are respectively 12·5mm. and 13mm. in the expanse of the forewings, which are decidedly narrow compared with their length, and, as Barrett points out, are grey, and with no tinge of ochreous in the colour. They appear to be identical with the series of Ratisbon *S. inconspicuella* in the "Stainton" and "Frey" collections, the specimens of which average 12·5mm.-13mm., and show the same peculiar narrowness of the forewings. The smaller of Mr. Bradley's examples appears also to be identical with an individual in our possession taken amongst a large number of ♂ *S. inconspicuella*, at Brentwood, by the Revs. C. Burrows and G. Raynor, and which varied considerably *inter se*. Compared with *S. wockii* from Silesia (of which there appear to be but two in the "Stainton" and two in the "Frey" collection) Mr. Bradley's examples are greyer in tone, without the decided ochreous tinge, and are proportionally narrower-winged than *S. wockii*. The examples of *S. wockii* in the "Stainton" collection are about 13mm. and 11·5mm. in expanse respectively, those in the "Frey" collection 12mm. and 12·25mm. The only feature in which Bradley's examples approach *S. wockii* is in the rather large pale specklings which, however, are just as abundant in some *S. inconspicuella*, although others are almost without them. Some Continental lepidopterists consider *S. wockii* to be a form of *S. inconspicuella*; we are not prepared to say that this is so, but there can be no doubt that the grey *Solenobia* from Wyre Forest is not the ochreous *S. wockii*. Having submitted the Wyre specimens to Lord Walsingham and Mr. Durrant, they write: "We have true *S. wockii* sent by

Wocke to Zeller. The species that Barrett recorded as *wockii* is not that species. It differs in its greyer colouring (in *S. wockii* it is yellowish), in its proportionately narrower wings, and less marked reticulation, but, in the latter respect, both *S. wockii* and *S. inconspicuella* appear to vary. It is somewhat greater in expanse than the largest British *S. inconspicuella*, wherein it appears to agree with the Ratisbon series. There is no proof that *inconspicuella* (true) has ever been taken abroad, or that *wockii* (true) has ever been taken in England. Continental authors having been inclined to unite their supposed *inconspicuella* with their *wockii*, rather tends to prove that their *inconspicuella* is not our *inconspicuella*, than that *inconspicuella*, Sta. = *wockii*, Hein. It is rather significant that the only ♂ specimens of *inconspicuella* in the 'Zeller' collection were received from Stainton and Douglas, and that the only continental specimen that he referred to *inconspicuella* (with a ?) [*vide*, *Stett. Ent. Ztg.*, xxxix., p. 117 (1878)] is now placed in his series of *wockii* to which it seems certainly to belong. Wocke's specimens of *wockii* (true) were originally labelled '*inconspicuella*.'" It may be that the two examples in the "Doubleday" collection, referred to by Durrant (*Ent. Mo. Mag.*, xxxiii., p. 220), are the form regarded by Barrett as *wockii*.

Comparison of S. inconspicuella with its allies.—*S. inconspicuella* only differs from *S. triquetrella** in having the upper wings a little narrower, and the discoidal lunule more distinctly marked in dark grey. The neuration also offers some slight differences. I consider it a distinct species. The ♀ only differs from that of *S. triquetrella* by its darker tint (Bruand). *S. inconspicuella* is smaller than *S. pineti* and has more blunted forewings, it also has much larger pale grey spots on them than have *S. clathrella*, *S. mannii* and *S. triquetrella*; the ground colour, too, is darkened at the end of the nervures that run to the outer margin, forming a row of spots. The body is somewhat darker than that of *S. pineti*, the hairs somewhat darker grey, and on the abdomen sparser . . . . The forewings of the males of *S. inconspicuella* are posteriorly somewhat widened, broader than in *S. pineti* towards the rounded and shorter apex, and broader than in *S. triquetrella* at the inner angle; they are as dark grey as in *S. pineti* but with many large whitish-grey spots, which are not sharply defined, and are more confluent than in the other species (Zeller). It is just possible that some of the so-called distinct Continental species are not specifically distinct from *S. inconspicuella*, their time of appearance and general habits being almost identical. We have already noticed the similarity between this species and *S. wockii*. Hofmann notes that the Breslau specimens of *S. wockii* are probably referable to *S. inconspicuella*. Of the six males of *wockii* he had, he says that three had the bases of nervures 4 and 5 apart, and the inner portion of the discoidal cell a little longer than the outer, whilst in the three others, the bases of 4 and 5 are joined and the inner portion of the cell much longer. They only differ, he says, from *S. inconspicuella*, in being somewhat larger and the inner portion of the middle cell being always somewhat longer than the outer. Chapman says that the *S. wockii* in Constant's collection have come from Switzerland, Silesia and Austria, but that he cannot

* Stainton refers (*Ent. Week. Intell.*, v., p. 147) Bruand's *S. triquetrella* to *S. inconspicuella*, Sta.

see any difference between them and the *S. inconspicuella* which are from Germany and England, the German ones being very like ours and having a small case with a suspicion of triangulation in some specimens.

Egg-laying.—The eggs are laid inside the larval case, not inside the pupal case (which is much dragged out from the former), the ovipositor being inserted near the anal end of the drawn-out pupal case for the purpose.

Case.—Two cases (collected by Coverdale) are 5mm. in length and 1·4mm. in width at the widest part. The case is somewhat flattened at the base, with moderately well developed lateral edges, leading up to a fairly developed longitudinal ridge along the upper edge. It is composed of whitish silk somewhat smooth inside, but outside so closely woven with very fine particles of sand and earth that the silk is covered and the case has a blackish-grey appearance, obtained from the extraneous particles thus used ; under a lens the surface is rough, although to the naked eye it appears to be smooth compared with that of *S. lichenella*, in which the particles used are much larger. The apex is moderately pointed, but the end from which the larval head is protruded is somewhat constricted just before the end. Another case from which a ♀ pupa-case is projecting came from Brentwood. It is about 5·5mm. in length, and 1·5mm. in width, it is otherwise exactly similar to the above, covered with fine particles of sand and earth, and with no trace of lichen (so common in some of the cases of allied species, and probably sometimes in this). The protruding pupa-skin is held in position by more or less defined ventral and dorsal flaps. Stainton describes the case as "soft, brownish, three-sided, the ventral side flat, the mouth downwards ; from Prestwich, on beech, Feb. 12th, 1859" (*in litt.*, *teste* Durrant) ; whilst others are described as "green, soft, three-sided, mouth cut off at an angle ; from Dunham Park, on beech, Edleston, Jan. 20th, 1859," this case referring to "the two-year species *vide*, Edl., *Ent. W. Int.*, v., p. 147" (*in litt.*, *teste* Durrant). Hofmann notes that the male and female cases (from Ratisbon) are each about three lines in length, narrower than the case of *S. pineti* and more slender anteriorly ; the three angles (especially the dorsal) sharply defined, the covering composed chiefly of minute particles of sand and earth.

Comparison of the cases of S. inconspicuella with those of its allies.—Compared with the cases of *S. lichenella* (from Wellington College) those of *S. inconspicuella* (Surrey and Brentwood) appear to be distinctly less in size, less keeled along the dorsal margin, rather more pointed apically, and to be covered with rather finer material. Compared with cases (from Hanover) sent as those of *S. triquetrella* one finds the latter still larger (8mm. long, 2mm. wide) and covered with much coarser material, the flaps holding the protruding pupa being also very large and well developed. Bruand says that the case of *S. inconspicuella* is near that of *S. triquetrella**, but the colour is blacker, probably, in this respect, resembling the tint of the rocks and the lichens on which they live in England. Zeller says that the female case of *S. inconspicuella* is 3‴ long, more slender than that of

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* Stainton considers (*Ent. Week. Intell.*, v., p. 147) *S. triquetrella*, Bruand, to be identical with *S. inconspicuella*, Sta.

S. pineti, otherwise very similar to it. Towards the anterior end it is thinner, with a distinct dorsal keel, and with somewhat distinct lateral keels only noticeable posteriorly.

LARVA.—Stainton describes the larva as "yellowish-grey; head blackish; 2nd segment black; 3rd and 4th segments each with two black spots above" (*Manual*, ii., p. 286). Durrant sends us from Stainton's MS. (F. 607) what is evidently an extended description of this larva. It reads: "Yellowish-grey, more yellowish posteriorly; head black; 2nd segment black; 3rd segment blackish with central pale line; 4th segment with a black spot on the upper part and side; 3rd and 4th segments with a blackish spot above the legs, other spots pale greyish, nearly the colour of the body; anal segment blackish above, a black spot on the side of the anal prolegs; legs blackish. Long. 5·5mm. Dunham Park, on beech, from Edleston, January 20th, 1859" [*vide* Edl., *Ent. W. Int.*, v., p. 147 (1859); *Zool.*, xvii., 6463 (1859); *Ent. W. Int.*, vi., p. 28 (1859); Sta., *Ent. Ann.*, 1860, p. 150. This is the larva of the insect referred to as "the two-year species," from which only ♀ specimens were bred; Stainton's fig. B. 10 is so like the fig. B. 12 that it had better be referred to *S. inconspicuella*, provisionally (Durrant)]. Durrant also sends us a second description from Stainton's MS. (F. 604), which refers to the form from which both sexes were bred by Edleston: "Greyish-white; head dark brown (not black); 2nd segment blackish (not black); 3rd segment dark grey above with a central pale line; 4th segment with a grey spot on the upper part of the side; 3rd and 4th segments each with a blackish spot above the legs; other spots very pale; anal segment with a pale brown spot above; legs blackish. Long. 6mm. Prestwich, on beech, from Edleston, February 12th, 1859" [*vide*, Edl., *Ent. W. Int.*, v., pp. 146-7 (1859); Sta., *Ibid.*, p. 147; Edl., *Zool.*, xvii., 6462-3 (1859); Sta., *Ent. Ann.*, 1860, p. 153]. Hofmann describes the larva as "yellow, with brown warts, and black head and legs; the first two segments with dark brown dorsal plates, divided medially by a narrow line, the metathorax with two small corneous spots; the anal segment brown."

PUPA.—♀ pupa (from Brentwood) already dehisced, protrudes from the case to the end of the 7th abdominal segment. Pale brown in colour, shiny, the dorsum not markedly darker than the venter. Somewhat rounded frontally, largest at the 2nd abdominal segment, somewhat convex dorsally, the anal segment blunt. The prothorax narrow, frontal; the mesothorax well developed, with slight median ridge from front to back; the metathorax fairly well developed, about the same width as the 1st abdominal, the 2nd, 3rd and 4th abdominals of almost equal bulk, from the 5th to anal segment gradually decreasing in size. The forewings moderately developed, extending to end of 2nd abdominal, the hind margin of hindwings also visible; the antennæ short but prominent; dorsum of the abdominal segments almost covered with minute black points; a broad transverse dorsal band of well-developed black spines on abdominal segments 2-7, anterior to tubercle i, and standing on a raised band of the segment; tubercles (each with a long white seta) evidently as in larva, i and ii trapezoidal, iii supraspiracular, iv and v (close together and in the same longitudinal line) subspiracular; abdominal segments 3-6 movable, 7-10 in one mass; the setæ on latter modified into long recurved hairs; two minute dorso-anal spikes on the anal segment; the spiracles small and round, but prominent.

Food-plants.—Generally reputed to feed on lichens on fences and trees; (?) *Synechoblastus fluccidus* (Schmid); larvæ would not eat rock lichens, but fed on dried lettuce leaves, possibly their natural food consists of low plants (Hofmann); dead flies, &c. (Healy).

Habits and Habitat.—The male flies by day, usually most freely in the morning sunshine, the female clings to the case in which she lays her eggs, and after pairing thrusts her ovipositor between the empty pupa-skin and the edge of the case. Stainton notes the cases as being found on palings and trunks of trees. Hudd says that the cases are to be found freely on old walls, palings, &c., near Bristol, and that they should be collected in the winter and spring, and may easily be reared. Burrows notes the species in large numbers upon an open fence by the side of Lord Petre's park at Thornton, about a mile south of Brentwood. Here the male imagines were observed at the end of April and in early May, at noon, drying their wings, generally near the bottom of the pales. (Do the male larvæ spin their cases low down whilst those of the females pupate higher up on the fences and trees?) Near Lyndhurst the species occurs in open country dotted with pinetrees (Smith). [In Aberdeenshire cases (which may be those of *S. inconspicuella*) are generally distributed on old lichen- and moss-covered stone walls (Reid)]. Edleston found cases on tree-boles in Prestwich Wood and others at the Brushes, near Manchester, on large millstone-grit stones and occasionally on stone walls on the moors, and to find the cases he had to turn over the large stones on the moors, the larvæ hiding beneath. The imagines from the first-named locality emerged early in April, those from the latter between May 1st-20th. Both are referred by Walsingham to *S. inconspicuella*, and we would suggest that the difference in the habitat of the two colonies might make some difference in the time of appearance. [Healy collected cases in Highgate Wood on November 1st, 1863, and gave the larvæ flies, &c., for food, and observed that the larvæ ate the abdomina of the flies and were more or less carnivorous.] Speyer says that many fullgrown larvæ and pupæ were found at Rhoden in shady places on the sandstone rocks and in the woods on the trunks of old oaks, partly under the loose bark, in the first half of April, 1850, the females laid eggs from which larvæ emerged at the end of May. Breyer finds cases on beech-trunks in the forest of Soignes in the autumn, the larvæ pupating in spring and the imagines appearing in about three weeks. Schmid says that he finds cases on the chalk rocks of the Danube mountains around Ratisbon, in southerly, sheltered positions, sometimes spun-up in the corners of stones, at other times still active on *Synechoblastus fluccidus* (?), which appears to be the principal food of the larva. He also observed cases at Kelheim. Hofmann also observes that the insect occurs on the chalk cliffs along the banks of the river Danube near Ratisbon, where the cases may be obtained at the end of March, spun-up on the face of the cliffs about two feet from the ground. He adds that as larvæ are rarely obtained in this position, and as he failed to breed those that he did capture on the rock-lichens, although they fed-up on dried lettuce leaves, he suspects that they feed on low plants and only resort to the cliffs for the purpose of pupation. From the pupæ obtained he bred males and females in about equal numbers.

The females, he says, rest with uplifted ovipositor on the case, and immediately after copulation, commence to fill the larval case with eggs. Copulation only lasts a few minutes, and during this time the male closes his wings roof-shaped; unfertilised females will sit for several days on their cases and dry up without laying eggs. This statement as to the *S. inconspicuella* with winged males, suggests that there is a marked physiological difference between the female of this and that of the parthenogenetic *S. lichenella*, for the latter will almost directly on emergence insert its ovipositor in the larval case, and lay its eggs as rapidly as possible.

Time of appearance.—The imago appears from late March to early May. March 10th, 1851, bred from cases found on Penge fence on February 23rd; March 28th-30th, 1852, bred, cases from Penge; May 20th, 1857, imagines, on Beckenham fence (Stainton); specimens in Stainton's collection, labelled *douglasii*, referable to *inconspicuella*, were captured (or bred) March 8th, 1858, from cases on gritstone, taken in Lancashire by Gregson; April 5th-8th, 1859, near Manchester, May 1st-20th, at the Brushes, April 1st-12th, 1859, imagines from pupæ kept out of doors, from Bowdon (Edleston); cases and pupæ, April, 1857, at Bristol (Vaughan); females bred May, 1873, from larvæ collected October, 1872, at Worcester, further supply of larvæ obtained June, 1873 (Edmunds); April 26th-May 7th, 1886, most abundant on May 3rd, bred May 6th, 1886, from captured cases, imagines May 7th, 1887, April 17th-May 7th, 1888 (and probably later), at Brentwood (Burrows); May 11th, 1888, on fence at Bexley, April 10th, 1894, beaten from juniper at Box Hill (Bower); March 31st, 1894, ♂, flying at 6 p.m., at Tarrington (Wood); first week in April, 1896, ♂, flying in morning sun, at Hereford (Tutt); April 3rd, 1899, males beaten from trees at Lyndhurst (Smith); a few cases on trees in February near Doncaster (Corbett). [Reutti says "in May and June in Baden," the "June" reference is suspicious.] The imagines emerge at the end of March (♂s and ♀s in equal numbers) near Ratisbon (Hofmann).

Localities.—? Aberdeen: Generally distributed (Reid). ? Banff: (Reid). Berks: Sulham (Hamm). Cambridge: Cambridge (Farren), Madingley (*teste* Warren). Cheshire: Birkenhead (Stainton), Jackson's Wood, Claughton (Gregson), Wirral (Brockholes), Bowdon, ? Rudheath (Edleston). ? Edinburgh: Pentland Hills (Evans *nec* Logan). Essex: Brentwood (Burrows). Gloucester: Bristol (Vaughan), Redland (Hudd). Hants: New Forest (Bankes), Lyndhurst (Smith). Hereford: Tarrington (Wood), Hereford (Tutt). Kent: Sydenham, Penge, Beckenham (Stainton), Pembury (Weir), Bexley (Bower), near Plumstead (Butterfield). ? Kincardine: (Reid). Lancashire: local (Ellis), The Brushes, near Manchester, Prestwich Wood (Edleston), Preston (Hodgkinson), Prestwich and Pendlebury (Chappell). Middlesex: Highgate Wood (Healy). Northumberland: Newcastle-on-Tyne (Stainton). Oxon: Hardwick (Hamm). ? Perthshire: (Reid). Shropshire: Wyre Forest, on borders of this county and Worcestershire (Bradley). Stafford: Rugeley (Freer). ? Suffolk: Brandon (Barrett). Surrey: Box Hill (Bower), Kennington (Stainton). Sussex: St. Leonard's Forest (Boyd), Eastbourne (Fletcher). Worcester: Worcester (Fletcher). Yorks: York (Stainton), ? Huddersfield (Hobkirk), Doncaster (Corbett). [Those marked with a ? may refer to *lichenella*, cases and females only being known.]

Distribution*.—Austria: Kaiser in the Tyrol (Hofmann), Lavantthal (Höfner). Belgium: Brussels (Fré), Forest of Soignes (Breyer), near Brussels

* Durrant and Walsingham write: "We doubt all Continental localities. There are no European specimens of *S. inconspicuella* in the 'Zeller' collection, and we have never taken it."

(Lambillion). GERMANY: Röfswihl near Waldshut, Höllenthal, near Lahr, Herrenwies-Ochsenkopf, Badener Höhe, Bernstein, near Ettlingen (Reutti), Alsace, in chalky districts between Colmar and the Vosges, Vignes-de-la-Hardt, Florimont (Peyerimhoff), Würtemberg, Breslau, Richtenstein (Hofmann), Ratisbon, Kelheim (Schmid), Waldeck, Rhoden (Speyer), Silesia (Assmann). SWITZERLAND: [? Grisons, Weissenstein (Killias *teste* Zeller, *vide wockii*)], the Valais (Frey).

SOLENOBIA LICHENELLA, Linné (sp. parthenogenetica).

SYNONYMY.*—Species: *Lichenella*, Linn., "Faun. Suec.," no. 1451, p. 370 (1761); "Sys. Nat.," xiith ed., no. 452, p. 899 (1767); De Geer, "Mém. Hist. Ins.," ii., pp. 380-6, pl. xi., figs. 1-8 (1771); "Abh. Ges. Ins.," ii., pp. 276-80, 441, pl. xi., 1-8 (1778); Müll., "Ed. Linn. Sys. Nat.," i. (5), no. 452, p. 756 (1774-5); Fab., "Sp. Ins.," ii., no. 94, p. 306 (1781); "Mant. Ins.," ii., no. 140, p. 253 (1787); "Ent. Sys.," iii. (2), no. 182, p. 329 (1794); Göze, "Ent. Btr.," iii. (4), no. 452, p. 124 (1783); Gmel., "L. Sys. Nat.," xiiith ed., i. (5), 2606, no. 452 (1788); Vill., "Linn. Ent.," ii., no. 943, p. 494 (1789); Jung, "Alph. Verz. Schm.," p. 316 (1791); [Brgstr.,] "Epit. Ent. Fab.," p. 171 (1797); Turton, "Sys. Nat.," iii., p. 378 (1802); [? Vallot, "Conc. Syst. Réaum.," p. 89 (with reference to Réaum., xv., figs. 7-8 = Geoff., no. 54) (1802)]; Zell., "Isis," 1838, 718; [(?) 1839, 182, no. 4]; 1839, no. 97, pp. 302-3, in part. (*nec* ♂ = *pineti*; *nec* p. 182 = *pineti teste* Zell.†); "Linn. Ent.," vii., pp. 353-5 (1852); Speyer, "Stett. Ent. Zeit.," viii., 18-21 (1847); Siebold, "Arbeit. Schles. Gesell. Vat. Kult.," (16-20) 84-88 (1850); "Stett. Ent. Zeit.," xii., 343-4, in part (1851); "Beit. Parth.," p. 145 (1871); Hdrch., "Lep. Eur. Cat. Meth.," p. 78, no. 17 (1851); Ghil., "Fn. It.," p. 78 (1852); Wocke, "J.-B. Schles. Ges. Vat. Cult.," p. 182 (1853); H.-Sch., "Sys. Bearb.," vi., p. 40 (1852); v., p. 88, no. 113 (1854); Hfmn., "Berl. Ent. Zeits.," iv., pp. 48-50, pl. ii., 5, 10 (1860); Staud. and Wocke, "Cat.," no. 1171, p. 105 (1861); Claus, "Stett. Ent. Zeit.," xxvii., p. 358 (1866); Röss., "J.-B. Ver. Nass. Nat.," xix-xx., 213 (313), no. 1279 (1866); Berce, "Bull. Soc. Ent. Fr.," 4 ser., viii., pp. xlix-l (1868); Hfmn., "Stett. Ent. Zeit.," xxx., pp. 299-303 (1869); Dohrn, Ibid., xxxii., p. 31 (1871); Hartmn., Ibid., xxxii., p. 166; "Kl. Münch., pp. 45-6 (1870); p. 9 (1871); Nolck., "Lep. Fn. Estl.," p. 467, no. 385 (1871); Wallgrn., "Bih. Svensk. Vet. Ak. Handl.," iii. (5), 32, no. 4 (1875); Bang-Haas, "Nat. Tids.," (3), x., 2, no. 4 (1875); Barr., "Mason's Hist. Norf.," app. xxxvi (1884); "Ent. Mo. Mag.," xxxiii., pp. 127-9 (1897); Tutt, "Ent. Rec.," xi., pp. 173-5 (1899). *Trigonotubulosa*, Retz., "Gen. Sp. de Geer," p. 44, no. 95 (1783). *Lapidosa*, Geoffr., "Fourcroy's Ent. Paris," ii., p. 336, no. 54, in part, with reference to "Hist. des Ins.," ii., pp. 204-5, no. 54 (1762). *Petrella*, Gn., "Ann. Soc. Ent. Fr.," pp. 11, 15 (1846). *Triquetrella*, Spey., "Isis," 1846, 29-31; Koch, "Schmett. S.-W. Deutsch.," 372, no. 18 (1856); Wernebg.,‡ "Btr. Schmett.," i., pp. 127, 188, 316 (1864); Balding, "Miller and Skertchley's Fenland," 623 (1878); Büttn., "Stett. Ent. Zeit.," xli., p. 423 (1880); Snell. v. Voll., "Sepp's Ned. Ins.," ser. 2, iii., p. 233, pl. 42, figs. 1-10, in part, *nec* ♂ (?1877); Snell., "De Vlinders.," &c., pp. 445-6, in part (1882); Steud. and Hfm., "J.-H. Ver. Nat. Württ.," xxxviii., p. 182 (1882); Schmid, "Cor.-B. Nat. Ver. Regens.," p. 102 (1886). *Pineti*, Hein., "Schmett. Deutsch. Tin.," pp. 22-3, no. 7, in part (1870); Staud. and Wocke, "Cat.," p. 267, no. 1336, in part (1871); Hartmn., "Mitt. Münch. Ent. Ver.," iii., p. 196, no. 1336, in part (1879); Peyer., "Lép. Als.," ii., p. 83 (1882); Sorh., "Die Kleinschmett. Brand.," p. 141, in part (1886); Reutti, "Lep. Bad.," 2nd ed., p. 305 (1898). *Lapidicella*, Reutti, "Lep. Bad.," 1st ed., p. 177 (1853) *teste* Spüler.

* In the synonymy here given, it is assumed that all Solenobiae formæ parthenogeneticæ are *lichenella*; whether, however, *lichenella* be one or more species time will show. When the monographer of *lichenella* appears, he will find the full synonymy useful, whilst for ordinary work it is in an accessible form for matured consideration (Durrant).

† We suspect Zeller made an error of reference here. His bibliographical reference to De Geer certainly refers to this species, *vide* our remarks *re pineti*.

‡ Réaum., xv., 7-8	= *S. triquetrella teste* Werneburg, "Btr. Schmett.," i., 127, no. 185 (1864)..	= *lichenella* as above determined.
De Geer, xi., 1-8	= *S. triquetrella teste* Werneburg, "Btr. Schmett." i., 188, no. 97 (1864) ..	
Geoffr., no. 54	= *S. triquetrella teste* Werneburg, "Btr. Schmett.," i., 316, no. 54 (1864) ..	
Linné, *lichenella*, 1451	= H. Sch. *teste* Werneburg, "Btr. Schmett.," i., 238-9 (1864)	

ORIGINAL DESCRIPTION.—*Phalaena Tinea lichenella* femina aptera laevi nigra. Habitat in *Lichene candelario* super muros templi Waxalensis. Larva habitat intra folliculum. Descr: Femina magnitudine vix Cimicis, nigra, tota glabra. Mas repertus non fuit, nec e larvis, cum feminis, produit (Linné, *Fauna Suecica*, p. 370, no. 1451). Femina aptera laevis nigra. Habitat in *Lichene candelario* super muros et rupes intra cucullum; plures larvas exclusit, nullas alatas phalaenas obtinuit. T. Bergman (*Sys. Nat.*, xiith ed., p. 899, no. 452). [De Villers adds (*Ent. Linn.*, ii., p. 494): In Gallia circa Lugdunum non rara.]

HISTORICAL NOTES ON SOLENOBIA LICHENELLA.—The *lichenella* of Linné has been practically obsolete since 1802, but it is the name to which, for many years, almost all authors have referred any *Solenobia* of which the male has been unknown, and the female has produced parthenogenetic progeny. Réaumur's "Teigne dont le fourreau est à trois pans presque plats" (*Mém.*, iii., p. 185, pl. xv., figs. 7-8) has been referred here, as also Geoffroy's "*Tinaea* lapidum, involucro triangulari" (*Hist. des Ins.*, ii., pp. 204-5), which he afterwards named *Tinea lapidosa*. There is nothing to be said against Réaumur's insect being so referred, but Geoffroy's own references to Réaumur show that he mixed up the latter author's account of two or three distinct species, and it is doubtful whether any part of Geoffroy's description, other than the larval case, refers even to a *Solenobia*. Guénée's *petrella* was based on the descriptions of Réaumur and Geoffroy, the insect being unknown to the author. With De Geer's *lichenella* (*Mém. Hist. Ins.*, ii., pp. 380-6) = *trigono-tubulosa*, Retz. = *lichenella*, Zell., *Isis*, 1839, p. 302, commences the real attachment of *lichenella* to a parthenogenetic species. Whether the descriptions of Réaumur and Linné really refer to De Geer's *lichenella* is doubtful, equally so, of course, whether they refer to the *lichenella* of Speyer (*Stett. Ent. Zeit.*, 1847, p. 18) and of von Siebold (*Ibid.*, 1851, p. 343), although there can be little doubt that the *lichenella* of De Geer, Speyer, and von Siebold are identical. Wocke, in the *Cat. Eur. Lep.*, p. 269, refers the *lichenella* of Zeller (*Linn. Ent.*, vii., p. 353) to the *pineti* of Zeller (*Ibid.*, p. 340), which may or may not be correct, but there is no evidence to show that Zeller's *lichenella* of the *Linnaea Entomologica* (p. 353) is the "forma ♀ parthenogenetica" as Wocke infers, for Zeller expressly states in his account of the insect that "though the females laid eggs without pairing, the eggs entirely failed to hatch." It is, therefore, doubtful whether Zeller's *lichenella* (*Linn. Ent.*, vii., p. 353) is the *lichenella* of Speyer and von Siebold, and Zeller certainly offered no evidence that his insect was a parthenogenetic form of *S. pineti*. [We have already shown (*ante*, pp. 158-160) that Hofmann's suspicions in this direction are far from conclusive.] On the other hand, the *lichenella* of Zeller, *Isis*, 1839, p. 302 (excluding the ♂ from Berlin), probably does refer to the *lichenella* of Speyer and von Siebold, whilst there is little doubt that Snellen van Vollenhoven's *triquetrella* is to be referred here. The facts relating to *lichenella* have been much obscured by different observers, and the evidence as to its specific value (as one or more species) is most unsatisfactory. Of recent authors, Wallengren considers (*Bih. Svensk. Vet. Ak. Handl.*, iii., (5), p. 32, no. 4) that the *lichenella* of Zeller is the *lichenella* of Linné, and the evidence of a Scandinavian author on the native

Linnean species cannot be overlooked although no facts are discussed. Whether, however, the *lichenella* of Linné be identical with the parthenogenetic insect of Speyer, von Siebold, Hofmann, Hamm, and others, or no, we wish it to be understood that, in our description of the insect, we are dealing as far as possible only with the parthenogenetic form. Structurally we find no difference between the British examples of this and the descriptions available of ♀ *S. inconspicuella* (*vide*, *Ent. Rec.*, xi., pp. 173-5), but it is necessary to separate an insect with such distinct physiological peculiarities, and we maintain it under this old name because we believe it to agree with the parthenogenetic insect referred thereto by various continental authorities.

Imago.—The female only is known. It has six well-developed legs, each with two terminal hooks, glassy and transparent, with dark shading at the joints. The head ventral; the antennæ long, glassy-looking, slender, with thickened base and apex, carried back at sides of body. Forewings moderately developed; prothorax narrow, ventral; mesothorax well developed frontal, with shiny, blackish-grey chitinous plates; the metathorax with a plate and very similar to the 1st abdominal segment; the latter slightly depressed, forming a sort of waist; the 2nd, 3rd, 4th, 5th, and 6th gradually increase in bulk, the 7th much narrower. One might, perhaps, homologise the black ovipositor, with its telescopic joints, as two segments, with another for the base. Beneath the 7th abdominal there is a very striking ventral cavity, more than filled with a protruding tuft of white silky hair. Each of the forewings forms a conspicuous, transparent, scaleless saccule, in the normal position; the hindwings are represented by similar but smaller saccules. The body is pale yellowish in colour, dorsally, however, each abdominal segment carries a broad, grey-brown, transverse band, so that the back appears to be alternately striped (transversely) with brown and yellow; laterally, the continuation of the dark, transverse dorsal bands is represented by many fine, short, grey-brown hairs; ventrally, these dark bands become conspicuous again. The eyes consist of large dark circular plates, with many conspicuous, well-developed facets. (Description made April 13th, 1899, from living female directly on emergence, from a case obtained near Wellington College by Hamm.) Walsingham notes that the dead females from Hamm's cases are blacker than those of *S. pineti*, although otherwise they are very similar. Undoubtedly, this dark colour has been assumed in drying, as the living female is not at all specially dark. Bacot also notes the females (from Wellington College) as having long antennæ (? 15-18 joints), with a tendency to become thickened towards the tip (last three joints); the thoracic and 1st abdominal segments, corneous and shiny; the skin of the abdomen shiny, almost bare dorsally, but with a few scale-like hairs (or hair-like scales) on the lateral area; the abdomen curved ventrally; the legs well-developed and fairly long; the abdominal segments black in and dorsally, but have a grey appearance along the sides where the scales are thickest; the wings small, movable, appear like semi-transparent bags of skin, and stand out almost horizontally from the body; the ovipositor large, strong, and black in colour, can be protruded to a considerable distance. De Geer describes the females as very small, without wings, looking rather like hexapod worms than Phalenes; the colour dull slaty; the body large, stout, and divided into segments;

the head rounded, with two large black eyes and two slender antennæ, the latter at least half the length of the body and terminated by an elongated thickening. The legs are also long, yellowish, of ordinary shape, and terminated by two rather large hooks; the abdomen is composed of six segments without counting the ovipositor (which forms a sort of tail behind), composed of three segments, capable of being drawn one within the other like the joints of a telescope; the dorsum is smooth and glassy, but laterally and ventrally are a large number of scale-like hairs, as in ordinary Phalenes; the 6th abdominal segment with a fringe of long hairs encircling it. These females are sluggish. From a large number of cases collected each year only females have been bred (unless the males are wingless), and from the eggs laid numberless larvæ have hatched.

Parthenogenesis in S. lichenella.—We have already noted that De Geer and others have recorded the occurrence of parthenogenesis in this insect, and we have further shown (*ante*, pp. 157-158) that authors have attempted to attach the insect to various species—*triquetrella*, *pineti*, &c. One or two other references, perhaps, call for notice. In 1847 Speyer published (*Stett. Ent. Zeitung*, 1847, pp. 18-21) a paper on "The natural history of *Talaeporia lichenella*, Zell." He notes that the mode of propagation of the species had long been a matter of controversy, and refers to the observations of Mann and Hering on the mode of copulation of *Psyche plumifera* and *P. stettinensis*, and to an earlier one in the *Isis* on that of *P. muscella*. He then states that having established by accurate observation the propagation of *T. lichenella*, L. and *P. triquetrella*, Tr. (? = *clathrella*, F. v. R.) parthenogenetically (*Isis*, 1846, p. 29), he had, four years previous to the publication of the paper, collected a further supply of cases in early April, which the larvæ had already spun up for pupation on a garden fence, and, having isolated them, found that they produced only females, which, after sitting a short time, began to oviposit without copulation, and that after about four weeks larvæ hatched from the unfertilised eggs. As it was possible (though very improbable) that the females had already been fertilised, he made further observations, and, in March, 1846, he again collected a number of *lichenella* cases, some still containing larvæ, some pupæ. The imagines, again only ♀s, emerged in the second half of April. Four specimens, whose emergence and egg-laying were especially noticed, were selected for separate observation. The larvæ came out at the beginning of June, and, to judge from their number, nearly all the eggs must have developed. They were not hard to breed. Some bits of lichen-covered wood from old fences and bark of trees, sprinkled daily with water, but never renewed, sufficed at first for feeding them. Later they were given dead moths, which they devoured with great relish. They ate all parts which were not too hard, and of a *Gastropacha populifolia* they left nothing but the heap of eggs. They needed but little light and air, grew slowly, and did not reach full size till autumn. They left off feeding in October, remained without moving till March, then got restless and spun up. About 15-20 grew very slowly, so that, in autumn, they were scarcely half the size of the rest, indeed, one couple had reached but little over a line in length. Some of these backward ones died during the winter, the rest re-commenced feeding in March. He took good care of them, but they gradually died off in the summer, without having grown much. In spite of losing many larvæ by various casualties, about 100 reached maturity, and these again produced, at the end of April, only ♀s, only six failing to emerge. The ♀s laid as usual, and a month later larvæ appeared. The completion of the life cycle without presence of the ♂ was thus demonstrated beyond possibility of error, &c. Speyer later noted that he had never bred the male, nor did he know it. Von Siebold notes (*Stett. Ent. Zeit.*, xii., p. 343) *S. lichenella* as common at Freiburg, in Breisgau, and describes it as "a wingless and sexless nurse, with an ovipositor, and laying eggs *sine coitû* which produce larvæ." He further supposes it may be the "nurse" of a species of *Taleporia* liable to alternation of generations, and adds that it is not established that *S. triquetrella* (of which both sexes are known) is co-specific with *S. lichenella*, whilst the cases are very different, that *lichenella* is found on old fences, about houses, in gardens, and *triquetrella* (probably feeding on grass) crawling up trunks and rocks in the woods to pupate. The cases of *lichenella* he describes as smaller and darker than those of *triquetrella*, and considers there is a probability that the sexuated and sexless individuals of a species may differ in form, and that the parthenogenetic form may belong to more than one species. There can be but little question that the *S. triquetrella* (exc. ♂) of Snellen van Vollenhoven (*Sepp's Ned. Ins.*, ser. 2, iii., p. 233, pl. 42, figs. 1-10) is to be referred here. His description, as well as his note that the unfertilised females laid eggs that produced larvæ, and that only this form (without males) was known to the Dutch entomologists, point to this conclusion. Steudel and Hofmann say that the parthenogenetic form (*lichenella*, Z.) occurs in Würtemberg, on isolated plants, and on walls, and produces only females; their cases are usually covered with yellow particles of lichen, and, therefore, look somewhat different. Wocke says that in many places in Silesia only the parthenogenetic form of the female is found. Peyerimhoff gives *lichenella* as common on fences, tree-trunks, and walls, in Alsace. He follows Wocke in calling it the parthenogenetic form of *S. pineti*, and adds that it is much more common than the ordinary male-producing form of the latter.

Egg-laying.—Hamm and Bacot both observe that the females (from the Wellington College locality) commenced to lay eggs almost as soon as they emerged, not really waiting for copulation. Both, too, observe that though no males were obtained, and that although the females were unfertilised, the eggs duly hatched. The eggs are laid inside the larval case, from which the empty pupa-skin protrudes, the ovipositor being inserted between the latter and the edge of the case, whilst mixed with them are hairs or wool from the anal tuft. The female retains much of her bulk till the eggs are all laid, expanding herself with air to replace the space previously occupied by the now deposited eggs. This is probably necessary to obtain proper fulcra for muscular action. [Zeller notes that a large number of eggs that were laid by an unfertilised ♀ in his possession, and referred by him to *lichenella*, failed to hatch, but formed empty white bladders of skin (looking brownish-yellow against the light), placed irregularly, and apparently contained nothing but air.]

Ovum.—About ·5mm. in length and ·4mm. in width, oval in outline, slightly depressed on upper surface; apparently a faint trace of longitudinal striæ; slightly shiny, pearly-white in colour with a faint tint of cream-colour when the eggs are in mass. [Described April 13th, 1899, under a two-thirds lens, ♀ from Wellington College.] Bacot describes the eggs as slightly over ·5mm. in length and about ·4mm. in width; oval in outline but with slight irregularities of contour; pale greenish-white in tint; surface rather dull (and not reflecting light to any extent), smooth, but with traces of a faint reticulation just discernible, the cells thus formed are very large compared with size of egg (April 30th, 1899, ♀ from Wellington College). This observer also notes that the "ova are firm and hard, very different from those of *Whittleia reticella*." Snellen van Vollenhoven notes them as "pearl-coloured," and lying loose in the case. De Geer describes the eggs as oval, yellow, very large in proportion to the size of the insect, so much so that they are readily discernible without the aid of a lens.

Case.—When only one day old, the case is pointed at anal end and widely open in front, very short, and the silk covered with minute fragments of paper from the box in which the larvæ are confined (Bacot). The full-grown cases vary much in shape, some more oval, others more trigonal in section. They average 5mm.-6mm. in length, and about 1·5mm. in width; trigonal in cross-section although some are much more cylindrical in appearance than others; one face is usually wider than the others and on this they appear to rest (whilst at the end of one of the cases, *in situ*, one sees what appear to be the delicate larval exuviæ, probably cast just before spinning down the case to the trunk for pupation). The flat side of the case forms the inferior face when the larva is moving, and is dragged along the surface on which it is walking. The case itself is formed of moderately tough silk, is entirely covered with minute particles of rock-dust, but is not hard and solid as is the case of *T. tubulosa* (*pseudobombycella*); the silk inside is quite white and when spun down for pupation the free end of the case (from which the imago will emerge) is seen to be formed of three flaps (agreeing with the three sides) neatly spun together with white silk to prevent ingress from the outside. Most of the cases are quite black in colour, as also is the old tarred fence on which they are found, although others are paler and have white patches of [illegible] size on the surface, probably due to the exceptional [illegible]. These come from an old railway fence, [illegible] lichens. [Described April 13th, 1899, from cases collected by Mr. [illegible], near Wellington College.] Bacot notes that "the case with the living larva in it is widest in middle, narrowed slightly towards either end, with a curved dorsal, and flat ventral, area, and slight lateral ridges. A more or less circular, slightly lipped, opening is at that end of the case from which the larva protrudes its head; the opening has a ventral aspect, with a slight tendency to a constriction or neck just before the aperture (this opening can be closed at will, the sides being drawn together so as to leave only a narrow slit-like aperture). The case is formed of soft, whitish silk, with fragments of dull or brighter grey-green lichen, the tints mottled in different proportions in different cases. Some of the fragments attached suggest that the larva uses grass as well as lichen, and one case has a few grains of sand." Hofmann says that the cases are almost three lines in length, narrower than those of *S. pineti*, more slender anteriorly; the three angles, especially the dorsal, sharply defined, the covering composed chiefly of minute particles of earth and sand. De Geer states that the cases are about four lines in length and one line in width; their form such as M. Réaumur has described with "three almost flat sides, the ventral one the widest, the two others equal; the ridge, which the latter form, runs the whole length of the dorsum, and is rounded, the two lateral ridges are also rounded." De Geer adds that those of his examples "had more acute ridges. The case is the widest at the middle and is narrow towards the two ends, at each of which there is an opening, the posterior one narrow and from this the larva ejects its excrement, the anterior one large, somewhat rounded, and it is from this the insect protrudes its head and anterior feet; the direction of this opening is oblique to the axis of the case," or "the contour of the opening is such that it is applied to the stone, the case being slightly inclined to the surface." The transverse section of the case is triangular. It is composed of silk, covered externally with minute pieces of stone, whilst De Geer states that they add other materials, "pieces of lichen, plants, wings and legs of dead insects that they meet by chance." Zeller says that "the case is nearest to that of *S. triquetrella*, somewhat shorter, with three sharper keels, also somewhat browner and more covered on the anterior (head) third, with coarser particles and insect *débris*. Among more than twenty cases collected in an old hedge were six that had the greatest likeness to those of *S. pineti*, except that they were not quite so blackish, since the larvæ had used pine-lichens, for the covering of their cases. The moths, which emerged in the beginning of May, from both sorts of cases, showed no differences and had a snow-white anal tuft. They began at once to push their ovipositor into the open end of the larval case, inserting it by the anal end of the empty pupa-case which protruded some distance." He adds that Réaumur's case cannot with certainty be referred here, because he states that the lateral keels are rounded.

Habits of Larva.—As soon as they are hatched the larvæ set about making their cases, detaching grains of sand and stone, and little fragments of lichen from the old cases of their parents, and so build small cylindrical cases, but clumsy and irregular and without definite figure. The larvæ walk with the head and anterior part of the body out of the opening of the case (De Geer). They feed up slowly but continuously until the autumn, when they appear to be almost or quite full-fed, but very little is known of the larval habits until they appear in some abundance on the rocks, walls, &c., in their special habitats in early spring. That they are very secretive when feeding is evident, and De Geer has noticed that larvæ that fed up on the lichens growing on a wall made of granite blocks leading to his house, left the wall in autumn and spring and climbed the walls of his house for the purposes of hybernation and pupation.

Larva.—The *newly-hatched* larva is 1·50mm. in length and ·40mm. in its widest part. The head, thorax and legs are brown, the abdomen white. The head and thorax are large compared with the abdomen, and comprise almost one-half the length of the larva, and as regards bulk form at least one-half. A distinct constriction occurs dorsally between the thorax and abdomen. The legs are very strong and powerful-looking. The prolegs are small, and the anal prolegs have a more complete circle of hooks than have those of the adult larva or the Macro-Psychids. The prothorax is about equal to three abdominal segments from front to back, the mesothorax about equal to two, whilst the metathorax is of about the same measurement as one of the abdominal segments. The head is large, rounded and partly retractile, dark brown in colour, corneous in appearance, with some very long scattered hairs; similar hairs are also present on the thoracic segments. The prothorax is lighter in colour, but covered with a corneous plate, the mesothorax paler, also covered with corneous plates, the metathorax appears to be covered with two dorsal plates and a separate lateral plate on either side. The abdominal incisions are distinct, whilst there is a fairly well-marked longitudinal lateral ridge. The hairs are proportionately larger than in the adult larva, but not so long as in the 1st instar of the Macro-Psychid larvæ. The ventral surface of the abdomen is rather flat, the prolegs (on abdominal segments 3-6 and 10) short. The dorsal tubercular hairs consist of a rather short one on the anterior trapezoidals (i), and a larger one on the posterior trapezoidals (ii), i is nearer the median line than ii; iii bears a very long supraspiracular hair nearly half the diameter of the larva in length; iv and v are as in all other Psychids (v small and iv larger), v is also rather lower than iv, although they are somewhat close together; vi and vii are single, somewhat close together, the latter at base of proleg. The nervous system is very well developed and obvious. [Bacot, May 24th, 1899, described from newly-hatched larva from eggs laid by parthenogenetic ♀ from Wellington College.] De Geer states that the newly-hatched larvæ, although very small, are really "large compared with the size of the ♀ imago. They are yellowish-white, with large brown head, and the three thoracic segments coloured like the head, are large and covered with a corneous shield. The abdominal segments membranous. The true legs very large (and enable the larva to walk very rapidly), the prolegs of little service. The head and body are sprinkled with many long hairs." The *full-fed* larva has the head small, partly retractile, with black and polished surface, and rather long but slender scattered hairs. The prothorax and mesothorax chitinous, glassy in appearance, dark brown in colour (lighter than head); metathorax brown, with chitinous plates, but less armoured than the pro- and mesothorax. The prothorax is wide and chitinous, the mesothorax rather less completely so, a slight gap existing between the lateral and dorsal plates. There is a slight tendency to a constriction or neck between the pro- and mesothoracic segments. The abdomen appears very soft and bulky, the 2nd to 7th segments are about equal as regards width (front to back), but the 3rd to 6th are of much greater diameter (side to side), the abdomen tapering rather rapidly to anus, more gradually to head. The anus is much curved ventrally, the posterior edge of the 8th and the 9th abdominals being smoky in colour, whilst the 10th bears black chitinous plates. The spiracles are small, circular, pale brown, with a raised rim, the prothoracic placed somewhat posteriorly on segment, the abdominal more centrally. The dorsal tubercles are—i, extremely minute, ii, much larger and almost behind i, both bearing a single hair (not placed so far forward as in *Pachythelia villosella* or *Luffia lapidella*); each of the abdominal segments appears to be subdivided into two subsegments, of which tubercle i is on the anterior and ii on the posterior. A long supraspiracular hair arises from iii (which is close down to the spiracle), and there are two subspiracular hairs, one each on tubercles iv and v. The prolegs appear similar to those of the larvæ of *Pachythelia villosella*, *Fumea*, *Epichnopteryx*, &c.

[Bacot, described March 26th, 1899, from larvæ sent by Hamm, and collected near Wellington College.] De Geer states that the adult larva has very short prolegs, but the true legs are very long and yellow-brown in colour. The head and prothorax also yellowish-brown* and shiny, and the mesothorax is of a darker brown, equally shiny; these two segments are covered dorsally with a common shield; the remainder of the body is membranous, dirty grey mixed with brown, with some slightly raised oval plates, the skin is smooth, whilst one only observes hairs on the head, pro-, and mesothorax. The abdomen is larger than usual posteriorly. The larva walks with difficulty when out of the case, the venter is dragged because the shortness of the prolegs is not suitable for walking, but only for clinging to the silk with which the case is lined.

Pupa.—The (living) pupa is about 3mm. in length, 1mm. in width, of a black-brown colour dorsally, and a much paler yellow or greenish-brown tint ventrally, the 8th, 9th, and 10th abdominals also of a paler brown colour, and apparently united somewhat closely. The segments appear to bear the same number of setæ (and in the same relative positions) as in the larva. The chitinous dorsum shiny, finely shagreened, striated transversely; the frontal area rounded, the prothorax very small; the mesothorax well-developed, the forewings extending to the middle of the venter across the 3rd thoracic segment, the 1st, and greater part of the 2nd, abdominals; the metathorax small, the hindwings just covering the spiracle of the 1st abdominal; the abdominal segments 1-6 almost equal in width and bulk, 7-10 rapidly narrowing to the rounded anus; the tubercles almost as in larva—i on the posterior margin of the transverse patch of spines on anterior margin of segment, and distinctly nearer the median line than ii, iii large, iv larger than v and a little higher and posterior to it, vi single, vii apparently with three hairs, viii ventral to proleg scar. The two dorso-anal spikes are distinct. The incision between 2-3 movable dorsally (soldered ventrally), those between 3-4, 4-5, 5-6, 6-7 movable. When on the point of emergence the dark bands of the imago show distinctly through the pupal cuticle, which, when empty, is somewhat uniform in its tint and general delicate texture, the darker areas being in reality due to the contained female. *Dorsally*.—The prothorax and anterior part of mesothorax, frontal, the forewings with a strongly defined costa and inner margin, the metathorax distinctly continued backwards to join base of hindwings. The metathorax and abdominal segments 1-6 are very characteristically formed as distinct hoops, depressed centrally, and raised at the segmental incisions, the anterior rims of segments 3-8 being roughened and provided with a patch of minute spines, about five deep centrally. There are recurved hairs on abdominal segments 8-10, six on either side of 8 and 9, and four on either side of 10. The cremastral area smooth, but bears two well-marked dorso-anal spikes, one on either side of the terminal dorsal edge. *Laterally*.—The spiracles are small, have a faintly raised rim surrounded by a slight depression, placed rather high up on the side of the segments. *Ventrally*.—The dorsal head-piece comparatively small; two bristles at base of labrum on either side, very long, and deflexed almost to the point

* One suspects that De Geer was describing a larva that had just moulted. He describes the young larva as having a "brown" head, and the head, in the larvæ of this genus, tends to get darker at every moult.

of the labrum, two (sometimes one or none) other bristles* above these; the eyes prominent, the antennæ apparently almost free, running along costa of forewings to end of second pair of legs (*i.e.*, almost to apex of wings); the third pair of legs (free at tips) project just beyond wings; the legs with conspicuous little terminal knobs (? claws); well-marked scars in position of larval prolegs; a deeply-marked median furrow extending to the anus, just in front of which are the external sexual marks, which seem to consist only of a slight terminal deepening of the furrow. [Described April 14th, 1899, from a pupa obtained at Wellington College, the imago emerging just as the description was finished.] How completely the ♀ pupa is a mere egg-bag is well shown by the fact that, in extracting a pupa carefully from its case, a slight pressure on the suture, between the head and anterior border of the prothorax, immediately caused the extrusion of some eight fully-formed eggs through the aperture. It also suggests the delicacy of the pupal cuticle. Bacot notes the pupa as slender, gradually tapering to anus, which is rounded, smooth, and without armature; pale brown in colour, darker on dorsal area; the wings distinct, the forewings reaching to end of the 2nd abdominal segment, the hindwings visible above (dorsal) forewings; spiracles small, raised, and circular, their lining showing through the envelope; the tubercular setæ on iv and v (subspiracular) small but distinct, iv larger than v; vi also distinct below them; the seta on iii larger than that on iv; that on i is very weak, ii larger and longer (i slightly inner to ii), the position of tubercles (and setæ) as in larva. (The pupal stage of this individual lasted from April 6th-23rd, 1899.)

Dehiscence.—The pupal envelope is thrust out at least two-thirds of its length, and the head-, leg-, and antenna-pieces come away like a shield, but are still attached by their lower ventral portions to the rest of the case and hang on as if hinged (Bacot). The eye-covers go with the faceparts and antennæ on dehiscence, the first legs (and trochanters) also adhere to headpiece (the legs do not so adhere in *N. monilifera*) (Chapman).

Food-plants.—*Lichen candelaris* which grows on rocks and old walls (Linné), lichens growing on fences and tree-trunks, also dead moths (Speyer), *Agaricus* (Hofmann), lichens, dead flies, &c. (Hartmann).

Parasites.—*Campoplex psilopterus*, Gr., *Hemiteles gastrocoelus*, Rtzb., *Microgaster longicauda*, Wesm., bred by von Siebold.

Habits and Habitat.—We have already stated that only females of *S. lichenella* are known, that, almost as soon as they emerge from the pupa, they oviposit in the larval case, and that the unfertilised eggs produced parthenogenetic young. Hamm obtains cases from two fences near Wellington College, the colonies being about half a mile distant; the first, an old tarred fence, now almost lichen-covered, on which many of the cases found are almost black, whilst the second is an old railway fence without any covering, except the green lichen that has grown on it, the cases on which are much paler and grey-green in colour. Almost all the cases were found at the foot of fences, but some on pieces of dead wood, and a few on stones.

* Chapman notes that certain Herefordshire pupæ which have been referred to *S. inconspicuella* have two hairs at base of labrum, on either side, and two (or one) others above these; those of *S. lichenella*, from Wellington College, have the two basal ones, rarely one above, and sometimes lose even one of the lower ones.

Walsingham considers some cases found by Evans on rocks in the Pentlands (near Edinburgh) to be of the same species as those collected by Hamm at Wellington College. Barrett notes (*Mason's History Norfolk*, app., p. xxxvi) that at Brandon the larvæ were abundant on old palings, but that only apterous and parthenogenetic females were bred therefrom. De Geer records finding cases on the walls of his house at Leufsta every year in autumn, and again in spring, but he says that they did not live there, and only came to undergo their transformations or to hybernate. He remarks that "leading to the house is a wall made of granite blocks covered with lichen. The larvæ live on this wall, are not rare, and feed on the tiny lichens growing on the stone; they do not undergo their transformation till spring (the commencement of May being the usual time for their appearance). These have always been female, and the pupa-case is drawn out almost entirely, so that it is held by its posterior end in the posterior opening of the case." Glitz says that the parthenogenetic form (of *S. pineti*) only occurs in Hanover, the larvæ being found on lichens on old fences, walls, and tree-trunks.

Time of appearance.—April (Speyer); March and April in Alsace (Peyerimhoff); May and June in Piedmont (Ghiliani); larvæ in March, imagines in April (Glitz). Early April to early May from near Wellington College (Hamm)—imagines bred April 12th-20th, 1899, from Wellington College pupæ (Tutt), April 23rd, 1899 (Bacot), April 2nd-25th, 1896, April 4th-21st, 1897, April 5th-26th, 1899, from Wellington College (Hamm).

Localities.—Berks: Near Wellington College (Hamm). ? Cheshire: Rudheath (Edleston). ? Edinburgh: Pentlands, near Edinburgh (Evans *teste* Walsingham). Suffolk: Brandon (Barrett). ? Sussex: Horsham, Augmering, near Worthing (Fletcher).

Distribution.—Austro-Hungary: Preth (Zeller). Denmark: (Bang-Haas). France: Paris dist. (Réaumur), ? Doubs (Bruand), Douai (Fuocart). Germany: Würtemberg, Stuttgart, Urach, Friedrichshall (Steudel), Silesia (Assmann), Pomerania (Büttner), Frankfort-on-Main, Cassel (Koch), Waldeck—Wildungen (Speyer), Munich (Hartmann), Hanover (Glitz), Nassau (Rössler), Alsace (Peyerimhoff), Bavaria (Heinemann), Ratisbon and Erlangen (Hofmann), Breslau (Wocke), Baden generally—Lahr (Reutti), Berlin, Freiburg-im-Breisgau (Siebold), [? Potsdam, Friedland, Stettin, Hamburg (Sorhagen)]. Italy: Piedmont (Ghiliani). Netherlands: very common, Gravenhage, &c. (Snellen). Russia: Baltic provinces (Nolcken), ? Dorpat (Petersen). Scandinavia: Waxalensis (Linné), Christiansand (Wocke), Suecica, Scania, Smolandia, Ostrogothia, Uplandia, western and northern Norway (Wallengren), Leufsta (De Geer). [? Switzerland: Oberalbula, Engadine (Zeller)]. Roumania: Grumazesti, Slanic (Caradja)

Palæarctic species of Solenobia not yet authenticated as British.

At one time or other many of the species of the genus *Solenobia* have been recorded as occurring in the British Islands. As a matter of fact it is quite possible that some are British, so little do we know of the species of the genus that inhabit Britain. *S. triquetrella* has stood for a half-century in our British lists, yet no male of the species can be referred to as an undoubted native. Barrett has introduced *S. wockii* as British, but as we have already shown (*ante*, p. 165) the insects thus referred certainly are not this species. Walsingham considers that three females, obtained from cases collected by Logan in the Pentlands, may be referable to *S. nickerlii*; *S. lichenella*, which appears certainly to be British, is considered by continental entomologists to be the parthenogenetic form of the sexuated *S. pineti*, whilst

Dr. Mason has submitted to us an undoubted male specimen of *S. clathrella* which he thinks must have been taken by Sang in Durham. One hesitates, however, to introduce the species as British on such uncertain evidence as this. At the same time, there is so much possibility that other species than those already described as British are native that we have no hesitation in giving a short account of the described Palæarctic species. It may possibly lead to the discovery of other species in our Islands.

Solenobia nickerlii, Heinemann.

Synonymy.—Species: *Nickerlii*, Hein., "Schmett. Deutsch. Tin.," p. 25 (1870); Snell., "De Vlinders," &c., p. 445, *footnote* (1882); [? Walsm., "Ent. Mo. Mag.," xxxiii., p. 129 (1897)]. *Conspicuella*, Nick., *in litt.*, *teste* Hein., "Schmett. Deutsch.," p. 24 (1870). [? *Triquetrella*, Barr., "Ent. Mo. Mag.," xxxiii., p. 127 (1897).]

Original description.—Whether the species which Nickerl finds at Prague and sends out as *S. conspicuella* belongs to *S. wockii* appears doubtful. The forewings are narrower (three times as long as broad), brighter and cleaner grey, the costa at the base only weakly curved, the outer margin shorter. It cannot be referred to *S. inconspicuella*, the latter species having much more pointed forewings and closer reticulation, *S. conspicuella* has the posterior half of the middle cell of the hindwings somewhat longer than the anterior, and nervules four and five originate from a point. The case is like that of *S. wockii*, but blackish-grey in colour. According to its case, a female from Brunswick belongs here; this is $1\frac{1}{2}'''$ in length, dark brown, with blackish head and thorax. I also refer to this species two males from this district. Should its specific distinctness be established, I propose for it the name of *nickerlii* (Heinemann). [Snellen suspects (*De Vlinders* &c., p. 445) that *nickerlii* may be *inconspicuella*].

Solenobia nickerlii possibly a British species.—Logan's three female *Solenobiae* and cases from the Pentlands, appear to agree with a species sent by Rebel as *inconspicuella*. The case is identical and the female has the same olive shade. They are not *S. inconspicuella* and they are not *S. triquetrella*, but are probably *nickerlii*, Hein., which he rightly differentiates from *S. wockii*, as well as from *S. inconspicuella*. The case of *S. triquetrella* is less triangular and apparently always roughened at the end of that of the female, and more or less all over in that of the male (Walsingham).

Solenobia wockii, Heinemann.

Synonymy.—Species: *Wockii*, Hein., "Schmett. Deutsch. Tin.," pp. 24-25 (1870); Staud. and Wocke, "Cat.," p. 267, no. 1340 (1871); Wocke, "Zts. Ent. Bresl.," 1874, p. 42, no. 1340; Hartmn., "Mitt. Münch. Ent. Ver.," iii., p. 196, no. 1340 (1879); Sorhg., "Die Kleinschmett. Brand.," p. 326, no. 4 (1886); Barr., "Ent. Mo. Mag.," xxxi., pp. 163-4, in part, excl. Angl. (1895); [? Drnt., "Ent. Mo. Mag.," xxxiii., p. 220, *an* n. sp. (1897)]. ? *Inconspicuella*, Zell., "Stett. Ent. Zeit.," xxxix., p. 117 (1878); ? Frey, "Lep. der Schweiz," p. 335 (1880). *Wockei*, Reutti, "Lep. Bad.," 2nd ed., p. 305, no. 1108 (1898).

Original description.—*Solenobia wockii*. Vorderflügel breit, mit runder Spitze, gelblich weissgrau, deutlich braungrau gegittert, mit dunklern Flecken am Querast und Saume, und einfarbigen Franzen, der Kopf klein, staubgrau behaart. $2\frac{1}{2}$-$2\frac{3}{4}$l. ♀ gelbbraun, mit schneeweisser Afterwolle. 2l. (Heinemann, *Die Schmetterlinge Deutschlands* &c., p. 24).

Imago.—Head small, with dust-grey hairs. Anterior wings rather broad, 11mm.-13mm., with rounded apex, whitish-grey with a yellowish tint, distinctly reticulated with brown-grey, a darker spot on the transverse nervule and at the margin, unicolorous fringes. ♀ yellow-brown, snow-white anal tuft, 4mm. (Heinemann).

Comparison of S. wockii with S. inconspicuella.—Before *S. wockii* was recognised as a distinct species, Hofmann observed (*Berl. Ent. Zeits.*, iv., p. 51) that examples sent from Wocke and captured at Breslau were possibly to be referred to *S. inconspicuella*. Of the six specimens examined he notes that three have the origin of nervures 4 and 5 of the hindwings separate, and inner part of the middle cell but little longer than the outer, while in the other three, nervures 4 and 5 start from one point, and the inner part of the middle cell is considerably longer than the outer. They differ only from *S. inconspicuella* in their somewhat superior size, and in having the inner part of the middle cell always longer than the outer. The female is entirely clear yellowish, with small dark grey dorsal spots and white anal tuft.

Case.—The male case is $2\frac{3}{4}'''$ long and $\frac{2}{3}'''$ wide, cylindrical, narrowed at both ends without distinct edges, the female case is almost $4'''$ long, flat beneath with distinct lateral and dorsal edges, overlaid with fine particles of sand and lichen; it is earth-brown in colour (Heinemann).

Time of appearance.—The larvæ in March on tree-trunks, imagines in April, in woods about Breslau (Wocke). Larvæ on rocks in woods, the imagines bred freely at the commencement of April, at Lahr (Reutti), April 4th, 1860, at Breslau (Wocke *teste* Durrant), June 28th, 1875, at Weissenstein (Zeller *teste* Durrant). The latter date must be very exceptional.

Distribution.—Germany: Breslau (Wocke), Silesia (Frey), Berlin (Heinemann), Lahr (Reutti *teste* Hofmann). Switzerland: Engadine (Frey coll.), Oberalbula—Weissenstein (Zeller).

Solenobia suifunella, Christoph.

Synonymy.—Species: *Suifunella*, Chris., "Bull. Mosc.," lvi. (2), no. 4, pp. 430-432 (1881).

Original description.—♂, 6-9mm.* Capite villis griseis incrassato, corpore fusco, albide-griseo-villoso. Alis anticis acutiusculis griseo-fuscis, albidescano reticulatis; vena transversa obscura incrassata. ♀ fusca, lana anali albida, 9mm. long., 3mm. lat. Der Sack kommt dem von *triquetrella*, F. R., am nächsten, ist aber noch breiter und dreikantig. Er ist mit feinen Pflanzentheilen und Sand dicht bedeckt und von Farbe schwarzbraun. Der weibliche Sack ist etwas grosser, 10mm. lang und 4mm. breit und hat weniger vortretende Kanten (Christoph, *Bull. Mosc.*, lvi., p. 430).

Comparison of S. suifunella with its allies.—It is near *S. wockii* but always larger and has less pointed wings. In wing-expanse it equals *S. clathrella* (Christoph).

Case.—The case comes nearest to that of *S. triquetrella*, F.v.R., but is broader and triangular. It is thickly covered with fine pieces of plant *débris* and sand and is of a black-brown colour. The ♀ case is somewhat larger, 10mm. long and 4mm. broad, and has less prominent angles.

* This, and the measurements of some other species, only gives the expanse of one wing.

Time of appearance.—Cases in early April on oak-trunks. Imagines at end of April at Nikolsk; ♂ at Wladiwostok on May 17th.

Distribution.—Asiatic-Russia: Amurland, Nikolsk, Wladiwostok (Christoph).

Solenobia cembrella, Linné.

Synonymy.—Species: *Cembrella*, Linn., "Faun. Suec.," p. 365, no. 1422 (1761); "Sys. Nat.," xii. ed., p. 892 [902], no. 405 (1767); O. Müll., "Fn. Ins. Frid.," 57, no. 508 (1764); "Zool. Dan. Prodr.," 156, no. 1579 (1776); P. Müll., "Ed. L. Sys. Nat.," i., 5, p. 747, no. 405 (1774-5); [Schiff., "Sys. Verz.," p. 136, no. 39 = ? *pineti* (1776); Göze, "Ent. Btr.," iii., 4, p. 107, no. 405 (1783); Gmel., "L. Sys. Nat.," 13th ed., i., 5, p. 2598, no. 405 (1788); [De Vill., "Linn. Ent.," ii., 477, no. 896, ? = *pineti*, in part, (1789)]; Jung, "Alph. Verz. Schm.," p. 111 (1791); [Charp., "Schiff. Schm. Wien. Geg.," 120 = ? *pineti* (1821)]; Wernbg., "Btr. Schmett.," i., pp. 236-7 (1864); Ersch. and Feild, "Cat. Lep.," p. 52 (1870); Staud. and Wocke, "Cat.," p. 267, no. 1337 (1871); Wlgrn., "Bih. Svensk. Vet.-Ak. Handl.," iii., 5, p. 32, no. 5 (1875); Schöyen, "Lep. Ark. Nor.," 217 (1881). *Combrella*, Fab., "Mant.," ii., p. 248, no. 82 (1787); "Ent. Syst.," iii., 2, p. 312, no. 111 (1794); [Brgstr.,] "Epit. Ent. Fab.," p. 170 (1797); Turton, "Sys. Nat.," iii., p. 372 (1802). *Clathrella*, Tgstr., "Not. Sällsk. Fn. Fenn.," i., p. 107, no. 2 (1847). *Pineti*, Tgstr., Ibid., iv., p. 175 (1859); "Bidr. Fin.," iii., p. 175 (1859); "Cat. Lep. Fenn.," 337 (1869); ? Wk., "Stett. Ent. Zeit.," xxiii., p. 68 (1862).

Original description.—*Phalaena Tinea cembrella* alis fuscis atomis albidis irroratis. Habitat in *Pinu sylvestri*; larva intra folliculum scabrum, more *Ph. pellionellae*. Descr: Minor musca domestica. Alæ obtusæ, fuscæ punctis albidis conspersæ, unde cinereæ adparent (Linné, *Fauna Suecica*, p. 365, no. 1422).

Imago.—Anterior wings about 13mm.-14mm. in expanse; dark grey in colour, the paler specklings very faint. Posterior wings unicolorous, rather darker grey than those of most of the allied species [Stainton coll., examples from Finland, Staudinger].

Specific identity of S. cembrella, L., and S. pineti, Zell.—In the "Frey" collection are some specimens labelled *triquetrella* from Polar Norway, received from Staudinger. In the same collection are other specimens called *cembrella*, also from Polar Norway. These appear to us to be identical, and we have no doubt that both are referable to *cembrella*, Linné, and represent a northern and rather dark form of *S. pineti*, Zell. This being so, there is no alternative but to consider the latter a southern variety of the former. The life-history that follows is taken from the more southern form—*pineti*.

Sexual dimorphism.—The winged *male* has been already described. The almost apterous *female* with extended ovipositor is two lines long, of a dirty greenish colour, with a small black head and prominent black eyes; the antennæ very like those of *S. triquetrella*, blackish-brown with 17-19 joints; legs blackish-brown with 4-jointed tarsus; the thoracic segments carry dark brown dorsal shields, the 7 dorsal spots and the ventral spots are also dark brown; the ventral ganglia shine through like a row of brown dots; ovipositor black; anal tuft white (Hofmann). The dried female is smaller than the male, glossy black-brown with paler legs and almost snow-white anal tuft (Zeller).

Variation.—There is no doubt, as we have said, that the *pineti* of Central Europe is a slightly larger and rather lighter form of *S. cembrella*. The form of the wing, the minute pale specklings, its general appearance and habitat are identical. We therefore retain the name *pineti* for the more southern form of the species.

a. var. *pineti*, Zell., "Linn. Ent.," vii., pp. 348-351 (1852); H.-Sch., "Sys. Bearb.," v., p. 88, no. 111 (1854); Hofm., "Berl. Ent. Zeits.," iv., pp. 46-8 (1860);

Staud. and Wocke, "Cat.," p. 105, no. 1,165 (1861); 2nd ed., p. 267, no. 1,336 (1871); Wocke, "Stett. Ent. Zeit.," xxv., p. 209 (1864); Hein., "Schmett. Deutsch. Tin.," pp. 22-3, no. 7 (1870); Ersch. and Feild, "Cat. Lep. Ross.," p. 52 (1870); Snell., "Tijd. v. Ent.," xvi., p. 29 (1873), xl., p. 339 (1898); "De Vlind.," p. 446 (1882); [? Mill., "Cat. Lép. Alp.-Mar.," pp. 295-6 (1875)]; Hartmn., "Mitt. Münch. Ent. Ver.," iii., p. 195, no. 1,335 (1879); Büttn., "Stett. Ent. Zeit.," xli., p. 423, no. 1,336 (1880); [? Peyr., "Cat. Lép Als.," 2nd ed., ii., 83, in part ♂ (1882)]; Stdl., "J.-H. Ver. Nat. Würt.," xxxvii., p. 182, in part ♂ (1882); Sorh., "Die Kleinschmett. Brand.," 141 (1886); Reutti, "Lep. Fn. Baden," 2nd ed., p. 305, no. 1,105, excl. ♀ (1898). [*Cembrella*, Schiff., "Sys. Verz. Schm. Wien," p. 136 (1776); De Vill., "Linn. Ent.," ii., p. 477, no. 896 (1789); Charp., "Schiff. Schm. Wien. Gegend," p. 120 (1821).] *Lichenella*,* Zell.,]"Isis," 1839, 182, no. 4 *teste* Zeller]; Ibid., p. 303 no. 99, in part ♂; [? Dup., "Hist. Nat.," supp. iv., pp. 428-9, no. 562, pl. 84, fig. 8 (1842); "Cat. Méth.," 358 (1846);]? Pritt., "Berl. Schles. Tausch. Schmett.," p. 15 (1843); Koch, "Is.," 1846, 950; [? Bruand, "Cat. Lép. Doubs," p. 64, no. 1,183 (1847); "Mon. des Psych.," pp. 105-6, 118, no. 78, pl. ii., figs. 78*a-b*, pl. iii., fig. 78 (1853)]; Koch, "Schmett. S.-W. Deutsch.," pp. 371-2, no. 17 (1856); Hofmn., "Stett. Ent. Zeit.," xxx., pp. 299-303, in part ♂ (1869).—*Solenobia pineti*, nov. sp.—♂. Capite mediocri villis cinereo-griseis vix incrassato, corpore fusco griseo-villoso; alis anterioribus acutiusculis cinereis, punctulis crebris canis subreticulatis. ♀ fusca, lana anali nivea. *Talaeporia lichenella*, Zell., *Isis*, 1839, p. 182. Diese Art kommt der vorigen (*mannii*, Zell.) ausserordentlich nahe, ist aber sicher von ihr verschieden. Sie ist zarter und gewöhnlich etwas kleiner; ihre Flügel etwas schmaler und gespitzter, und die Gitterpunkte der vordern sind kleiner und durch stärkere Zwischenräume getrennt. Von meiner *S. triquetrella* unterscheide ich sie durch ihr dunkleres, nicht staubiges Grau, ihre in der Gegend des Innenwinkels mehr erweiterten Vorderflügel, die daher einen weniger abgerundeten Innenwinkel haben, und durch die kleinern und zahlreichern, weissgrauen Punkte auf denselben. *S. inconspicuella* ist kleiner mit abgerundetern Vorderflügeln, grösseren, mehr verfliessenden, weissgrauen Fleckchen auf denselben und einer Reihe dunkelgrauer Fleckchen längs des Hinterrandes. Körper schwärzlich-braun mit bräunlich-grauer Behaarung, welche nach hinten auf dem Hinterleibe dichter und länger wird; After gelblich. Fühler und Kopf wie bei *S. mannii*. Beine dunkelgrau, an den Spitzen der Schienen und Fussglieder verloschen hellgrau; Hinterschienen hell staubgrau mit ziemlich reichlichen solchen Haaren. Vorderflügel 3-3⅓‴ lang, ziemlich gestreckt, in der Gegend des Innenwinkels erweitert, mit seicht und lang eingedrücktem Vorderrand und ziemlich spitzem, etwas abgerundetem Vorderwinkel, einfarbig grau, etwas dunkel, ohne Glanz, mit vielen kleinen weissgrauen Punkten besprengt, welche gegen die Flügelwurzel verlöschen, gegen die Flügelspitze hin sich mehr zu Querreihen zusammenstellen. Selten sind einzelne dieser Punkte grösser und wie aus zweien zusammengeflossen; sie finden sich bisweilen am Vorderrande vor der Spitze und am Innenwinkel. Die Querader ist selten als ein sehr verloschenes, dunkleres Strichelchen zu erkennen. Franzen ausser an der Wurzel ein wenig heller als die Grundfarbe. Hinterflügel etwas spitzer als bei *S. mannii* und heller grau. Die ganze Unterseite ist einfarbig lichtgrau" &c. (Zeller, *Linn. Ent.*, vii., pp. 348-349).

The specimens of *pineti* in the "Stainton" and "Frey" collections average about 14mm.-14·5mm. in length, are dark grey in colour

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* Zeller distinctly separates (*Linn. Ent.*, vii., p. 348) his *lichenella* of the *Isis*, 1839, p. 182, which he refers to *pineti*, Zell., from his *lichenella*, *Isis*, 1838, p. 718, and 1839, p. 302. Both these latter he refers, as well as his *lichenella* of the *Linnaea Entomologica*, to *lichenella*, Linné. This makes Snellen's reference (*De Vlinders*, p. 446) incorrect. In *Isis*, 1839, p. 182, however, Zeller describes no specimen, and the reference is of a critical bibliographical character (dealing with De Geer, &c.); there appears, therefore, to be no reason for considering *Isis*, 1839, p. 182, no. 4 = *pineti*; the insect of the old writers there referred to goes to *lichenella*. On the other hand certainly part of *lichenella*, Zell., *Isis*, 1839, p 303, no. 97 must go to *pineti*, *i.e.*, the part dealing with actual specimens—*e.g.*, a winged ♂, taken at Berlin, April 24th, can have no connection with *lichenella*, L., in fact, it is referred (*Linn. Ent.*, vii., p. 351) by Zeller to *pineti*. Durrant suggests that Zeller "made a mistake under *pineti*, and that the reference there intended was *lichenella*, *Isis*, 1839, p. 303, no. 97, in so far as it related to actual specimens, and not *Isis*, 1839, p. 182, but of course the Zellerian 'motif' of *Isis*, 1839, p. 182, may have been identical."

(inclining very slightly to brownish), the paler specklings very minute, the apex and costal point (with fringes) slightly darker. The posterior wings unicolorous grey. Hofmann notes that in 21 specimens examined he found much variation in the neuration of the hindwings; in twelve examples, four and five (German method of numbering), rise separately, and six far beyond five, in nine others these nervures spring from a point (in one, indeed, they spring from a point on the right wing, and from a short stalk on the left).

β. ab. *alba*, n. ab.—Steudel and Hofmann record (*J.-H. Ver. Württ.*, xxxviii., p. 182) the capture of two pretty albino specimens from Wildbad, on the authority of H. Simon.

Comparison of S. cembrella with S. mannii.—Just as *S. cembrella* and *pineti* show their specific identity in their general resemblance and their minute speckling, so there can be no doubt *S. mannii* is abundantly distinct in both particulars, being larger than these and with larger specklings on the forewings, in fact, *S. mannii* appears to be nearer *S. clathrella* than *S. cembrella*. Zeller says that *S. pineti* comes extraordinarily near *S. mannii*, but is certainly distinct from it. It is more delicate, usually somewhat smaller, its wings somewhat narrow and more pointed, and the lattice-spots of the forewings smaller, with broader division bars. It can be differentiated from *S. triquetrella*, Zell., by its darker grey colour, by its forewings being more enlarged at the inner angle, which is, therefore, less rounded off, and by the smaller, more numerous whitish-grey spots on the forewings. *S. inconspicuella* is smaller, with more rounded forewings, larger white-grey spots, more gradually blending with the ground colour, and a row of dark grey spots along the hind-margin (Zeller). Chapman says that the *S. pineti* in Constant's collection are "similar to *S. mannii*, except that the cases are a little smaller; the feet appear to have but four joints in tarsi (the third very small), the ♀ with 19 joints to flagellum."

Case.—The case is 6-7mm. long and 2·3mm. wide; roughly trigonal, but with considerable variation; wider at the end from which the pupa emerges; black in colour and covered with particles of dirt, bark, and lichen. Obtained from fir trees at Glogau and pine trees at Ratisbon (Stainton coll.). The case is formed alike in both sexes, $2\frac{3}{4}$-$3\frac{1}{4}'''$ long, almost cylindrical, somewhat roughly formed, covered with blackish-brown, and a few grey, finely-powdered particles of lichen, bark, and wood, very rarely with a grain of sand; it is very little thinner towards the anterior end, but more so towards the posterior; the ventral side is tolerably flattened; on the middle of the dorsum a weak keel runs out from the anterior end, the keel usually disappearing beyond the middle; it has, therefore, some similarity to the case of *S. mannii*, but is shorter and more rudely formed, and its side keels are not so well-developed (Zeller). Case three lines long, the same size in both sexes, cylindrical, covered with finely granulated, generally blackish or dark brown, pieces of bark and lichen, but frequently mixed with grey, reddish, or greenish particles, so that the case becomes variegated, only slightly narrower at the ends, flat ventrally, with the longitudinal ridges only weakly developed (Hofmann).

Larva.—Yellow, with intestinal canal showing through greenish; head and thoracic legs blackish-brown, shining, the first two segments bear dark brown dorsal shields, traversed by a very fine, pale, median, longitudinal stripe, which is, however, very indistinct on the mesothorax; on the back of the metathorax are two lateral brown spots; anal flap shining dark brown (Hofmann).

Pupa.—Dark brown head and back, the ventral area yellow-brown (Hofmann).

Food-plant.—The lichen growing on the trunks of pine trees (Millière).

Parasites.—*Hemiteles gastrocoelus* bred by Hofmann.

Habits and Habitat.—The males and females emerge from the cases in about equal numbers—Hofmann obtained 15 males, 25 females, and 25 ichneumons out of some 70 cases collected at Erlangen. The males generally emerge in the evening or early morning, and the females, which do not differ from those of the sexual *S. triquetrella*, await them seated on the outside of the case. They lay no unfertilised eggs, but will remain from 10 to 14 days if prevented from pairing, and will die on the outside of their cases without ovipositing. In confinement, Zeller says that the males fluttered without moving much, and when frightened they crept under a piece of bark, or stood still, their wings drawn roofwise over the body; they fly very lightly. They also easily cripple when emerging, saccular dilatations filled with a yellowish fluid being frequent. They nearly all emerged in the early morning and late afternoon. Linné found the cases from which the original specimens were bred on trunks of *Pinus sylvestris*, and such references as are made to the habitat of *S. cembrella*, confirm this as its usual position. De Villers records it from the stems of the *P. sylvestris* in southern France, whilst Zeller collected on April 9th, 1851, above 100 cases in three hours in an old fir wood near Glogau. They were to be found on the trunks of both old and young trees at an elevation of from 1½ft.-6ft. from the ground, chiefly on the south side, on the green growth which forms the base of the fir lichens. On many trees no case could be discovered, generally only one, more rarely two or three, whilst in some instances as many as eight cases were found on one tree. As they are similar in colour to the green growth on which they rest, they are difficult to find, yet, with a little practice, it is doubtful whether one misses any; some larvæ were still on the move, most, however, had already spun up, and it was found best to chip off the little bits of bark to which the cases were attached. A few solitary ones were found on the loose leaf-like skin of the bark. The cases are fastened by the "head" end very firmly, and lie almost flat upon the bark. Hofmann notes that at Ratisbon the cases may be beaten from old lichen-covered pine-trees, and again, full-grown, in spring. At Erlangen the insect is found in an old fir wood, sometimes more and sometimes less abundant, the cases resting on the trunks with the free end downwards, and the ventral side lying close to the trunk, so that they are difficult to see; seldom more than two or three cases are found on a trunk, and these from 2ft-6ft. from the ground. A few were also found on trunks in a little oak wood that is on the border of a large fir wood. Wocke says that the larva is obtained full-grown in early spring in Silesia on pine and deciduous trees, but notes it from Fogstuen on birch. Snellen says that it is fairly common in the Netherlands, occurring in pine woods regularly in both sexes; Moeschler says that it is widely distributed in Upper Lusatia, and especially common in the heath country. Millière notes the larva as fixing its case after hybernation in the spring, on the trunks of pines in the forests of the sub-alpine districts of the Alpes-Maritimes. [Peyerimhoff refers examples found on old pines in the Neederwald de La Vancelle to this species, certain trunks having hundreds of cases on them. His date of appearance for the imagines, "June 20th to the end of the month," is very suspicious, although his reference to Bruand's fig. 78 (*S. lichenella*), which = *S. pineti*, would suggest this species.]

Time of Appearance.—From the middle of April to the middle of May. April 24th, 1839, ♂ in the Haisenhaide, near Berlin; cases at Glogau, April 9th, produced 50 imagines (only two females) on April 20th before 10 a.m., several more males in the afternoon, April 21st, in the morning, 20 males and several females, April 22nd there were three males and several females, none appeared after this date (Zeller); May 2nd, 1863, May 9th, 1864, May 1st, 1866, from Meseritz, May 12th, May 18th, 1877, from Grünhof, near Stettin, case on August 28th, 1855, at Gross Glogau (Zeller *teste* Durrant); April 24th-25th, 1858, at Nuremberg (Hofmann *teste* Durrant); from the middle to the end of April at Ratisbon and Erlangen (Hofmann); the full-fed larva in early spring in Silesia, the imagines in April (Wocke); both sexes in the latter half of April and beginning of May at Ratisbon (Schmid); appears in June in the pine forests of the sub-alpine valleys of the Alpes-Maritimes (Millière); in May and June in the Doubs dept. (Bruand); cases on rocks from May 10th-24th at Bergen, &c. (Wocke); May 7th, 1898, in Gelderland (Snellen); in the middle of May in the Baltic provinces (Teich).

Distribution.—Austro-Hungary: Innsbruck, Tyrolean valleys, Taufers, common (Weiler), Vienna (Schiffermüller). Finland: Finland (Staudinger), Helsingfors, Abo (Tengström). France: ? Chatillon, Doubs (Bruand), ? Douai (Foucart), all the sub-alpine valleys of the Alpes-Maritimes (Millière), Paris (Constant coll.), southern France (De Villers). Germany: Upper Lusatia (Moeschler), Nuremberg (Hofmann), Wildbad (Simon), Würtemberg—Ratisbon, Erlangen, &c. (Steudel and Hofmann), Silesia, common—Breslau, &c. (Wocke), Menitz (Büttner), Glogau, Haisenhaide near Berlin, Posen—Meseritz, Pomerania—Grünhof near Stettin, Hermsdorf, Hohenzuge (Zeller), Stuttgart, Kreisewitz (Prittwitz), Bavaria (Heinemann), Freiburg, Karlsruhe, Heidelberg, the Rhine Palatinate, Wurtemberg, Nassau (Reutti), ? Alsace generally—Neederwald de la Vancelle, &c. (wants confirmation) (Peyerimhoff), [? Potsdam, Friedland, Hanover, Hamburg (Sorhagen)]. Netherlands: Common in pinewoods—Gelderland, Arnhem, Keppel (Snellen). Russia: St. Petersburg (Erschov), [(? = *lichenella*) Baltic Provinces (Teich), Dorpat (Petersen)]. Scandinavia: Sweden (Linné), Uplandia (Wallengren), Bergen, Fogstuen, Bossekop, Hammerfest (Wocke), Lapland (Staudinger), Polar Norway (Frey coll.).

Solenobia fumosella, Heinemann.

Synonymy.—Species: *Fumosella*, Hein., "Schmett. Deutsch. Tin.," p. 24, no. 9 (1870); Staud. and Wocke, "Cat.," p. 267 (1871); Glitz, "Jahresbericht. Hanover," xxvi., p. 18(1877); Hartmn., "Mitt. Münch. Ver. Ent. Ges.," iii., 196, no. 1339 (1879); "Kleinschmett. Eur.," p. 56 (1880); Peyer., "Cat. Lép. Als.," 2nd ed., ii., p. 84 (1882); Snell., "De Vlinders," p. 446 (1882); Sorh., "Die Kleinschmett. Brand.," p. 326, no. 3 (1886); Reutti, "Lep. Bad.," 2nd ed., p. 305 (1898). [Snellen states his suspicion that *S. fumosella* is co-specific with *S. pineti*.]

Original description.—*Solenobia fumosella*. Vorderflügel dreieckig, ziemlich spitz, bräunlich grau, vor der Spitze durch lichte Fleckchen kaum gegittert, der Kopf klein, dunkel gelblich braun behaart, der Körper schwarzbraun. $2\frac{1}{2}$-$2\frac{3}{4}$l. ♀ länglich, braun mit weisslicher Afterwolle (Heinemann, *Die Schmetterlinge Deutschlands*, &c., p. 24).

Imago.—Head small, with dark yellowish-brown hairs. Body black-brown. Anterior wings 12mm.-14mm., triangular, tolerably pointed, brownish-grey, faintly latticed with pale before apex.

Comparison of S. fumosella with its allies.—*S. fumosella* is distinguished from *S. clathrella*, *S. wockii*, and *S. triquetrella* by the more pointed (not rounded) forewings; from *S. inconspicuella* by the absence of the dark spots at the margin; from *S. mannii* and *S. pineti* by the shorter forewings, and from the latter by the more brownish colour, and from all by the faint reticulation of the forewings. It is also distinguishable from most of the species by the dark head-hairs (Heinemann).

Case.—Two female cases are 2·5‴ long and just under ·75‴ broad, one rather thinner than the other, somewhat flattened beneath, with slightly rounded lateral ridges, the upper ridge scarcely perceptible. They are densely covered with intensely fine white-grey and blackish particles of wall-lichen without intermixture of particles of earth or sand. The ♂ case not known (Heinemann).

Time of appearance.—Bred in May from larvæ found in April on tree-lichens in woods in Hanover (Glitz); appears in May and June in the Hautes-Vosges (Peyerimhoff).

Distribution.—Germany: Hanover (Krösmann), Breslau (Heinemann), Brunswick (Sorhagen), Alsace—Hautes-Vosges (Peyerimhoff).

Solenobia triquetrella, Hübner.

Synonymy.—Species: *Triquetrella*, Hb., "Eur. Schmett.," pl. iv., fig. 373 (by error 273) (? 1812); "Verz.," p. 402, no. 3,868 (1826); Zk., "Germ. Mag. Ent.," i. (1), 23, 38 (1813); F. v. R., "Abbild. Schm.," pp. 87-9, pl. xxxix., figs. *a*—*r* (1837); Sieb., "Stett. Ent. Zeit.," xii., pp. 343-4, in part ♂, excl. parth. ♀ (1851); Hdrch., "Lep. Eur. Cat. Meth.," p. 78, no. 18 (1851); Sta., "Supp. Cat. Br. Tin.," app. 17 (1851); Zell., "Linn. Ent.," vii., pp. 351-3 (1852); [? Brd., "Mon des Psych.," pp. 106-7, pl. ii., 79 *a-d*, pl. iii., 79-79*bis* (1853) = *inconspicuella teste* Sta., "Ent. W. Int.," v., p. 147 (1859);] H.-Sch., "Sys. Bearb.," vi., p. 40 (1852); v., p. 88, no. 112 (1854); Frey, "Die Tineen," &c., pp. 13-14, no. 1 (1856); "Lep. Schweiz," pp. 334-5 (1880); Fol., "Ann. Soc. Ent. Belg.," iii., p. 135, no. 16 (1859); Hofm., "Berl. Ent. Zeits.," iv., pp. 40-6, pl. i., fig. 4, ii., figs. 6-8 (1860); "Stett. Ent. Zeit.," xxx., pp. 299-303 (1869); Staud. and Wocke, "Cat.," p. 105, no. 1,166 (1861); 2nd ed., p. 267, no. 1,338 (1871); Kef., "Stett. Ent. Zeit.," xxii., p. 439 (1861); Now., "Ver. z.-b. Ges. Wien," xv., abh. 186 (1865); Mann, "Ver. z.-b. Ges. Wien," xvi., abh. 349 (1866); Ibid., xix., abh. 384 (1869); Hein., "Schmett. Deutsch Tin.," pp. 23-4, no. 8 (1870); Hartmn., "Kleinsch. Münch.," p. 45, no. 332, in part ♂ (1870); "Stett. Ent. Zeit.," xxxii., p. 166 (1871); "Mitt. Münch. Ent. Ver.," iii., p. 196, no. 1,338 (1879); Dohrn, "Stett. Ent. Zeit.," xxxii., p. 31 (1871); Nlk., "Lep. Fn. Estl.," p. 467, no. 384 (1871); [? Wocke, "Verz. Falt. Schles.," 42, no. 1,338 (1874) = ? *lichenella*;] Mill., "Cat. Lép. Alp.-Mar.," p. 296 (1875); Walgrn., "Bih. Svensk. Vet.-Ak. Handl.," iii. (5), p. 32, no. 6 (1875); Snell. v. Voll., "Tijd. v. Ent.," xix., pp. xl-li (1876); "Sepp's Ned. Vlind.," iii., p. 233, in part, ♂ only (1877); Peyr., "Cat. Lép. Als.," 2nd ed., ii., p. 84 (1882); Snell., "De Vlind.," pp. 445-6, in part (1882); Steud. and Hofm., "Ver. Nat. Württ.," xxxviii., pp. 182-3, in part (1882); Sorh., "Die Kleinschmett. Brand.," p. 141, no. 3 (1886); Barr., "Ent. Mo. Mag.," xxxi., p. 164, in part (1895); Reutti, "Lep. Fn. Bad.," 2nd ed., p. 305, no. 1,106 (1898); Tutt, "Ent. Record," xi., p. 166 (1899); *nec* Barr., "Ent. Mo. Mag.," xxxi., p. 163, in part (1895), xxxiii., pp. 125-129 (1897); *nec* Chapmn., Ibid., xxxii., p. 79 (1896); Walsm., Ibid., xxxiii., p. 129 (1897). [? *Lichenella*, Dup., "Hist. Nat.," supp. iv., 428-9, no. 562, pl. 84, fig. 8 (1842); "Cat. Méth. Lep. Eur.," p. 358 (1846); Bruand, "Cat. Lép. Doubs," p. 64, no. 1,183 (1847); "Mon. des Psych.," pp. 105-6 (1853), *vide* synonymy for *pineti*, p. 185., where these references probably belong].

Original figure and description.—Hübner's insect may be described as follows: ♂. Anterior wings pale ashy-grey, three faint incomplete transverse lines towards centre, the third (outside one) containing the darker discoidal lunule, the outer half of wings faintly reticulated. The posterior wings ashy-grey faintly reticulated towards outer margin. ♀. Apterous (with no characters that can be used for its determination), simple antennæ, and six legs [*Europ. Schmett.*, fig. 373 (273)]. The male appears (in a crude way) to satisfy Fischer's description and probably represents the species. Fischer's diagnosis reads as follows: "Alis dilutis cinereis subhyalinalis, anticis obsolete reticulatis" (*Abbild. Schmett.*, p. 87).

N.B.—Fischer von Röslerstamm, although insisting that Hübner's *triquetrella* is not *triquetrella*, Tr. (=*clathrella*, Fisch.), considers his *triquetrella* identical with that of Hübner, remarking that, although "it has the form of *S. clathrella*, yet the wings are narrower, as Hübner pretty correctly represents them." On the other hand, Fischer doubts whether the *triquetrella* of Zincken is that of Hübner. Guénée considers the *triquetrella* of Hübner and of Fischer to be identical. Zeller notes that Hübner's *triquetrella* is neither *pineti*, Zell., nor *triquetrella*, Fisch., and that he prefers to omit it altogether; Zincken's *triquetrella*, he says, appears to be identical with Hübner's, the added 'mihi' possibly indicating that he had both suggested the name and sent the insect to Hübner, whilst the statement that "the ♂ is very little smaller than *pseudobombycella*" contradicts the figure which is much smaller, indeed of the same size as Fischer's *S. triquetrella*. Zeller concludes that Zincken's note, "♀ without anal wool," is evidently based only on an example that has laid its eggs, for the female appears to belong to his (Zeller's) *triquetrella*. The fact is that Hübner's figure is undoubtedly a *Solenobia*, and about as bad as most of his smaller figures, and that its species is practically unrecognisable.

Imago.—Anterior wings 14mm. in expanse; unicolorous dark grey in colour (darker than *S. mannii* and *S. pineti*), the paler specklings exceedingly fine and sparse. The posterior wings grey, rather paler than the forewings (Stainton coll.). [Fischer and Bruand treat the pale specklings as the ground colour and say that the wings are reticulated with darker grey. It is questionable whether Zeller's description (which Hofmann says is a good one) refers to the species as represented by the specimens in the "Stainton" collection].

Sexual dimorphism.—*Male*: The thorax of the male dark grey, the abdomen somewhat lighter, the antennæ grey-brown with very fine and lighter pectinations, all the wings with a light ash-grey ground colour, the nervures and almost imperceptible transverse streaks (making the surface reticulated) being of a darker grey; a still darker, almost black, linear spot, at the end of the discoidal cell, the wings slightly glossy, the fringes light grey. The underside is entirely unicolorous grey, the dark central spot showing faintly through (Fischer). The ground-colour grey, very slightly tinged with yellowish-brown (consequently dust-grey); the clear whitish-grey dots are almost everywhere larger and fewer in number, and scarcely form reticulations behind the discoidal lunule; the latter forms an obscure, moderately thick streak, rather darker than the ground colour (Zeller). Hofmann notes (*Berl. Ent. Zeits.*, 1860, pp. 40-6) that Zeller has given a good description of the male which "varies from 5-7 lines; the head thickly haired, brown (sometimes nearly black), the antennæ and tarsi not ringed; the nervures of the hindwings showing great variation (4 and 5 sometimes separate, at others united, sometimes springing from a common stalk of greater or less length, with intermediate forms)" &c. *Female*: The female is very small, wingless, with perfect legs, cherry-brown head, grey filiform antennæ; the thoracic segments black, the abdominal light grey, spotted with darker; the anus brown, some tufts of white hairs beneath, the long ovipositor light brown or yellowish-grey. Dried examples are almost entirely black-brown (Fischer). Hofmann states that the female measures 2-2¼‴, the head small, dark brown, with prominent black eyes, the antennæ thread-like, dark grey, composed of 18-20 unequal segments, the last segment ending in a small pointed knob bearing a few bristles, the legs dark brown, with yellow 5-jointed tarsi. . . . The first three body-segments bear shiny, dark brown, dorsal plates, the ground colour dark grey, the dorsal bands and lateral spots dark brown, laterally the abdominal segments have black hairs. Ovipositor light grey, dark brown at base. Anal tuft greyish-white.

Comparison of S. triquetrella with its allies.—The male of *S. triquetrella* is considerably smaller than that of *T. pseudobombycella*, being scarcely as large as *sulzella*. It has, however, the form of *S. clathrella* only the wings are narrower, as Hübner also pretty correctly represents them (Fischer). The *triquetrella* of Hübner is very similar to the *clathrella* of Fischer v. R., which it resembles very much indeed, differing only from it in its shape, the presence of the discoidal lunule, and the form of its case (Guénée). *S. triquetrella* is of the size of *S. pineti* and much resembles it, in form and colour of body there appears to be no difference, but the wings are different, the forewings are posteriorly less enlarged, the costa is not at all concave, the inner margin is continued into the hind margin almost without indication of the anal angle, and the apex is somewhat more rounded (Zeller). Barrett notes that *S. triquetrella*, as known abroad, is larger and paler (than ?*S. inconspicuella*), with the reticulations or latticing very faint, and the forewings more pointed, much like *S. clathrella* but not so large. This is hardly so, although some descriptions may incline one to this opinion because certain authors have described the pale specklings as the ground colour, and the effect of the dark striæ that make up the mass of the wing, is then apt to be overlooked. The examples in the "Stainton" collection are very dark. Barrett's statement (*Ent. Mo. Mag.*, xxxi., p. 164) that Fischer's *triquetrella* is not a *Solenobia* is untenable, *vide*, *Ent. Rec.*, xi., p. 166.

Egglaying.—After copulation the ♀ maintains its position near the opening of the case, inserts its ovipositor and lays its eggs within.

Case.—The case (as represented in the "Stainton" coll. from examples found on the sand rocks at Ratisbon) is 8·5mm. long, and 2·3mm. wide, larger and coarser than that of *inconspicuella*, pale in colour, covered with sand. Fischer describes the case as the shape of a small barley-corn, triangular, dilated centrally, grey in colour, covered with grains of earth and sand or particles of plant *débris*, lined with white silk. That of the ♀ is larger than that of the ♂. Bruand says that the case is trigonal, a little elongated, *i.e.*, it is composed of three equal faces which are widened medially and terminate in a point at each end. It is soft, of a more or less dark grey colour, coated with particles of stone, earth, sand or minute pieces of lichen ; the lower (posterior) extremity is more pointed than the upper (anterior), where is the head of the larva. The case is frequently found upon old oaken fences, old walls exposed to the north, on rocks, and even on rocks well up the mountains. The same author notes a case from the high mountains, which he is inclined to refer here, clothed with almost white lichens. Zeller received cases from Mann, which he considered were specifically identical with the above. They were 4‴ long, more attenuated towards both ends than the case of *S. pineti*, with very noticeable, complete dorsal keel and flat ventral surface, so that the lateral keels are conspicuous, though blunt. The surface is clothed with fine, clear, dust-grey, particles of sand and earth, sometimes also with particles of chalk intermixed. At the anterior end coarser pieces are utilised, and one finds here also scraps of insect remains. Hofmann notes the length of the case as being 3-4 lines in length, that of the ♂ smaller than that of the female, triangular in section, with a flat base and swollen medially, narrowing to each side, and covered with sand and earth, the colour depending upon the tint of the material with which it is covered, many of the cases with loose particles of insects, &c., attached to the angles of the anterior end where they sometimes form a distinct collar, others are covered with such particles over most of the surface, whilst others again are nearly smooth. Hofmann believes that the material used for covering the case depends upon the environment, for some larvæ that he reared from eggs, and provided with sand, made almost perfectly smooth cases.

Larva.—Hofmann (who reared* the insect) describes the larva as having a light reddish-brown head with darker mandibles and light brown legs; the prothorax and mesothorax with shiny brown plates divided medially by a pale longitudinal line; on the metathorax are two small brown dorso-lateral spots. The remaining segments are yellow with many small brown warts and solitary white hairs. The anal plate is shiny brown. Bruand's description† does not agree with this. He says "the larva is grey, with the head black and shining, and with two corneous shields of a blackish-grey colour placed on the superior part of the pro- and mesothorax. These shields have the form of a long rectangle, they occupy all the upper parts of the anterior segments and are only separated by the incisions. One observes on the 3rd segment a small lateral dark grey spot, which replaces the shield, and below the stigmatal line, a small blackish-grey streak. The feet are blackish." As elsewhere noted (p. 175), we suspect that Snellen van Vollenhoven's description, although referred to *S. triquetrella*, really refers to *S. lichenella*.

Pupa.—No description of the pupa appears to be available. Hofmann notes that it has "the head and dorsum dark brown, the venter yellow-brown."

Food-plants.—*Dematium virescens* and *Chloridium viride* (Fischer), lichens on oak-palings and rocks (Bruand), lichens on tree-trunks (Hofmann).

Parasites.—*Hemiteles albipennis*, Rtzb., *H. gastrocoelus*, Rtzb., *H. leucomerus*, Rtzb., *H. melanarius*, Gr., bred by von Siebold; *Campoplex difformis*, Gr., *Hemiteles tristator*, Gr., bred by Hofmann.

Habits and Habitat.—Like the rest of the true Solenobias, this species reaches the imaginal stage in the early spring at Dresden, the male flying freely, the female sitting on the case after emergence, and, after copulation, laying its eggs therein, covering them with the hairs from the anal tuft, the cases are to be found on fences and tree-trunks around Dresden on the green wall-mould, the larvæ having crawled up after hybernation during the first sunny days of March (Fischer); the

* Hofmann, who bred what he termed "sexual" and "parthenogenetic" *S. triquetrella*, does not say to which of these forms the above description belongs.

† Stainton refers Bruand's *triquetrella* to *inconspicuella*.

larvæ are to be found on the lichens on walls and stones about Freiburg (Siebold); on lichen-covered rocks and trunks of oak, wild pear, and sometimes spun up on grass-culms and stems of *Spartium scoparium* at Ratisbon (O. Hofmann); on pine- and fir-trunks at Nuremburg (E. Hofmann); not rare at the end of April and commencement of May among the old trees in the forest of Soignes, where the cases occur on the bark of beeches in autumn, pupation taking place in the following spring, the pupation-period lasting 2-3 weeks (Fologne); the larvæ hybernate, attain their full size in spring, when they are to be found in the Doubs dept. on old oak palings and walls exposed to the north, and even on the rocks of the mountain wastes (Bruand); Gartner says that the larvæ live in September on fences, walls, &c., close to the ground, where they feed on *Dematium virescens*, hybernate in crevices or among grass, and appear again on their food with the first sunny days of March. He never found at the beginning or middle of March a male larva, but at the end of April and beginning of May he usually found empty female and full male cases. Steudel and Hofmann, who only found *lichenella* at Stuttgart and looked upon it as the parthenogenetic form of this species (*S. pineti*), considered that the sexuated *S. triquetrella* required animal food for its development, the cases being always clothed with fragments of devoured insects.

Time of appearance.—The earliest imagines appear sometimes in March, usually, however, in April, but sometimes as late as May at Dresden (Fischer). Harzer says that the females always emerge earlier than the males, which Zeller remarks is unexpected after his experience with *S. pineti*. The latter notes the cases as common after hybernation in March, the imagines appearing in March and April in Vienna; imagines in April and May in the Doubs dept. (Bruand), at the end of April and beginning of May in the forest of Soignes (Fologne), cases from September to April, the imagines in April and May at Ratisbon, bred May 2nd, 1868 (Hofmann), imagines on May 10th, 1865, at Lemberg (Nowicki), in May at Dobrudschka (Mann), April and May at Nuremburg (Hofmann), cases in February and March, the imagines also in March in Alsace (Peyerimhoff) [whilst Millière gives "July" for the imagines at Berthémont and Thorenc, which makes one suspect his species].

Distribution.—Austro-Hungary: Vienna, Tyrol—Montepiano, Dobrudschka, Dalmatia (Mann), Tyrol—Taufers, common (Weiler), Lavantthal (Höfner), Brünn (Gartner), Galicia—Lemberg (Nowicki). Belgium: Soignes (Fologne). ? Denmark (Bang-Haas). France: Doubs—mts. of Barchey near Les Ages (Bruand), ? Aube (Jourdheuille), [? Berthémont-les-Bains, ? Thorenc (Millière)]. Germany: Dresden (Fischer), Freiburg (Siebold), Ratisbon, Erlangen (Hofmann), ? Breslau (Wocke), Waldeck—Wildungen (Speyer), Munich (Hartmann), Dutzenteichwald near Nuremberg (E. Hofmann), Alsace, common (Peyerimhoff), Frankfort-on-Main (Koch), Steglitz, Finkenkrug, Hamburg, Halle, Stettin (Sorhagen), Ueberlingen, Lahr, Karlsruhe, Rhine Palatinate, Würtemberg (Reutti), Nassau (Rössler), Erfürt (Keferstein). ? Netherlands (Snellen). Roumania: Neamtz, Varatic, Slanic, Grumazesti, Tultscha (Caradja). Russia: Baltic provinces (Sintenis), Kemmern (Teich), Pichtendahl (Nolcken). Scandinavia: Sweden, East Gothland (Wallengren). Switzerland: Lausanne (La Harpe), ? Viège (Benteli).

Solenobia mannii, Zeller.

Synonymy.—Species: *Mannii*,* Zell., "Linn. Ent.," vii., pp. 346-8 (1852);

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* It is probable that Guénée's *triquetrella* belongs to *S. mannii*, the statement "folliculum sat elongatum tineiforme," at least points rather to this than to *S.*

H.-Sch., "Sys. Bearb.," v., p. 88, no. 110 (1854); Staud. and Wocke, "Cat.," p. 105, no. 1164 (1861); 2nd ed., p. 267, no. 1335 (1871); Mann, "Wien. Ent. Monats.," viii., p. 184 (1864); Now., "Ver. z.-b. Ges. Wien," xv., abh. 186 (1865); Sta., "Tin. Syr. As. Minor," 33, 76 (1867); Hein., "Schmett. Deutsch. Tin.," 22, no. 6 (1870); Staud., "Hor. Soc. Ent. Ross.," xv., p. 269 (1879); ? Peyer., "Cat. Lép. Als.," 2nd ed., ii., p. 83 (1882); Reutti, "Lep. Bad.," 2nd ed., p. 305 (1898); Car., "Iris," xii., p. 196 (1899). *Lichenella*, [? Dup., "Hist. Nat.," supp. iv., pp. 428-9, no. 562, pl. 84, fig. 8 (1842); "Cat. Mét.," p. 358 (1846)]; Sta., "Supp. Cat.," app. p. 17 (1851). [? *Triquetrella*, Gn., "Ann. Soc. Ent. Fr.," 2nd ser., iv., pp. 10-11, 14 (1846).] (Herrich-Schäffer notes that the *lichenella* of Fischer von Röslerstamm's collection is referable to this species.)

Original description.—*Solenobia mannii*, n. sp. ♂. Capite mediocri villis cinereo-griseis vix incrassato, corpore fuscescenti, griseo-villoso; alis anterioribus minus rotundatis, griseo-fuscis, confertim canescenti-reticulatis. ♀ fusca, lana anali sordide exalbida. *Talaeporia lichenella*, Mann, *in litt.*; Sta., *Suppl. Cat.*, p. 17. Vorderflügel $3\frac{1}{3}$-$3\frac{1}{2}'''$ lang, ein wenig gestreckter als bei *clathrella*, wegen des weniger eingedrückten Vorderrandes mit schwächer hervortretender Flügelspitze, die auch etwas zugespitzter ist, und mit flacherem Hinterrande; glanzlos, verdünnt graubraun mit sehr reichlichen, hellen, weisslich-grauen Punkten, welche gegen die Flügelwurzel am meisten von der Grundfarbe verdeckt sind, nach hinten zu aber immer deutlicher werden und ein dichtes Gitter mit feinen Oeffnungen bilden; gegen die Spitze bilden sie deutlichere Querreihen als in der Flügelmitte. Die Querader ist schwach verdunkelt und bildet einen verloschenen, wenig merklichen, kurzen Querstrich. Franzen etwas heller als die Grundfarbe. Hinterflügel gewöhnlich etwas spitzer als bei *clathrella*, einfarbig lichtbräunlich-grau wie die ganze Unterseite, wo die Vorderflügel jedoch ein wenig dunkler sind (Zeller, *Linnaea Entomologica*, vii., pp. 346-8).

Imago.—Anterior wings 15·5mm. in expanse; dark grey with paler specklings, finer at the base, coarser along the inner and outer margins. Posterior wings and fringes unicolorous grey (two examples in the series with much finer specklings and traces of darker discoidal lunule) [Stainton coll.].

Sexual dimorphism.—The *male* with the body clear-brown with brownish-grey (posteriorly somewhat paler) clothing of hairs, dirty-yellowish anal tuft. The legs pale-brown, scarcely haired, with the tarsi (of 1st pair) whitish. The forewings $3\frac{1}{3}'''$-$3\frac{1}{2}'''$ in length, a little more elongated than those of *S. clathrella*, on account of the less convex costa with less well-developed apex which is, however, more pointed; pale grey-brown in colour, not glossy, with many clear whitish-grey spots, which are less distinct at the base; these form a close lattice with fine openings. Towards the apex they form more distinct transverse rows than in the centre of the wing; the discoidal lunule slightly darkened, hardly noticeable. Fringes somewhat paler than the ground-colour. The hindwings somewhat more pointed than those of *S. clathrella*, unicolorous, pale, brownish-grey in tint. The whole underside is also pale brownish-grey the forewings rather the darker. The *female* smaller than that of *S. clathrella* and is (when

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triquetrella. Duponchel's *S. lichenella* (supp. iv., pp. 428, 527, pl. 84, fig. 8) appears to have been sent from Mann (Duponchel names Parreyss every time instead of Mann), and might belong to this species, but the statement "le fourreau a la forme d'un grain de seigle," does not in any way fit *S. mannii*, and on account of the "molécules terreuses noirâtres," with which the case is covered, Duponchel's species also cannot be referred to my *triquetrella* (Zeller).

dried) yellowish-brown, the ovipositor and dirty yellowish-white anal tuft (wool) are on the underside of the anal segment (Zeller).

Comparison of S. mannii with S. clathrella and S. pineti.—Most like *S. clathrella*, but with smaller head, lighter body, less rounded, more closely and distinctly reticulated forewings. It differs from *S. pineti* in its somewhat larger size, stronger build, and the somewhat larger whitish-grey spots with narrower dividing lines, giving the markings a distinctly latticed appearance. *S. mannii* is less than *S. clathrella* in size, and is also of more delicate appearance. Head shaggy with grey hairs on the crown and face; the antennæ as in *S. clathrella* (Zeller). Chapman notes that the *S. mannii* in Constant's collection are "rather smaller and paler, slightly reddish, very delicate, otherwise not unlike, superficially, a small *T. tubulosa*; the case, however, smaller, indistinctly trigonal, except at one end."

Case.—The cases in the Stainton collections are 9·4mm. long and 2·3mm. wide, almost cylindrical in outline, covered with particles of stone, &c. Zeller says that "the cases are formed almost alike in both sexes; that of the ♂ is $4\frac{1}{2}'''$ long, that of the ♀ is $4'''$. The surface is covered with black particles of earth and lichen and with small grains of sand, sprinkled amongst them. The cases are somewhat long, bluntly trigonal (but with rounded ends) slightly spindle-shaped, with a more distinct dorsal edge and flattened ventral side, at the hinder end somewhat more pointed than in front. They consequently differ extraordinarily from the cases of *S. clathrella*, and from those of *S. triquetrella* by their greater length and more slender form. That the cases belong to the species here described as *S. mannii* is certain, for from a ♂ case which I received from Mann, the imago, having failed to emerge, had one of its forewings fully-developed, hanging from the pupa-case, whilst the other wings, crippled, were sticking partly in the pupa-case."

Time of appearance.—March and April, 1863, flying in the morning sun at Vienna (Mann). Mann also took the species in middle April flying in the morning sunshine in bushy places on mountain ridges near Brussa. Staudinger doubts whether these were really quite identical with the Austrian *S. mannii*. He adds that the single Macedonian *Solenobia* he has, appears to be *S. inconspicuella*. Cases on rocks in April near Vienna (Herrich-Schäffer), May 23rd, 1865, in woods near Lemberg in Galicia (Nowicki), end of March and April at Colmar (Peyerimhoff).* Cases on trunks and palings in April and May at Grumazesti (Caradja).

Distribution.—Asia Minor: Brussa (Mann). Austro-Hungary: Vienna, Mödling (Mann), Galicia—Lemberg (Nowicki). ? France (Duponchel). Germany: Alsace—Florimont, near Colmar, limestone hills of the Vosges (Peyerimhoff). Roumania: Grumazesti (Caradja).

Solenobia pallida, Staudinger.

Synonymy.—Species: *Pallida*, Staud., "Hor. Soc. Ent. Ross.," xv., p. 268 (1879).

Original description.—*Talaeporia pallida*, Stgr., n. sp. Ich brachte ein am 10 Mai, wahrscheinlich hinter unserem Hause gefangenes frisches Stück mit, das einer neuen Art angehört, und sandte Johann

* Peyerimhoff says that Heinemann's description agrees with the Alsace specimens except for the colour, which is slaty-grey and not clear grey.

später noch zwei leider recht mässige Stücke ein, von denen das eine am 14 April gefangen ist. Flugelspannung 16mm. Vorderflügel ganz lichtgrau mit ziemlich starkem Seidenglanz, und ganz schwach fein gekörnt. Hinterflügel etwas dunkler grau mit sehr langen Fransen am Innenrand. Kopfhaare licht grau, schmutzig gelbweiss. Fühler kurz bewimpert, etwa wie bei *alpestrella*. *T. pallida* unterscheidet sich sofort durch die viel bleichere Färbung von allen andern *Talaeporia* Arten. *Alpestrella* hat eine fast ähnliche blasse Grundfarbe, aber da sie sehr stark dunkelgegitterte Vorderflügel hat, auch etwas kleiner und schmalflügeliger ist, so kann sie nie mit *pallida* verwechselt werden. *Conspurcatella* hat gleichfalls stark dunkelgefleckte Vorderflügel und sehr lang gewimperte (gekämmte) Fühler. Ebensolche Fühler hat die übrigens viel kleinere und dunklere *lapidella*. Mit den anderen grösseren und dunkleren (gelbbraunen) Arten, wie *politella*, *borealis*, und *pseudobombycella*, ist *pallida* nun gar nicht zu verwechseln. Ebenso ist sie viel lichter als *improvisella* und hat keinen gelben Kopf, wie diese Art. Die Vorderflügel scheinen im Verhältniss kürzer und stumpfer zu sein als bei den andern Arten, sie sind sehr schwach dunkler gekörnt oder gegittert, weit weniger als bei *pseudobombycella* (Staudinger, *Hor. Soc. Ent. Ross.*, vol. xv., p. 268).

Imago.—Anterior wings 15·5mm., grey (rather paler than *S. mannii*), very minutely but abundantly speckled. Posterior wings and fringes pale grey. Amasia, Staudinger (Stainton coll.).

N.B.—This species is exceedingly near *S. mannii*, and is, undoubtedly, a true *Solenobia*, judged from the specimen in the "Stainton" collection. If this latter be correctly named (and as it is labelled as coming from Amasia, and sent by Staudinger, one cannot doubt it) one is entirely at a loss as to why Staudinger made the above comparison with the specimens of *Bankesia* and *Taleporia* instead of with *S. mannii* and *S. clathrella*, to which it bears the closest possible resemblance.

Solenobia clathrella, Fischer von Röslerstamm.

Synonymy.—Species: *Clathrella*, F. v. R., "Abbild.," pp. 84-6, pl. xxxviii., figs. 1 *a-d* (1837)*; Sch., "Stett.E.Zeit.," 85 (1845); Zell., "Isis," 1839, p. 182; "Linn. Ent.," vii., pp. 344-6 (1852); Dup., "Hist. Nat.," supp. iv., p. 430, no. 558, pl. 84, fig. 9 (1842); "Cat. Méth.," p. 358 (1846); Gn., "Ann. Soc. Ent. Fr.," xv., 2nd ser. iv., pp. 10, 14 (1846); Hdrch., "Lep. Eur. Cat.," p. 78, no. 16 (1851); Sta., "Supp. Cat.," app. 17 (1851); "Tin. S. Eur.," pp. 283, 322 (1869); Ghil., "Fn. Ital.," p. 78 (1852); Brd., "Mon. des Psych.," pp. 101, 103-4, pl. ii., figs. 77 *a-b* (1853); H.-Sch., "Sys. Bearb.," v., p. 88, no. 109 (1854); Staud. and Wocke, "Cat.," p. 105, no. 1,163 (1861); 2nd ed., p. 266, no. 1,334 (1871); Hein., "Schmett. Deutsch. Tin.," pp. 21-2, no. 5 (1870); Ersch. and Feild, "Cat. Lep. Ross.," p. 52 (1870); Walgrn., "Bih. Svensk. Vet.-Ak. Handl.," iii. (5), p. 32, no. 3 (1875); Hrtmn., "Mitt. Münch. Ent. Ver.," iii., p. 195, no. 1334 (1879); Sand, "Cat. Lép. Auv.," p. 154, no. 1,334 (1879); Snell., "De Vlinders," &c., p. 445 (1882); Sorh., "Die Kleinschmett. Brand.," p. 336, no. 2 (1886) [*nec clathrella*, Brd., "Ann. Soc. Ent. Fr.," 1844, p. 175 = *Bacotia sepium*]. *Triquetrella*, Tr., "Die Schmett.," x. (1), pp. 169-170, 275 (1834).

Original description.—Die Flügel von *clathrella* haben zwar eine mäusegraue Grundfarbe, sie ist aber mit einem schwachen Hellbraun überzogen, wie es bei *triquetrella*, Hb., der Fall nicht ist. Die Sehnen, und die kleinen, zwischen ihnen stehenden Querstrichelchen, wodurch eine Art von Gitter entsteht, sind graubraun. Obwohl die Vorderflügel, nach Treitschke, keinen Metallglanz haben sollen, so finde ich

* The date of this part, usually given as 1834, should be 1837 (Durrant).

denselben doch auf meinen Exemplaren schwach angedeutet, aber nicht so stark, als er es bei der ihr sonst, auch in der Grösse und Gestalt sehr ähnlichen *pilulella*, Hb., fig. 409, ist. Das Weib ist mir unbekannt, nach Treitschke soll es glänzend schwarzbraun sein, eine schwarze Legeröhre und etwas weisse, nach Zincken aber gar keine Afterwolle haben. Dieses bewiese wieder, dass Zincken's Art nicht meine *triquetrella* ist, weil diese letztere ziemlich viel weisse Afterwolle und eine hellbräunliche Legeröhre hat, wodurch sie sich auch von *clathrella* unterscheidet. Es müsste denn der Fall sein, das Zincken ein Weib vor sich hatte, an welchem durch das Eierlegen die Afterwolle schon verloren gegangen war. Das Weib, welches Hübner, neben dem Mann abbildete, ist so klein, dass die Legeröhre und Afterwolle nicht bemerkbar gemacht werden konnten, aber eben diese Kleinheit beweiset wieder, dass es nicht zu *clathrella*, gehören kann, weil dessen Weib viel grösser sein muss; das meiner *triquetrella* ist aber wirklich so klein, wenigstens nicht viel grösser (Fischer, *Abbildungen Ber. Ergänz. Schmett. Microlepidopterologie*, pp. 84-85).

N.B.—Zeller notes Fischer's figure as recognisable for the species, but failing in shape and colour. He confirms Treitschke (and contradicts Fischer) that the forewings have a metallic gloss. Guénée notes that it has "mac. cellularis nulla," and Fischer figures no discoidal lunule, but Zeller notes that one is present. He further considers Duponchel's figure recognisable, and states that according to the larva it can be no other. Duponchel distinguishes his *S. clathrella* from *S. lichenella* in that the former has the forewings of a paler grey, and with a slightly reddish tinge. Zeller thinks Tengström's *S. clathrella* was probably *S. pineti*, but gives no reason for the supposition.

Imago.—Anterior wings 16mm.-17·5mm. in expanse; dark grey (resembling *pineti* in its depth of colouring); specklings but little paler than ground colour (hence very unicolorous in appearance). Posterior wings and fringes dark grey (Stainton coll.).

Supposed British example of S. clathrella.—Dr. Mason has a specimen of *S. clathrella*, slightly browner in tone than any in the "Stainton" and "Frey" collections, otherwise in size, shape, and general appearance, especially in the rough, brown head, and rather thickly clothed abdomen, identical with two examples in the "Stainton" collection (received from Mann, and bred April 1850 from larvæ found at Vienna, on sloe). The large size and wing shape make it impossible for the specimen to be anything but *clathrella* or *mannii*, and, although the pale mottling of the forewings is exceedingly well-marked, we have no hesitation in referring it to *clathrella*. Except that it is supposed to have come from Sang, Dr. Mason has unfortunately no information to offer about the specimen.

Sexual dimorphism.—*Male:* The head covered with dark grey-brown hairs, which stand out all over it; antennæ of length of abdomen, fine, weakly dentated towards brown tip, fringed with pale grey hairs, white-grey on dorsal area, the bases of joints dark; body black; thorax and abdomen sparsely haired, the anal end thickly clothed with light hairs; legs, hairy, brown, with white-grey tips (to 1st pair); forewings 3·75‴-4‴ in expanse, somewhat elongated, slightly convex on middle of costa, wing apex strongly rounded. Ground colour pale grey-brown, not shiny, darker at base and along the costa; a number of small, pale grey spots give a latticed appearance to the wing, more distinct towards hind margin. The principal nervures and nervules somewhat darker than the ground-colour, forming fine lines but not at all striking. The outer edge of fringes lighter than the ground-colour. Hindwings rather long, blunt, light brownish-grey, not glossy, fringes paler. The whole underside is scarcely darker than the upperside of the hindwings (Zeller). Bruand notes the male as having elongated wings with the costa slightly depressed centrally; the colour grey-brown, slightly darkened, but the forewings are marked with small transverse blackish-grey striæ, forming, with the nervures, which are of the same tint, a lattice work, which makes the wing appear as if covered with a curtain. The head and body are of the same dark colour as the striæ and the nervures. The legs and antennæ are rather paler. The latter are simply ciliated, with distinct joints, and with a tuft of scales forming a sort of spine, on the left and right, at each joint. *Female:* According to Treitschke, glossy, black-brown; antennæ black; white anal tuft, ovipositor black. Zeller's dried example was yellowish-brown, the antennæ and ovipositor similarly coloured, the anal tuft pale grey, exteriorly whitish. Bruand describes the female as "blackish-grey, with short legs, appears similar to that of *F. crassiorella*, although the dried specimens examined do not allow one to see whether it has, like that species, square plates on the dorsal area."

Comparison of S. clathrella with its allies.—Zeller states that this is "the largest member of the genus, distinguished more particularly by its larger head, which appears still larger from its thickened covering of hairs, whilst its blacker body shining through the hair is also a good distinction. It is most like *mannii*, from which it differs not only in the characters just mentioned, but also in the deeper 'going-back' costa and the more projecting and rounded apex of the forewings, the whitish-grey spots on the forewings are also somewhat larger and more obsolete; *S. triquetrella* is always smaller, more delicate, with less blunt forewings, and only slightly sprinkled with whitish-grey. My other three species are much smaller."

Case.—The cases in the "Stainton" collection are very different from those of *S. mannii* but somewhat similar to those of *S. triquetrella;* 12·5mm. long and 3mm. wide, thinning off at the ends which are somewhat blunt and rough; covered with particles of brownish earth, sand, &c. (The larvæ that made these cases were found on sloe near Vienna, by Mann). The cases vary according to the sex and make the species easily recognised. They are 5''' long, of a brownish earth-colour, freely covered with particles of earth and sand, especially on the edges and head end, rarely with pieces of beetles. The male case is much distended, longish, more attenuated anteriorly than posteriorly, bluntly trigonal, the sharpest edge dorsal, the two lateral are considerably rounded off, more so in some than others. The larva fixes the case just before pupation by the "head end" on a dry grass stem, and swings to and fro in the wind. The interior of the case is smooth, tapestried with glossy white silk. The female case (F. v. Rösl., 1 *c, d*) is of the same length but only half the width of the male case, and does not appear to belong to the same species. It is also much more attenuated towards the unfastened end than the ♂ case, yet less so, than the attached end. It is very firmly attached to a stem and lies quite close to the latter (Zeller). Fischer von Röslerstamm has noted that Treitschke has described a wrong case as belonging to this species. Bruand describes the case as being large, much enlarged medially, almost ovoid in form, but with the obtuse edges (or ridges) feebly indicated, so that it has a somewhat trigonal appearance. The case is soft, the "parois" of it slightly thickened, greyish-black, with some very small particles of earth on its surface.

Pupa.—The pupa appears to be fastened in this spacious case chiefly at the tail. It is somewhat glossy, yellow-brown in colour, and protrudes far on emergence (Zeller).

Food-plants.—Lichens growing on walls (Treitschke), on old fences and walls (Bruand), on *Genista* (Herrich-Schäffer), lichens on sloe-bushes (Mann).

Time of appearance.—Cases in April and May, the imagines in the latter month (Hartmann), June (Duponchel), cases in May and June, imagines in July (Schaum).

Distribution.—Austro-Hungary: Buda (Treitschke), Vienna (Mann). ? Finland (Erschoff). France: An alpine species—Guéret (Sand), Savoy (Ghiliani). Germany: South Germany (Herrich-Schäffer), Munich (Hartmann), Nieder-Sachsen (Treitschke). Italy: Piedmont (Ghiliani). Russia: St. Petersburg, ? Esthonia (Erschoff and Feild). Scandinavia: Sweden—Scania, Gothland, Upland (Wallengren). Switzerland: Locarno (Chapman).

Nearctic species of Solenobia.

Only one North American species of *Solenobia* (*in sensu strictu*) appears to have been named, *viz.*, *walshella*, Clem., and there are in the "Walsingham" collection two males bearing this name which are regarded by Durrant and Walsingham as representing two species. The one considered "to be the true *walshella* is of the size of *S. triquetrella*, but quite distinct, more mottled with brown than *S. wockii*, and not such a smooth-looking species. The other (with a case) is close to *S. triquetrella*. The name '*walshella*' probably does duty for a large number of species (and perhaps genera). Clemens describes *walshella* as without ocelli. Lord Walsingham and I have carefully studied both specimens, and consider them both to be *Solenobia* in your sense" (Durrant).

Family: TALEPORIIDAE.

This family is very closely allied to the Solenobiids, from which, however, it may readily be distinguished by the presence of ocelli in the male imagines, and by the position of the larval tubercle ii which is placed directly behind i on the abdominal segments. In the possession of ocelli this family comes nearer to the Diplodomids and the general larval habits are not at all dissimilar. The yellow speckling of the male *Taleporia tubulosa* is not at all unlike that of *Diplodoma herminata*, but the Taleporiid females are almost wingless and this affords a sharp separating line between the two families. There appear to be only two genera yet recognised in this family—*Bankesia* and *Taleporia*—the former thinly scaled, strongly marked with the characteristic pale Solenobiid specklings (here very large) but heavily mottled with darker markings. In many respects *Bankesia* appears to form a strong connecting link between the Solenobiids and Taleporiids, the superficial facies tending to the former, whilst structurally it belongs to the latter, at the same time the imagines, like those of *Solenobia*, appear in the early spring. The darker-coloured imagines of *Taleporia* (*tubulosa*, *politella*, &c.) are more thickly scaled, have the characteristic Solenobiid specklings much reduced or absent, and appear in the early summer. The eggs are laid by the almost wingless females (which rest on the outside of the case) within the larval case, and are mixed with hairs from the anal tuft, and, like those of the rest of the Micro-Psychids, the pupa-cases of both sexes protrude from the puparium. Structurally the larva has, in the migration of the posterior trapezoidal tubercles (ii) behind the anterior (i), reached a higher Psychid plane than *Diplodoma* and *Solenobia*, whilst the pupa is of distinct Micro-Psychid type. There are but few species described as belonging to this family, and even of those included by various authors in the genus *Taleporia*, some appear to be wrongly placed. We have in Britain only one generally recognised representative in each genus. In *Taleporia* we have *tubulosa*, in *Bankesia*—*staintoni*, Walsm., hitherto known as *conspurcatella*, Zell. There is, however, the unique *douglasii* to be considered; certainly it appears to us to be distinct from any described *Solenobia*, and, so far as one can judge from its superficial appearance, it is a *Bankesia*. One, however, is unable with an unique specimen to risk the examination that would positively determine the matter.

Subfam.: TALEPORIINAE.
Tribe: TALEPORIIDI.
Genus: BANKESIA, Tutt.

SYNONYMY.—Genus: *Bankesia*, Tutt, "Ent. Record," xi., p. 191 (1899); Walsm., Ibid., pp. 256 *et seq.* *Talaeporia*, in part, [Mann and] Zell., "Stett. Ent. Zeit.," 1850, p. 59; Hdrch., "Lep. Eur. Cat.," p. 78 (1851); H.-Sch., "Sys. Bearb.," v., p. 113 (1854); Sta., "Ent. Ann.," 1862, p. 120 (1861); "Tin. S. Eur.," pp. 55, 70-1, 332 (1869); Staud. and Wocke, "Cat.," p. 105 (1861); 2nd ed., p. 266 (1871); Hein., "Schmett. Deutsch. Tin.," pp. 19-20 (1870); Mill., "Cat. Lép. Alp.-Mar.," p. 295 (1875); Rössl., "Stett. Ent. Zeit.," xxxviii., p. 376 (1877); Hrtmn., "Mitt. Münch. Ent. Ver.," iii., p. 195 (1879); Curò and Turati, "Bull. Soc. Ent, Ital.," xv., p. 3 (1882); Sorh., "Die Kleinschmett. Brand.," p. 326 (1886); Chrét., "Le Nat.," p. 103 (1893); Const., "Ent. Rec.," xi., pp. 255-6 (1899); Walsm., Ibid., pp. 256-8 (1899). *Psyche*, in part, Bruand, "Mon. des Psych.," pp. 103, 118 (1853). *Solenobia*, Zell., "Linn. Ent.," vii., p. 356 (1852); Sta., "Ent. Ann.," 1868, pp. 127-9 (1867); Ibid., p. 2 (1874); Swinton, "Ins. Var.," pp. 2-3 (1880); Berce, "Bull. Soc. Ent. Fr.," xxxvii., 4th ser. viii., pp. xlix-l (1868). *Talaeporina*, Seeb., "Ann. Soc. Esp. N.H.," viii., p. 124 (1879). *Taleporia*, Meyr., "Handbook," pp. 775-6 (1895).

The generic name *Bankesia* was first proposed in the *Entom. Record*, vol. xi., p. 191, when *conspurcatella*, Sta., *nec* Zell. = *staintoni*, Walsm., was cited as the type. As the generic diagnosis had already been drawn up, and was based on British examples of so-called *conspurcatella*, since renamed *staintoni* by Walsingham, *staintoni* must be considered the true type of the genus. This genus, which is very distinct from its allies, may be diagnosed as follows:

OVUM.—Oval, surface smooth, delicate in texture, laid in larval case.

CASE.—Large, coarse, trigonal in transverse section, covered with coarse sand, pupa-case of both sexes protrudes at emergence of imago.

LARVA.—Head retractile; thoracic segments also partially retractile, covered with corneous plates; true legs strong, a prominent rounded eminence bearing a short thick hair between the true legs on either side; the basal joint of the true legs swollen, with strong ventral bristles; prolegs short with oval of hooks broken on inner edge; the abdominal segments flattened ventrally, formed of distinct plates; the anal segment large, swollen, with large, triangular, corneous dorsal plate; tubercles i and ii trapezoidal, ii just outside i; on the pro- and mesothorax tubercles i and ii fused into one plate; antennæ 3-jointed; eyespot with only one (? two) ocelli discernible.

PUPA.—*Male:* Dorsal head-piece moderate, labrum large and square, two hairs on each side; maxillæ triangular, with a very large maxillary palpus; mandibles rounded, projecting; labium divided, the labial palpi project, divided for two-thirds length; antennæ to end of wings, and wings to end of 5th abdominal; the

2nd pair of legs beyond wings, and 3rd pair beyond 2nd, the 1st pair shorter than wings; tubercles as in larva; dorsal spines form patch in front of i on abdominal segments 3-8; long recurved setæ on 8-10, two dorso-anal spikes close together; spiracles on small conical projection; two swollen bulbs on venter of 9th abdominal; movable segments 3-7. *Female:* Mouth-parts modified, labium in three sections, maxillary palpi obsolete; antennæ only to end of labial palpi; wings to end of 2nd abdominal; movable segments 3-6; eyepiece large; dorsal spines, recurved setæ, and dorso-anal spikes much as in male.

IMAGO.—*Male:* Wings elongate, strongly speckled (as in *Solenobia*); tongue obsolete; ocelli as in *Taleporia*, antennæ with each segment thickened basally and distally, with two transverse rows of scales dorsally, and a transverse row of long hairs at base ventrally, a few shorter hairs in front of this row. *Female:* Nearly apterous, legs well-developed, anal tuft strongly developed; ovipositor as in *Taleporia* and *Solenobia*, emerges from case for copulation, and remains outside for egg-laying.

The genus *Bankesia* has been but little studied, and, at present, only two species can be considered as well known, *viz.*, *B. alpestrella* a widely-distributed species in the Alps of central Europe, and the species that occurs in England, Belgium, ? France and Corsica, and that has, until quite recently, been known as *conspurcatella*, Zeller, but which Walsingham has recently determined to be distinct from Zeller's Tuscan type, and for which he has proposed the name *staintoni*. Besides these, Walsingham has described another species taken on the slopes of the Monte d'Oro, near Vizzavona, in Corsica, under the name of *montanella*, whilst Constant has also described a species allied to *conspurcatella* and *staintoni*, as *vernella*. This occurs in the Alpes-Maritimes in March, and Chapman notes it as being similar to *staintoni*, but larger, more uniformly dotted and rarely with the dark mark on the inner margin. Another of Constant's species is named *defoliella*, and is reported from the Estérels and Alpes-Maritimes in November. Some doubt, however, has been expressed as to whether this be really a *Bankesia*, its antennal structure disagreeing therewith. It appears probable, therefore, that the genus is more extensive than has been generally supposed. The life-histories of *B. alpestrella* and *B. staintoni* have been fairly thoroughly worked out, although until now the latter has not been published. We have already noted (p. 200) our uncertainty as to the position of *douglasii*. Its superficial appearance leaves us no option but to place it in this genus. Durrant says that "it strongly recalls *staintoni*, and one might assume that this conformity would be also indicated in the larval stage, but in any case neither *douglasii*, *vernella* nor *staintoni* are identical with the true *conspurcatella*."

BANKESIA DOUGLASII, Stainton.

SYNONYMY.—Species: *Douglasii*, Sta., "Ins. Brit.," pp. 19-20 (1854); "Man.," ii., p. 286 (1859); Meyr., "Handbook," &c., p. 775, in part (1895); Walsm., "Ent. Rec.," xi., p. 257 (1899). *Triquetrella*, Dbld., "List," 2nd ed., p. 27 (1859), *nec* Treitschke. [Meyrick's reference of this species to *wockii*, Hein., appears, after comparison of the specimen with *wockii*, to be erroneous.]

ORIGINAL DESCRIPTION.—*Solenobia douglasii*, n. sp. Alis anticis vix angustis, apice paullulum rotundato, cinereo-fuscis, apicem versus saturatioribus, maculis numerosis irregularibus mediocribus fere distinctis albidis. Exp. al. 6 lin. Head, face, and antennæ greyish-fuscous. Anterior wings hardly narrow, with the apex slightly rounded, greyish-fuscous, towards the apex rather darker, with numerous irregular rather large whitish spots somewhat sharply defined; cilia whitish, with some fuscous patches opposite the fuscous portions of the hinder margin. Posterior wings pale-grey with paler cilia. A single specimen, in the collection of Mr. Douglas, taken by him at Birch Wood in the spring (Stainton, *Insecta Britannica*, pp. 19-20).

Note on the unique specimen of B. douglasii.—This certainly appears to be most decidedly a species quite distinct from any of the known Palæarctic species; and we cannot even imagine that it can possibly be an extreme aberration of any of them. We have little doubt that it is a *Bankesia*, and its superficial appearance is very like *B. staintoni*, although, owing to its pale ground colour, it reminds one even more of *B. alpestrella*, whilst it shows no really very close connection therewith. The darker fuscous markings are prominent and take the form of somewhat irregularly oblique lines from costa to outer margin before the apex, but the specimen is aberrant, for on the left forewing these form a V with the point on the outer margin. The other more regular dark markings of the right forewing are also aberrant on the left, where the discoidal cell is in a pale transverse band distinctly edged on its inner margin by a fuscous line which separates the basal and outer areas of the wing. No such band is observable on the right forewing. There is a distinct but small fuscous spot about halfway along the inner edge of the forewing (in the same position as the larger one in *B. staintoni*), whilst a paler marginal blotch just within this spot is also distinctly traceable.

Comparison of S. douglasii with S. inconspicuella.—Anterior wings, 6‴ in expanse, broader than those of *S. inconspicuella*, the tip less rounded, the whitish spots more sharply defined, and the dark marginal spots wanting. Perhaps only a form of *S. inconspicuella* (Stainton).

Locality.—Surrey: Birch Wood (Douglas).

Bankesia staintoni, Walsm.

Synonymy.—Species: *Staintoni*, Walsm., "Ent. Record," xi., pp. 257-8 (1899). *Conspurcatella*, [? Bruand, "Mon. des Psych.," pp. 103, 118, no. 76, pl. ii., fig. 76 (1853)]; Sta., "Ent. Ann.," 1868, pp. 127-9, (pl.) fig. 3 (1867); 1874, p. 2 (1874); Hein., "Schmett. Deutsch. Tin.," pp. 19-20, in part (1870); Staud. and Wocke, "Cat. Lep. Eur.," p. 266, no. 1,330 (1871); [? Rössl., "Stett. Ent. Zeit.," xxxviii., p. 376 (1877)]; [?Seeb., "An. Soc. Esp. N.H.," viii., p. 124 (1879); ?Hrtmn., "Mitt. Münch. Ent. Ver.," iii., p. 195, no. 1,330 (1879)]; Swinton, "Ins. Var.," pp. 2-3 (1880); Curò and Tur., "Bull. Soc. Ent. It.," xv., p. 3, in part (1882); [?Sorh., "Die Kleinschmett. Brand.," p. 326, no. 1 (1886)]; Meyr., "Handbook," &c., pp. 775-6 (1895); Chapman, "Ent. Mo. Mag.," xxxii., p. 80 (1896). [Heinemann considers (evidently following Zeller) this species to be possibly the *lapidicella* of Guénée (*Ann. Soc. Ent. France*, iv., p. 14 (1846)=*pectinella*, Dup. (*Hist. Nat.*, supp. iv., p. 512, pl. 89, fig. 6), which is incorrect.]

Original description.—A careful description of the British species hitherto confused with *conspurcatella*, Zell., will be found, *Ent. Ann.*, 1868, pp. 128-9, (pl.) fig. 3, of which I have the original MS., but as this was evidently taken from Belgian specimens sent by M. Fologne, before Mr. Swinton's English specimens were received, it cannot at present be safely applied to an English type, although it would fit it extremely well*. . . . It would be appropriate to apply to this the name *staintoni* (Walsingham, *Ent. Record*, xi., p. 257). Stainton's description reads as follows: "Alis anticis angustulis, albido-stramineis, nitidis, concinne fusco-punctatis, maculis tribus majoribus fuscis, prima

* We have no hesitation in stating that the specimens in the "Stainton" coll. received from M. Fologne (Brussels) and Swinton (Southampton) are specifically identical.

dorsi basim versus, secunda dorsi ante medium, tertia disci pone medium; antennis distinctissime ciliatis. Exp. al. $5\frac{1}{2}$-$6\frac{1}{2}$ lin. Head fuscous. Face fuscous, mixed with whitish straw colour. Antennæ pale fuscous, very distinctly ciliated. Anterior wings shining, whitish straw colour, delicately spotted with fuscous, and with three larger fuscous spots, the most distinct at the end of the discoidal cell; on the inner margin, a little before the middle, is another almost as distinct, and the third lies on the inner margin near the base of the wing; the small spots along the costa beyond the middle are particularly distinct; cilia fuscous at the base, then paler fuscous, intersected by several faint dashes of whitish straw colour. Posterior wings pale grey, with a faint purplish gloss; the cilia silky pale grey. In markings this perhaps comes nearest to *S. inconspicuella* but is distinguished at a glance by the very different ground colour, by the more opaque hind-wings, and by the distinctly ciliated antennæ" (Stainton, *Ent. Annual*, 1868, pp. 128-129). Stainton adds: "This description had been written out for M. Fologne, whilst under the impression that the insect was new to science. . . . but in working at my forthcoming volume, *The Tineina of Southern Europe*, when I came to the description of *Solenobia conspurcatella*, it at once occurred to me that this was my Southampton friend, and, on comparing description and specimens together, this identity was at once apparent." Walsingham, by comparison of British examples with Zeller's original type, has arrived at a contrary opinion.

Imago.—Anterior wings average 11mm.-13mm., shining whitish straw coloured, delicately spotted with fuscous, with three larger fuscous spots, the most distinct at end of discoidal cell, the second on inner margin a little before the middle, the third on inner margin near the base; the small spots on outer half of costa particularly distinct; cilia fuscous at base, then paler fuscous intersected by faint dashes of straw colour. Posterior wings pale grey, with a faint purplish gloss, cilia pale silky grey.

Variation.—The series in the "Stainton" (continental) collection consists of: (1) Five examples labelled "Fologne, v, '61," which vary from 10·5mm.-14mm. in wing expanse, and also vary in the size and distribution of the dark fuscous spotting. (2) Two specimens and a case (numbered 3,313), 12·5mm. and 14mm. in expanse quite similar to the others. The series in the "Frey" collection consists of:—(1) Two examples labelled "Brüssel" (the larger one set exactly as those in the "Stainton" collection labelled 3,313). (2) Four specimens from Ajaccio, labelled "*S.* spec.?." The first two specimens in this series are rather more thickly sprinkled with dark fuscous spots than are the darkest Brussels examples, the third is so little sprinkled and the spots so small that one is reminded of the palest specimens of *B. alpestrella*, the fourth is intermediate, though tending to the pale ill-marked form. This last appears to be almost identical with a Southampton example we have. That these four all represent one species is certain from the rather narrower wings and, I think, the rather more convex costa of the forewings (though the first example does not show this). They are very uniform, 12·5mm., in wing expanse. In spite of their variation we believe that they are specifically identical with our British insect. In the "Stainton" British collection, are four of Swinton's specimens from Southampton Water, poor as to condition, but varying in the amount of dark fuscous speckling; there is also a specimen labelled "bred March '92, Southampton Water (Bankes)," 13mm., which is very dark.

Comparison of B. staintoni and B. conspurcatella.—The differences cited by Walsingham as distinguishing *B. staintoni* from Zeller's type of *conspurcatella* are, on the whole, perhaps less than those existing between the former and two specimens in the "Frey" collection from Ajaccio, but which we have little doubt are specifically identical with our British insect, and one feels that one would like a fair representative lot of Mann's original captures, or a modern series from Pratolino or Pratovecchio, to determine the matter more definitely. Walsingham's comparison of the two insects reads as follows: "As compared with the true *conspurcatella*, Zell., the English species is distinctly darker, the ground colour having a more yellowish tint, the darker markings being more distinctly brownish-fuscous (not 'gelbbraunen' as described by Zeller), the hindwings are much darker than in any other species of the *conspurcatella* group, and have a purplish tinge. Another very noticeable point is that in the true *conspurcatella* the outer half of the cilia of the forewings is pale yellowish, as described by Zeller [*Linn. Ent.*, vii., 357—'Franzen an der Wurzelhälfte braungrau, aussen bleich-gelblich'], whereas in the British species they are noticeably shaded by a series of strong brownish-fuscous streaks running through them from the dark basal portion, which, however, in both species, occupies somewhat less than one-half of their total length. The forewings are also slightly less elongate, and with a more rounded apex, having a generally more abrupt appearance. The legs and abdomen are also of a very distinctly darker shade, to which the terms of Zeller's description: 'Körper gelbbräunlich mit bleich-ocherbräunlicher Behaarung und solchen Fühlern und Beinen' (*loc. cit.*, 356) could not apply." There is sufficient uncertainty about a species separated on the tint and the amount of elongation of the forewings (three of the Ajaccio specimens in the "Frey" collection have noticeably pointed forewings, and so have some British examples) to tempt us to give Zeller's original diagnosis of *conspurcatella*. This reads (excluding the synonymy) as follows:

Talaeporia conspurcatella (Kollar, *in litt.*), [Mann and] Zeller, "Stett. Ent. Zeit.," xi., pp. 59-60, no. 4 (1850); "Linn. Ent.," vii., p. 356 (1852); Hdrch., "Lep. Eur. Cat.," p. 78, no. 2 (1851); H.-Sch., "Sys. Bearb.," v., pl. lii., fig. 365 (1851); p. 113, no. 207 (1854); Staud. and Wocke, "Cat.," p. 105, no. 1,162 (1861); 2nd ed., p. 266, no. 1,330, in part (1871); Sta., "Ent. Ann.," 1868, pp. 127-9, in part (1867); "Tin. S. Eur.," pp. 55, 70-1, 332 (1869); Hein., "Schmett. Deutsch. Tin.," pp. 19-20, in part (1870); Curò and Tur., "Bull. Soc. Ent. It.," xv., p. 3, in part (1882); Walsm., "Ent. Rec.," xi., pp. 256-8 (1899). Im März bei Pratolino und Pratovecchio an einer überhängenden Felsenwand beim Arno; hier fing ich in den Morgenstunden bei trübem Wetter gegen 20 Männchen. [*Conspurcatella*, mas., antennis interrupte longius ciliatis, alis ant. albido-griseis fuscescenti-punctatis, macula paria venae transversæ obscuriore. Grösse wenig über *Tinea stelliferella* oder *Micropteryx sparmannella*, Flügel noch gestreckter als bei *T. triquetrella*. Körper bräunlichgrau, Kopf etwas heller und wenig behaart. Fühler mit langen, am Ende verdickten Gliedern; jedes Glied hat an der Verdickung mehrere längere steife Haare, daher sind die Fühler in zwei Reihen unterbrochen langhaarig gefranzt. Beine graugelblich. Vorderflügel unrein bleichgelb, sehr hell, etwas glänzend, mit ziemlich reichlichen, groben, hellbraunen Punkten bestreut, die am Hinterrande wenig dichter stehen, als anderwärts. Ein brauner, durch hellbraune Einfassung zum Fleck verstärkter Punkt steht auf der Querader. Franzen an der Wurzelhälfte braungrau, sonst bleichgelb. Hinterflügel schmal, sehr licht grau. Unterseite aller Flügel einfarbig gelbbräunlichgrau, etwas glänzend. Das Weibchen sowie der Raupensack ist mir unbekannt. Diese kleinste *Talaeporia*, die ich kenne, ist vielleicht nur *T. lapicidella*, über welche Guénée im 4ten Bande der neuen Reihe der *Annales de la Soc. Entom.*, p. 14, Folgendes schreibt: *Talaeporia*, B. antennis [maris] valde pectinatis: *Lapidicella* [*Lapicidella*], Zell., in not., Réaum. [!], Geoffr. [!]*—*Pectinella*, Dup., *Suppl.* (non aliorum auctor). Statura vix *stelliferellae*. Alae anticae albogriseae nitidulae, strigulis inaequalibus, puncto cellulari maculaque apicali obscurioribus. Posticae albidae, corpus cinereum. Folliculum [!] conicum, recurvum, breve, granis undique conspersum. Fem. fusco-rubricans, scutulo brunneo. Das durch die Schrift Ausgezeichnete in der Beschreibung weicht von meinem Exemplar der *conspurcatella*, ab.—Duponchel's Abbildung (supp. iv., pl. 89, fig. 6, *Solenobia pectinella*) lässt sich eben so wenig wie seine Beschreibung mit Sicherheit hierher bringen; in beiden fehlt der dunkle Fleck der Vorderflügel] (Zeller, *Stettin. Entomologische Zeitung*, 1850, pp. 59-60).

Zeller notes (*Linn. Ent.*, vii., p. 356) *conspurcatella* as being as small as *S. inconspicuella*, but very recognisable by its ochreous-yellow colour and the strongly fringed antennæ. The body yellowish-brown with pale ochreous-brown hairs, antennæ and legs. The antennæ have long joints, thickened at the ends, and in each thickening two tufts of rather long, stiff, pale hairs, whereby they appear as two rows of interrupted, tufted fringes†. The forewings $2\frac{3}{4}'''$, elongate, with a very rounded anal angle, slightly convex hind margin and rounded apex, pale dirty-yellow, very slightly glossy, with many rather coarse yellow-brown spots, which, however, appear as spotlets (Pünktchen) to the naked eye and are somewhat more closely placed at the hind margin than elsewhere. A brown dot, increased to a patch by a lighter shade surrounding it, forms the discoidal lunule. Fringes brown-grey, pale yellow exteriorly. The hindwings narrow, scarcely widened beyond the middle, with a slightly rounded apex, very pale grey in colour. The underside of all the wings, shiny, unicolorous yellow-brownish-grey (Zeller). Mann discovered the species in Tuscany, at Pratolino and Pratovecchio near Florence, on a wall of overhanging rocks by the Arno, capturing about twenty males in March, 1846, in the morning, in dull weather.

Comparison of B. staintoni with B. vernella and B. montanella.—Closely allied as are *B. staintoni* and *B. conspurcatella*, it would appear that *B. vernella* and *B. montanella* are equally closely allied to them. Stainton considered that specimens of a *Bankesia* obtained at Fontainebleau were referable to *B. staintoni*. Constant now says (*Ent.*

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* Wenn Auctoren auf diese Weise hinter einem Namen aufgeführt werden, so bedeutet dies doch wohl, dass der Name bei ihnen vorkomme. Dies ist aber weder bei Réaumur, noch bei Geoffroi der Fall (Zeller).

† Chapman notes the antennæ of *B. staintoni* as being somewhat different from the description of those of *B. conspurcatella* as here given, but suspects that, when the difficulties of obtaining an exact account of them are taken into consideration, they are really meant to refer to it. He notes: "In dry specimens (*staintoni*), it is not easy to be at all sure where the joints between the segments of the antennæ occur, but the sequence of parts is not affected by this difficulty—the only difference would be in placing the joint at a different point in the sequence. Assuming a certain darker transverse line to be the joint, then, *dorsally*, a little beyond this is a transverse row of several scales, not reaching to the end of the segment, whilst beneath the ends of these arises another row reaching beyond the end of the segment and past the joint to the base of the first row of scales of the next segment. *Ventrally*, the segment is thickened basally, and again slightly distally. The basal thickening carries seven or eight long pale hairs ($1\frac{3}{4}$ times the length of segment) in an almost exact transverse line, whilst beyond this are two rather shorter hairs on the more slender middle of the segment, one beyond the other, and again, two or three shorter on the terminal thickening, one or two similar ones preceding them, and about one-fourth the length of the segment."

Record, xi., pp. 255-256) that he is unable to distinguish these Fontainebleau examples from his *vernella*, which he describes (excluding the synonymy) as follows :

Talaeporia vernella, Cnst., "Ent. Rec.," xi., pp. 255-6 (1899); Walsm., Ibid., 256-9, in part (1899). ? *Lichenella*, Berce, "Bull. Soc. Ent. Fr.," 4th ser. viii., pp. xlix-l (1868). ? *Conspurcatella*, Mill., "Cat. Lép. Alp.-Mar.," p. 295, excl. case (which = *L. lapidella*) (1875); [?Chrét., "Le Nat.," p.103 (1893)].—♂. Envergure : 11-12*mm*. Fond des ailes supérieures d'un gris jaunâtre ou argileux, semé irrégulièrement sur toute sa surface d'un assez grand nombre de traits noirâtres, très courts, ordinairement plus épais sur la côte, et formant, chez les sujets en bon état, une sorte de réseau à mailles plus ou moins serrées; quelquefois une bande transversale de même couleur, étroite, interrompue, contour ne l'extrémité de la cellule, et aboutit un peu avant le milieu du bord interne, sur lequel sa présence n'est souvent indiquée que par une petite tache obscurément quadrangulaire. Angle anal peu saillant, arrondi, presque effacé. Frange de la couleur du fond, distinctement entrecoupée de noirâtre. Ailes inférieures d'un gris pâle uni. Dessous des quatre ailes de la même couleur que le dessus, mais sans reproduction sensible des traits et dessins des supérieures. Corps entièrement d'un gris-brun. Antennes brunes, avec deux rangs opposés de cils courts. La ♀ m'est inconnue. Alpes-Maritimes en mars. Beaucoup d'exemplaires.

Constant notes that this species is somewhat near *B. alpestrella*, always smaller (about 3mm.), its head brown not whitish ; its wings darker, the forewings much sprinkled with black scales. He doubts its being distinct from the species captured in the neighbourhood of Paris and sent out as *conspurcatella*.

B. montanella is, according to Walsingham, most nearly allied to *B. vernella*, but to be distinguished from it by the larger proportion of the pale ground colour on the forewings, especially between the end of the cell and the apex, the hindwings being also somewhat more acutely pointed. The species is described as follows :

B. montanella.—Antennæ biciliate (2½); pale cinereous, banded with pale brownish fuscous. Palpi loosely clothed, pale cinereous. Head and thorax brownish-cinereous. Forewings slightly shining, pale yellowish-cinereous, with pale brownish-fuscous speckling on the basal half, becoming less frequent beyond the middle and more confluent around the apex and termen, where it forms a series of small irregular spots ; a spot of this confluent speckling occurs about the middle of the costa, and is followed by a rather more conspicuous costal spot a little beyond it, with two or three, less noticeable, between this and the apex; on the dorsum is also sometimes a confluent spot before the middle; in the amount of confluence of the darker shade-speckling, specimens vary considerably, the tendency to such confluence being to form a shade at the base, one or two shade-spots on the cell, the outer one always at its end (in addition to the marginal and apical spots already noticed) ; the cilia are of the pale ground-colour of the wing, but show a slight brownish-fuscous shade running through them near the base, not, however, reaching to one-half of their length. Exp. al. 11mm.-12mm. Hindwings pale grey ; cilia shining pale greyish-cinereous. Abdomen greyish-fuscous. Legs pale brownish-cinereous, tarsi very faintly pale-spotted. Type: ♂ (81,616) Mus. Wlsm. (♀ ignota). Habitat: Corsica—Vizzavona, May 9th-15th, 1896 (26 specimens) (Walsingham, *Ent. Record*, xi., pp. 256-8).

This appears to be most nearly allied to M. Constant's Cannes species, but is distinguishable by the larger proportion of the pale ground-colour on the forewings, especially between the end of the cell and the apex ; the hindwings are also somewhat more acutely pointed. I am unacquainted with its larval habits, not having met with the case, although I carefully searched the many rocks which crop up among the mass of low junipers (*Juniperus sabina*), over which the male flies in the early morning at a considerable elevation, near Vizzavona, on the slopes of Monte d'Oro (Walsingham).

Comparison of B. staintoni and B. alpestrella.—*B. alpestrella* is a rather larger and paler insect than *B. staintoni*, which differs from the former in the shorter wings, their more yellowish tint, and the more extended, and longer ciliations to the antennæ (Heinemann). The original description of *alpestrella* (excluding the synonymy) reads as follows :

Alpestrella, Hein., "Schmett. Deutsch. Tin.," p. 20, no. 4 (1870); Staud. and Wocke, "Cat.," p. 266, no. 1,331 (1871); Frey, "Stett. Ent. Zeit.," xxxii., p. 130, no. 43 (1871); "Lep. der Schweiz," p. 334 (1880); Hartmn., "Mitt. Münch. Ent. Ver.," iii., p. 195, no. 1,331 (1879); Sand, "Cat. Lép. Auv.," p. 154, no. 1,331 (1879). *Conspurcatella*, Meng., "Stett. Ent. Zeit.," xxii., p. 164 (1861); Frey, "Mitt. Schw. Ent. Ges.," iii., p. 42 (1869). ♂. Vorderflügel hell silbergrau mit braungrauen Querstricheln und einem solchen Fleckchen am Queraste, die Franzen an der Wurzel dunkel gefleckt, die Fühler kurz und dicht gewimpert. 3 L. ♀. Gelbbraun mit dunkelbraunem Kopf und Thorax und gelbgrauer Afterwolle. 1½ L. . . . In Ober-Engadin, im Juli, die Raupe an den Flechten der Felsen. Der Sack kurz, mit weissen und braunen Flechtentheilen bekleidet. Ein Stück vom Alpeleck von Wocke hat merklich breitere, an der Spitze gerundetere Flügel, das Gitter auf den vordern verloschen und die Wurzel der Franzen fast ungefleckt dunkel. Es scheint eine besondere Art zu sein, ich wage aber nicht, es als solche aufzustellen, zumal ihm die Palpen fehlen, die vielleicht abgebrochen sind (Heinemann, *Schmett. Deutsch. Tin.*, p. 20).

This species is recorded from the Upper Engadine, Zermatt, St. Moritz to Sils, Maloja (Frey), Mont Dore, Auvergne (Sand) ; cases were seen on the rocks about Fusio, the Simplon, Evolena, Arolla, during the last summer (1899) and the species is probably widely distributed (Chapman and Tutt).

Egg-laying.—The ♀ emerges from her case and the male copulates with her whilst clinging to the emergence-end. She then lays her eggs inside the larval-case, packing them securely among the wool detached from the end of her abdomen (Bankes).

Ovum.—The egg is oval in outline, ·6mm. long, ·4mm. wide; surface smooth and very delicate in texture.

Case.—The case is somewhat large and coarse, being from 6-8mm. in length and 2·75mm. wide at its broadest part. It is distinctly trigonal in transverse section, composed of three almost equal faces. It is made of whitish silk and is thickly covered externally with coarse sand, but is rather soft in texture, the faces collapsing very readily. The end at which the pupa emerges is not divided distinctly into three flaps or valves, but appears somewhat rounded, the opposite end is rather finely pointed. The pupa emerges to the end of the 6th abdominal segment.

Habits of larva.—The anterior segments are protruded from the case by a crawling motion, as if the larva were about to creep out, but when the thoracic segments have been exposed the case is brought forward with a jerk, which usually loosens the hold of the third pair of legs (Chapman). [Millière says "the larva emerges in the summer, and is almost full-fed before the winter. It lives in a little conical case composed of silk and of very fine grains of sand," a statement quite incorrect as to *staintoni* (*conspurcatella*), but most probably referring to *L. lapidella*.]

Larva.—Although the case is 8mm. long, the larva extracted is barely 5mm., possibly in part due to desiccation in preparation for pupation. The head is brown, retractile within prothorax, the latter within mesothorax, and this partially into the metathorax, the darker pro- and mesothorax dark fuscous, the metathorax pale fuscous. These segments are well enclosed in chitinous plates of the same texture as those forming the dorsal plate of the prothorax in so many lepidopterous (and other) larvæ. There is a gradual transition in paleness, from the pro- to meso-, and meso- to metathorax, but an abrupt break to the very pale, white or straw-yellow, abdominal segments, the colour being due to contained fat-masses, the skin itself being colourless, as well as in the size, the thoracic segments being swollen for leg-attachment. Except for the usual four pairs of ventral prolegs on 3-6, the abdominal segments are much alike, the 9th is similar but very narrow, the 10th large and swollen, carries a strong dorsal plate and two powerful prolegs. The abdominal segments are flattened beneath; the thoracic being nearly cylindrical, look, by comparison, rounded beneath. The larva viewed laterally has much resemblance to many coleopterous larvæ owing to the strong legs and the swelling of the last segment. This is probably accentuated by the shrinking already referred to. The abdominal segments consist of certain plates, apparently firmer than the general integument, though differing but slightly in colour, having a trace of fuscous, and not obviously different in texture, but they are separated by furrows. The plates are more shiny and polished than the general surface. These plates are: (1) A broad plate on either side dorsally at the front of each segment, broad at the median line, diminishing to an angle outwardly. (2) Posterior to 1, on either side, a plate obliquely placed, broad at the outer end, narrowing to the middle line and larger than the anterior plates, although less markedly so on the hinder segments. [These plates probably represent trapezoidal tubercles, not altogether unlike those of a newly-hatched Acronyctid larva, *e.g.*, *Jocheaera alni*.] (3) A triangular plate below 1 and 2, and forming the lateral flange, with its base forwards, the series, viewed dorsally, presenting a serrated outline. (4) Two narrow plates, below 3, which, viewed together, form two longitudinal cylindrical ridges. (5) Similar to 4 but quite ventral, broadened posteriorly and tending to meet its fellow on the opposite side in the middle line, by leaving a space in front, which, in the segments without prolegs, is occupied by (6) an oval plate, occupying the middle line and common to both sides. Each of the two dorsal plates carries a short bristle, the posterior being the larger, *viz.*, about $\frac{1}{25}$th and $\frac{1}{6}$th the diameter of the larva in length, respectively, the posterior being longest on the posterior segments; these are i and ii, and are arranged trapezoidally, ii being slightly external to i; iii is also present as a supraspiracular tubercle. The first (anterior) cylindrical plate carries a minute bristle at its anterior end, and the second (posterior) two bristles, a larger and a smaller, the latter in front about its middle; on the ventral plate are also two on either side, at the bases of prolegs on 3, 4, 5, and 6 abdominals. The prolegs have no very distinct pedicel, and bear an elliptical series of hooks, broken, however, at the inner edge, and on contraction forming an anterior and posterior row, the hooks are, especially in the posterior row, smaller towards the median line. The hooks are 16-18 in number, eight or nine in each row, the number variable, most numerous on the 3rd pair of prolegs, which sometimes have 20. The anal hooks are precisely similar, 17-19 in number, rather larger, the ellipse rather more circular, with a rather larger gap in the hooks at its inner edge; the individual hooks are short and thick, but, especially in the anal ones, have a very sharp claw-like free extremity. The 9th abdominal is only half the width (front to back) of those in front, and wants, apparently, the anterior trapezoidal plate. The 10th, anal, segment carries a large convex plate, triangular in outline, marked with deep brown spots, carrying at least four hairs on either side, it also carries the anal prolegs on rather swollen pedicels, which also carry several hairs. There are nine pairs of spiracles, the first is just below the large plate on prothorax, the others immediately below the triangular plate, all at about the middle of the segment. The prothoracic and last two abdominals being much the largest, the tracheæ within are easily seen. On the pro- and mesothorax the trapezoidals are fused into one plate, divided by a fine medio-dorsal line, and form a large strong shield covering the whole side and dorsum of the segment; on the metathorax the trapezoidals remain separate, but are narrower and less fully developed than those of the pro- and mesothorax. The plate on the prothorax is wider (back to front) and narrower (side to side) than that on the mesothorax. On meso- and metathorax are the usual four hairs, but apparently six, in two rows, on the prothorax. What appears to be the supraspiracular on meso- and metathorax forms a strong plate, but is not evident on prothorax. The subspiracular is evident at metathorax, hardly visible on mesothorax. The next (cylindrical) plate is quite distinct on these (meso- and metathoracic) segments and is followed by a very large and strongly developed plate armed with various hairs. This appears to be the posterior ventral plate and forms the base for legs. This plate and the dorsal one are the only two to be easily seen on the prothorax. Between the legs on each segment, each of these plates, one on either side, projects as a rounded eminence, the thick short hairs looking like a palpus, and specially developed on metathorax, where the whole plate is very large, and reminds one of a similar development in *Selenia*. The legs have 3 joints, the first swollen internally and armed with several long bristles, the 2nd with four bristles (one on outer side) towards its distal extremity, the 3rd with a few short bristles and strong claw. The great strength of these parts, the complete encasement with strong chitinous plates, well supplied ventrally with bristles, the larger size of the mesothorax ventrally than prothorax, still more of metathorax than mesothorax, are the special features of the larva. The head is rather small, rich brown in colour, with four or six long, and various short, hairs on either side, and a pair of 3-jointed antennæ armed with three little palpi and a long bristle as long as the antenna which is about one-fourth of the head. There is the usual clypeus rather narrow upwards, with a line outside its margin, a large eye-spot (eye-pigment) in the usual place, the individual ocelli not distinguishable, the jaws strongly serrated, labrum clothed with very short bristles, and labium with spinneret, but the palpi could not be demonstrated in the specimens examined (Chapman).

Pupa.—The pupa is somewhat arched, forming a convex curve dorsally; the terminal segments 8-10 pale yellowish-brown in colour, the remainder of the pupa of a slightly darker brown. *Male:* The dorsal headpiece semilunar in outline, at broadest part twice the width of prothorax; the labrum large and square, two hairs on each side close to each other (none above these); the maxillæ triangular with a very large maxillary palpus at the apex; the mandibles rounded and projecting; the labium divided; the labial palpi project about twice the length of the maxillæ and are divided for about two-thirds their length. The antennæ reach to end of wings and the wings to the end of the 5th abdominal segment; the 2nd pair of legs extend just beyond the wings and the 3rd just beyond the second, the 1st pair falling a segment short of the end of the wings; femora of the 1st pair of legs very largely developed, forming a large central piece (on either side) below the labial palpi. The tubercles consist of a single chitinous base and one simple seta, and are placed as in the larva. The dorsal spines form a patch well to the front of tubercles i (four spines in depth, very small, neat and sharp) on abdominal segments 3-8. No long recurved hairs on abdominal segment 8, four on each side of 9, and one on either side of 10, the two dorso-anal hooks very close together, small, and placed well back; scars of prolegs faint; spiracles on small conical bosses directed backwards. The 5th abdominal segment with a wide ventral depression for forewings and the 6th and 7th with a central groove for the legs. Two swollen bulbs on front of venter of the 9th abdominal with genital organs between. *Female:* The eye-pieces form very large and distinct areas. The labium instead of being a simple structure as in ♂, is divided into three sections transversely, the base forming two almost rectangular sections which, in turn, are separated from the palpal extremities; the maxillæ do not appear to carry a palpus (well developed in male); the antennæ only reach to the end of the labial palpi, the wings to the end of the 2nd abdominal segment, the 1st pair of legs beyond the antennæ, the 2nd as long as the wings, and the 3rd extending just beyond. There are six long recurved hairs, on abdominal segment 8, on each side; five on each side of 9, and two on 10; most of the hairs on the 7th abdominal segment are more or less recurved at the tip. The male pupa dehisces so that the eye goes with the faceparts and antennæ, but not the legs. In the female pupa, the headpiece carries the first pair of legs on dehiscence. Chapman notes as follows: The male and female pupæ have a length of 3·4mm., the wings in female extend to 2nd abdominal, in male to 5th or 6th. The *female pupa* is slightly curved, especially the anterior segments, so that the head is turned directly ventrally instead of rather forwards. The wings and legs are fixed to the abdominal segments 1 and 2. The 3rd abdominal segment is fixed anteriorly, the 4th, 5th, and 6th free, the 7th to anal, fixed. The spiracles on 2-7 abdominals are very distinct, each raised on a mammilla which is surrounded by a vallum. There is a brown supraspiracular hair immediately dorsal to this, fine and pointed on the anterior segments, but with a thickening or hook on the posterior, first obvious about the 6th abdominal; there is a finer hair ventrally at some distance from the spiracle and rather towards the middle line ventrally. Although the moth-hairs are very obvious, they are so sparse on the abdomen that the tracheal trunks are easily visible through the pupal and imaginal skins. Dorsally there are two (trapezoidal) hairs on either side, the anterior rather the shorter, which tend to be hooked at about the 7th segment, and all these hairs on 8, 9, 10 are quite hooked. They are quite recognisable on the abdominal segments as three dorsal (i, ii, iii) and six ventral (iv, v, vi, two vii, and one just external to leg-scar) hairs, on either side, except that on the 9th abdominal the posterior trapezoidals appear to be wanting. On the 10th, the anterior trapezoidals are very strong being rather spines than hairs, and are accompanied by the two short sharp dorso-anal points (one on either side), and two hairs which appear to represent the post-spiracular hairs of the 8th abdominal. The mouthparts are rather dwindled. There are two labia centrally, *i.e.*, the labium consists of two portions, one above the other, without being divided into two palpi; the maxillary palpus is not evident except as a point of maxilla. The eye is distinctly divided into an inner true eye and a glazed eye. The imaginal eye within is apparently represented by a small black disc about one-fourth the diameter of pupal eye. The pupal antennæ, vaguely three-jointed, are broad, short, flat plates (something like those of a ♂ Saturniid) with a very large basal portion, forming nearly half the antenna (something like the base of a Nepticulid antenna). The imaginal antenna (seven- or eight-jointed) within, is a narrow thread not extending the whole length of, and about one-fourth the width of, the pupal antenna. The anterior pupal wings meet, except where separated by the tarsal extremities, in the middle line; the hindwings are a small strip at the dorsal margin of the forewings, no imaginal structure can be seen within the wings. The wings are very transparent, and, from the obviousness of the hairs on the general surface beneath and which show through the wing position, one concludes there are no imaginal wings. The legs are short and stumpy, rather prominent, and the position of the tarsi is marked by the imaginal terminal hooks (of which there is a pair to each tarsus), which are very conspicuous within them. There are two rather strong, deflexed, supra-oral hairs on either side. In the case of the posterior legs, at least, the imaginal leg is much more slender than the pupal. Ventrally there are, on the 3rd, 4th, 5th and 6th abdominal segments, pairs of slight shield-like rounded elevations in the position of the usual eight prolegs; the general surface is very finely pitted. Dorsally the pupa is darker (? due to presence of more hairs on imago), and there is a distinct keel on the mesothorax. The intersegmental membranes between abdominal segments 1-2 and 2-3 are stretched out and look as if these moved but this is not so; the whole area is finely pitted, but on the 3rd abdominal there are some slight longitudinal ridges or rather wrinkles, which are more pronounced on the following segments, and on 5 and 6 form a patch of distinct sharp points directed backwards. They are anterior to the trapezoidal hairs, and are somewhat irregular in disposition, thinning out both laterally and backwards, there are about twenty from side to side and four or five from back to front on each segment. The *male* pupa is without the anterior curving of the *female* (? due to atrophy of appendages), and is quite straight. The head forms a rather bulbous projection and there is also a deep waist formed, especially dorsally (*i.e.*, seen sideways), by the 1st abdominal falling in to form a hollow between it and the 2nd abdominal. The wings and antennæ extend to the end of the 5th or 6th abdominal segments and the posterior legs to the end of the 6th or 7th; they appear to be free from the 4th, but from the analogy of the ♀ are probably so from the 3rd. The hairs are much as in ♀, the preoral hairs recurved, two on each side; the 7th abdominal segment is very distinctly free. The visible portion of hindwing extends as far as the the 2nd abdominal incision. Dorsally there is a distinct ridge on mesothorax, the incision between meso- and metathorax is straight and transverse and deeply cut, and is followed by an escutcheon-shaped (triangular) raised portion of 1st abdominal, which is very depressed centrally, and has a narrow ridge at bottom of groove. The dorsal spines appear on the 3rd abdominal, are distinct (and rather more pronounced than in ♀) on the 4th, 5th, 6th and 7th, and exist as wrinkles, at least, on 8th. The intersegmental membrane, when movable, is pale, as also is that between the 2nd and 3rd abdominals, where it is less movable; it is black between the 1st and 2nd. There are four hairs dorsally on the 9th, two on 10th, none on 8th, and four on the 7th, abdominal segments.

Food-plants.—Grey powdery lichens on tree-trunks, palings, &c. (Bankes).

Habits and Habitat.—This species has only been taken in England, near Southampton Water, by Swinton and Bankes, where the imagines are to be found at rest in crevices and chinks of tree-trunks, railings, and palings, during the daytime, the females, of course, being only found clinging to the end of the cases from which they have emerged, the pupa-skins protruding from the end of the larval case in both sexes. The males appear to be on the wing from about 7.30 a.m.-9.30 a.m. probably during sunshine (Bankes).

Time of appearance.—Throughout March. The latter end of March, 1867, on the shore of Southampton Water, opposite Calshot Castle, flying not uncommonly in the neighbourhood of spruce firs (Swinton). Imagines captured at rest March 24th-28th, 1892, March 6th-7th,1893 near Southampton Water. Larvæ from the same locality produced imagines March 26th-April 2nd, 1892, from cases collected March 26th-28th; March 6th-17th, 1893, from cases collected March 6th-7th, 1893, also March 2nd, 1893, onwards, from ova laid by ♀ s captured in March, 1892; March 2nd-22nd, 1894, from cases collected on March 1st, 1894; in 1894 imagines must have appeared in February, fresh cases with protruding pupa-cases being taken on March 1st (Bankes); March 15th, 1861, imagines bred at Brussels from pupæ taken three weeks earlier under the bark of a dead tree, imagines taken freely on the wing between March 15th-28th, 1861 (Fologne).

Locality.—Hants: Southampton Water (Swinton and Bankes).

Distribution.*—With the exception of the Belgian and Ajaccio examples the remaining records may belong to other species—*conspurcatella*, Zell., *vernella*, Const., and *alpestrella*, Hein. Our belief that the Ajaccio specimens are *B. staintoni* has already been stated (*ante*, pp. 203-4). Belgium: near Brussels (Fologne). Corsica: Ajaccio (Frey coll.). [? France: Cannes (Millière), Fontainebleau (*teste* Stainton), Paris (Constant coll.).] [? Germany: Halle (Sorhagen). Recorded by Herrich-Schäffer as a German species, but it is possible that he confused it with *alpestrella*, which Hofmann sent out as *conspurcatella* (Heinemann).] [? Italy: Val Bregaglia in north Italy and Tuscany (Curò).]

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* On p. 206, *ante*, in the synonymy of *B. vernella*, Const., there is a reference to the *conspurcatella* of Chrétien (*Le Nat.*, 1893, pp. 103-105), and we are informed (*in litt.*) by Constant that Chrétien is responsible for the specimens from Fontainebleau, that he notes as being sent out as *conspurcatella*, and which he fails to distinguish from the *vernella* of the Alpes-Maritimes. On reference to *Le Naturaliste*, 1893, pp. 103-5, we find in reality no mention of the moths obtained at Fontainebleau, but Chrétien states that he obtained 200 cases from the island of Jersey, where they were in great numbers on the rocks. The account of the egg, larva, pupa, case, and life-history that he gives of these, agrees very well with that of *B. staintoni*, but he gives no description of the imago. He then adds that *conspurcatella* is certainly French, since it is not rare on the rocks in the forest of Fontainebleau. The Jersey locality suggests strongly the possibility of the insect obtained there being the same species as that taken at Southampton. There is no doubt that *vernella*, Const., *conspurcatella*, Chrétien, from Jersey, and *conspurcatella*, Chrétien, from Fontainebleau, require to be very critically compared before their relationship can be finally determined.

Genus: TALEPORIA*, Hübner.

SYNONYMY.—Genus: *Taleporia* (rect. *Talaeporia*), Hb., "Verz.," p. 400 (1826); Meyr., "Handbook of British Lepidoptera," p. 775 (1895). *Phalaena*, Retz., "Gen. et Sp.," p. 44, no. 94 (1783). *Tinea*, Hb., "Eur. Schmett.," viii., text p. 17, no. 9 (1796); Zk., "Germ. Mag.," i., pp. 36-7 (1813). *Psyche*, Ochs., "Die Schmett.," iv., pp. 54, 199-200, no. 8 (1816); Tr., Ibid., x. (1), pp. 169, 274-5 (1834); Zell., "Isis," 1838, p. 714, no. 177; "Ber. Schles. Tausch. Schmett.," ii., 4 (1841), iii., 6 (1842); Speyer, "Isis," 1839, pp. 113-4; Bdv., "Ind. Meth.," p. 79, no. 627 (1840); Dup., "Cat. Méth.," p. 66 (1842); Bruand, "Mon. des Psych.," pp. 34-6, 115, no. 16 (1853). *Capillaria*, Haw., "Lep. Brit.," p. 522, no. 10 (1828); Stphs., "Sys. Cat. Br. Ins.," ii., p. 201, no. 7257 (1829); "Nomen. Br. Ins.," 1st ed., p. 49 (1829). *Cochleophasia*, Curt., "Br. Ent.," xi., expl. pl. 487 (1834); "Guide," 2nd ed., p. 208, no. 1001 (1837); Stphs., "Ill. Brit. Ent.," iv., p. 233 (1834); Wood, "Ind. Ent.," p. 183, pl. xli., no. 1266 (1839); Humph. and West., "Brit. Moths," 2nd ed., ii., p. 199 (1851). *Talaeporia*, Zell., "Isis," 1839, pp. 182, 301-2; "Ber. Schles. Tausch. Schmett.," v., p. 16 (1844); vi., p. 11 (1845); vii., p. 7 (1845); "Stett. Ent. Zeit.," xi., p. 59 (1850); xxxix., p. 117 (1878); "Linn. Ent.," vii., pp. 339-42 (1852); "Ver. z.-b. Ges. Wien," xviii., p. 605 (1868); Doering, "Ber. Schles. Tausch. Schmett.," iv., p. 15 (1843); Tied., "Preuss. Prov.," p. 334 (1845); Lienig, "Isis," 1846, p. 270; Tgstr., "Not. Sällsk. Fn. Fenn.," i., p. 106, no. 1 (1847); Koch, "Isis," 1848, p. 950; "Schmett. S.-W. Deutsch.," p. 371, no. 14 (1856); Sta., "Sys. Cat. Br. Tin.," &c., p. 6, no. 2 (1849); "Zool.," viii., p. 2788 (1850); "Supp. Cat. Br. Tin.," app. 17 (1851); "Ent. Comp.," 1st ed., pp. 10, 27, 31, 36, 39 (1852); 2nd ed., pp. 8, 26, 30, 71, 73 (1854); "Ins. Br.," p. 18 (1854); "List. Br. An. B. M.," xvi., Lep. p. 5, no. 2 (1854); "Man.," ii., 285 (1859); "Ent. Ann.," 1861, p. 103 (1860); 1874, p. 1 (1874); "Tin. Syr.," pp. 33, 76 (1867); "Tin. S. Eur.," pp. 55, 105, 283, 322 (1869); Hdrch., "Lep. Eur. Cat.," 78, no. 14 (1851); Bhm., "Act. Holm.," p. 155 (1852); de Graaf, "Herklots' Bouwst. Fn. Ned.," i., p. 42 (1853); iii., pp. 208-9, no. 5 (1863); Reutti, "Lep. Bad.," 1st ed., p. 175 (1853); 2nd ed., p. 305 (1898); Mann, "Ver. z.-b. Ges. Wien," iv., abh. 383 (1854); xvii., pp. 72, 839 (1867); xix., p. 384 (1869); "Wien. Ent. Monats.," vii., p. 184 (1864); H.-Sch., "Sys. Bearb.," v., p. 113, no. 206 (1854); Frey, "Die Tin.," pp. 12-13, no. 2 (1856); Fré, "Ann. Soc. Ent. Belg.," ii., p. 109 (1851); Speyer, "Stett. Ent. Zeit.," xx., p. 33 (1859); Now., "Enum. Lep. Hal. Or.," p. 167, no. 1012 (1860); Healy, "Ent. Wk. Int.," viii., pp. 44, 156 (1860); "Zool.," xviii., pp. 7059-60 (1860); xix., p. 7155 (1861); Hofmn., "Berl. Ent. Zeits.," iv., p. 53 (1860); Staud. and Wocke, "Cat.," 1st ed., p. 105 (1861); 2nd ed., p. 266, no. 1329 (1871); Ver Huell, "Sepp's Ned. Ins.," 2nd ed., p. 16 (1860); Greb., "Tijd. v. Ent.," vii., pp. 24-5 (1864); viii., p. 20 (1865); Rössl., "J.-B. Nassau. Ver.," xix.-xx., p. 213 (313) (1866); Const., "Cat. Lép. Saone-Loire," p. 306 (1866); Hein., "Schmett. Deutsch.," p. 19, no. 2 (1870); Hartmn., "Kleinsch. Münch.," p. 45 (1870); "Mitt. Münch. Ent. Ver.," iii., p. 195 (1879); Jourdh., "Ann. Soc. Ent. Fr.," xxxix., 4th ser. x., p. 115 (1870); Ersch. and Feild, "Cat. Lep. Imp. Ross.," 52 (1870); Nolck., "Lep. Fn. Est.," p. 467 (1871); Wocke, "Zeit. Ent. Bresl.," p. 40 (1874); Wlgrn., "Bih. Svensk. Vet.-Ak. Handl.," iii. (5), 32 (1875); Bang-Haas, "Nat. Tids.," (3) x., 1-2 (1875); Mill., "Cat. Lép. Alp.-Mar.," p. 295 (1875); Röss., "Stett. Ent. Zeit.," xxxviii., p. 376 (1877); Baldg., "Miller and Skertchley's Fenland," p. 623 (1878); Tur., "Bull. Soc. Ent. It.," xi., p. 198 (1879); Staud., "Hor. Soc. Ent. Ross.," xv., p. 260 (1879); Sand, "Cat. Lép. Auv.," p. 154 (1879); Büttn., "Stett. Ent. Zeit.," xli., p. 423 (1880); Snell., "De Vlinders," pp. 447-8 (1882); Stdl. and Hofm., "Ver. Nat. Würt.," xxxviii., p. 182 (1882); Curò and Tur., "Bull. Soc. Ent. It.," xv., p. 3 (1882); Peyer., "Cat. Lép. Als.," 2nd ed., ii., p. 82 (1882); Porr., "Tr. Yk. Nat. Un.," ii., 133 (1883); Barr., "Mason's Hist. Norf.," app. p. xxxvi (1884); Sorh., "Die Kleinschmett. Brand.," p. 140 (1886); Rbl., "Ver. z.-b. Ges. Wien," xlii., p. 527 (1892); Chapm., "Ent. Mo. Mag.," xxxii., p. 80 (1896); Carad., "Iris," xii., p. 196 (1899). *Solenobia*, Dup., "Hist. Nat.," supp. iv., pp. 197-8 (1842); "Cat. Méth.," p. 359 (1846); Ghil., "Fn. Ent. It.," p. 78 (1852). *Taloeporia*, Gn., "Ann. Soc. Ent. Fr.," xv., 2nd ser. iv., pp. 6, 7, 8, 9, 13-14 (1846).

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* In the *Verzeichniss*, p. 400, Hübner uses the generic name *Taleporia* for *tubulosa*, and *Taleporiae* for the family name of the group to which *Taleporia* belongs. We have retained Hübner's family name, only changing it to *Taleporiidae* to bring it into line with modern requirements as to the termination of family names. The correct spelling of these family and generic names, if the root be considered, is *Talaeporiidae* and *Talaeporia* respectively.

Psiche, Brd., "Cat. Lép. Doubs," p. 64 (1847). *Talaeporina*, Seeb., "An. Soc. Esp. N.H.," viii., p. 124 (1879). *Talaeoporia*, Frey, "Lep. der Schweiz," p. 334 (1880).

This genus was diagnosed by Hübner (*Verz. bek. Schmett.*, p. 400) as follows:

Die Schwingen mit dunklen Schüppgen undeutlich bezeichnet.—*Taleporia glabrella*, Ochs., *Psy.*, 8=*pseudobombycella*, Hb., *Tin.*, 212, 282. *T. triquetrella*, Zinc., *Beob.*, 5; Hb., *Tin.*, 373.

The two species included by Hübner in *Taleporia* are heterogeneric, and, in 1839 (*Isis*, p. 182), Zeller restricted the name to *tubulosa* (*pseudobombycella*), which, therefore, became the type, whilst later *triquetrella* was included in Duponchel's genus *Solenobia*, as restricted by Zeller (*Linn. Ent.*, vii., p. 343). The discovery of other Taleporiid species, however, not strictly belonging to the genus *Taleporia*, led to the genus becoming again heterogeneric, and in Staudinger and Wocke's *Catalog* (1871), it contained, besides the true Taleporias, *Bankesia conspurcatella* and *B. alpestrella*, *Luffia lapidella* and *Bacotia sepium* (*tabulella*), the two last-named even belonging to a different family of the Psychids. Stainton showed (*Ent. Ann.*, 1870, p. 1) that *pubicornis* was not a *Taleporia*, and Meyrick has removed it to the Lamproniids. The genus really is a very restricted one and contains, probably, not more than three (or four) Palæarctic species—*politella*, *borealis*, *tubulosa* and ? *improvisella*. The chief characters of the genus may be summarised as follows:

Ovum.—Oval in outline; long axis horizontal; pearly in tint, surface smooth; deposited in case.

Case.—Trigonal in section, with fairly sharp ridges, except centrally, where it is nearly cylindrical; very long compared with width; with three distinct flaps at posterior end; covered with particles of earth, vegetable and animal *débris;* very solid and resistant (beyond other Psychids even of much larger size).

Larva.—Head small, black, shiny; antennæ rather long; prothorax large, black, corneous; meso- and metathorax with corneous plates, brown; abdominal segments tapering from 7; tubercles on chitinous plates, ii almost behind i, iv (strong), v (weak), in line longitudinally, vii with two setæ; the prolegs short, crochets form a narrow oval, broken on inner margin, hooks strong; spiracles small, round, stand out distinctly; lateral flange (divisible into three elements) strongly developed.

Pupa.—The dorsal head-piece moderate; labrum round, two hairs at base prominent; mandibles rounded, not projecting much; maxillary palpi well developed, continuous with maxilla; labium large, roughly rectangular, labial palpi small in ♀, separate, tubercular, one at each front corner of labium; femur of 1st pair of legs very long; tubercles almost as in larva; ii at anterior margin of intersegmental membrane; the patch of dorsal spines (on 3-8) reaches behind i medially; recurved hooks on abdominal segments 8-10; dorso-anal spikes very minute; spiracles large; movable incisions 2-3 (dorsally), 3-4, 4-5, 5-6, 6-7 (male 7-8 also).

Imago.—Head rough; tongue and maxillary palpi obsolete; labial palpi, porrect, terminal joint pointed; posterior tibiæ loosely haired; eyes compound, ocelli (♂) at base of antenna; antennæ (in ♂) ciliated, basal joint without pecten. Female apterous with anal tuft.

Neuration.—Forewing: 1b furcate, 7 and 8 stalked, 7 to termen. Hindwing: all veins separate (Meyrick).

The genus is very characteristic of the Micro-Psychids, yet it commences to show certain Macro-Psychid characters. Among these are the somewhat delicate nature of the egg, the migration of tubercle ii behind i in the larva, the general resemblance of the female to those of the Fumeids, especially when the eggs are laid, as also the large size, colouring and general appearance of the male imago. The male Taleporias have somewhat broad wings, large ocelli (as well as compound eyes), whilst the tongue and maxillary palpi are wanting. The female is almost apterous, with fairly long antennæ, rather strong legs, faceted eyes, and well-developed ovipositor, surrounded by the woolly anal tuft. The female emerges from the case and rests on the outside until copulation has taken place, when the eggs are laid in the larval case, the ovipositor being forced between the protruding pupa-skin and the rim of the case. The pupa is distinctly Micro-Psychid in structure, with dorsal spines on anterior portion of abdominal segments, long recurved setæ on segments 8-10; and two small dorso-anal spikes on 10. We have, in Britain, only one species, *Taleporia tubulosa*.

Taleporia tubulosa, Retzius.

Synonymy.—Species: *Tubulosa*, Retz., "Gen. et Sp. Ins.," p. 44 (1783). *Pseudobombycella*, Hb., "Eur. Schmett.," viii., p. 17, figs. 212, 382 (1796); Zk., "Germ. Mag.," i., 36-7 (1813); Tr., "Die Schmett.," x. (1), 169, 274-5 (1834); F. v. R., "Abbild. Schmett.," 80-4, pl. xxxvii., *a-p* (1837); Zell., "Isis," 1838, p. 714, no. 177; 1839, p. 182, no. 2, pp. 301-2, no. 96; "Ber. Schles. Tausch. Schmett.," ii., p. 4 (1841); iii., p. 6 (1842); v., p. 16 (1844); vi., p. 11 (1845); vii., p. 7 (1845); "Stett. Ent. Zeit.," xi., p. 59 (1850); xxxix., p. 117 (1878); "Linn. Ent.," vii., 339-42 (1852); "Ver. z.-b. Ges. Wien," xvii., abh. p. 605 (1868); Speyer, "Isis," 1839, pp. 113-4; "Stett. Ent. Zeit.," xx., 33, no. 120 (1859); Bdv., "Ind. Meth.," 79, no. 627 (1840); Doering, "Ber. Schles. Tausch.," iv., 15 (1843); Dup., "Cat. Méth.," p. 66 (1842), p. 359 (1846); Tied., "Preuss. Prov.," p. 334 (1845); Gn., "Ann. Soc. Ent. Fr.," xv., 2nd ser. iv., pp. 6, 7, 8, 9, 13-14 (1846); Lienig, "Isis," 1846, p. 270; Brd., "Cat. Lép. Doubs," p. 64 (1847); "Mon. des Psych.," pp. 34-6, 115, no. 16, pl. i., 16 *a-d*, pl. iii., 16 (1853); Tgstr., "Not. Sällsk. Fn. Fenn.," i., p. 106, no. 1 (1847); Koch, "Isis," 1848, p. 950; "Schm. S.-W. Deutsch.," p. 371, no. 14 (1856); Sta., "Sys. Cat. Br. Tin.," p. 6, no. 2 (1849); "Zool.," viii., 2788 (1850); "Supp. Cat.," app. 17 (1851); "Ent. Comp.," 1st ed., pp. 10, 27, 31, 36, 39 (1852), 2nd ed., pp. 8, 26, 30, 71, 73 (1854); "Ins. Brit.," 18, pl. i., 4 *a-c* (1854); "List. Br. An. B.M.," xvi., Lp. 5, no. 2 (1854); "Man.," ii., p. 285 (1859); "Ent. Ann.," 1861, p. 103 (1860); 1874, p. 1 (1874); "Tin Syr." &c., pp. 33, 76 (1867); "Tin. S. Eur.," pp. 105, 283, 322 (1869); [Richter,] "Stett. Ent. Zeit.," xi., p. 25 (1850); Hdrch., "Lep. Eur. Cat.," 78, no. 14 (1851); Bhm., "Act. Holm.," p. 155 (1852); Ghil., "Fn. Ent. It.," p. 78 (1852); de Graaf, "Herklots' Bouwst. Fn. Ned.," i., 42 (1853); iii., 208-9, no. 5 (1863); Mann, "Ver. z.-b. Ges. Wien," iv., abh. 583 (1854); xvii., abh. 72, 839 (1867); xix., abh. 384 (1869); "Wien. Ent. Monats.," vii., p. 184 (1864); H.-Sch., "Sys. Bearb.," v., p. 113, no. 206 (1854); Frey, "Die Tineen," pp. 12-13, no. 2 (1856); "Mitt. Sch. Ent. Ges.," iii., p. 42 (1869); "Lep. der Schweiz," p. 334 (1880); Healy, "Ent. W. Int.," viii., pp. 44, 156 (1860); "Zool.," xviii., 7059-60, 7155 (1860); xix., 7363 (1861); Hofmn., "Berl. Ent. Zeits.," iv., p. 53 (1860); Staud. and Wocke, "Cat.," 1st ed., 105, no. 1161 (1861); 2nd ed., 266, no. 1329 (1871); Ver Huell, "Sepp's Ned. Ins.," p. 16, pl. ii., 1-18 (1860); Greb., "Tijd. v. Ent.," vii., 24-5 (1864); viii., 20 (1865); Röss., "J.-B. Nass. Ver.," xix-xx., p. 213 (313), no. 1278 (1866); Const., "Cat. Lép. Saone-Loire," 306, no. 1106 (1866); Hein., "Schmett. Deutsch. Tin.," p. 19, no. 2 (1870); Hartmn., "Kleinsch. Münch.," 45, no. 332 (1870); "Mitt. Münch. Ent. Ver.," iii., 195, no. 1329 (1879); Jourdh., "Ann. Soc. Ent. Fr.," xxxix., 4th ser. x., p. 115 (1870); Ersch. and Feild, "Cat. Lep. Imp. Ross.," 52 (1870); Nolck., "Lep. Fn. Est.," 467, no 383 (1871); Wocke, "Zeit. Ent. Bres.," 40, no. 1329 (1874); Walgrn., "Bih. Svensk. Vet.-Ak. Handl.," iii. (5), 32, no. 2 (1875); Bang-Haas, "Nat. Tids.," (3), x., pp. 1-2, no. 3 (1875); Mill., "Cat. Lép. Alp.-Mar.," 295 (1875); Röss., "Stett. Ent. Zeit.," xxxviii., 376 (1877); Bald., "Mill. and Skertch. Fenland," 623 (1878); Staud., "Hor. Soc. Ent. Ross.," xv., p. 268 (1879); Sand, "Cat. Lép. Auv.," p. 154, no. 1329 (1879); Seeb., "An. Soc. Esp.," viii., 124 (1879); Büttn., "Stett. Ent. Zeit.," xli., 423, no. 1329 (1880); Snell., "De Vlind.," 447-8 (1882); Steud. and Hofmn., "Ver. Nat. Würt.," xxxviii., 182 (1882); Curò and Tur., "Bull. Soc. Ent. It.," xv., 3 (1882); Peyr., "Cat. Lep. Als.," 2nd ed., ii., 82 (1882); Porrt., "Tr. Yk. Nat. Un.," ii., 133 (1883); Barr., "Mason's Hist. Norf.," app. p. xxxvi (1884); Sorh., "Die Kleinschmett. Brand.," p. 140 (1886); Rbl., "Ver. z.-b. Ges. Wien," xlii., 527, no. 123 (1892); Meyr., "Handbook," p. 775, fig. 776 (1895); Chapmn., "Ent. Mo. Mag.," xxxii., p. 80 (1896). *Glabrella*, Ochs., "Die Schmett.," iv., p. 54, no. 8, pp. 199-200, no. 8 (1816); Hb., "Verz.," p. 400, no.

3867 (1826). *Tessellea*, Haw., "Lep. Brit.," 522, no. 10 (1828); Curt., "Br. Ins.," xi., pl. 487, expl. (1-2), no. 1 (1834); "Guide," 2nd ed., 208, no. 1001 (1837); Stphs., "Ill. Brit. Ent.," iv., 233 (1834); Wood, "Ind. Ent.," 183, pl. xli., fig. 1266 (1839); Humph. and West., "Brit. Moths," ii., 199, pl. cx., figs. 1-2 (1851). *Tesserella*, Stphs., "Sys. Cat. Br. Ins.," ii., 201, no. 7257 (1829); "Nomen. Br. Ins.," 1st ed., 49 (1829); Curt., "Guide," 1st ed., 180, no. 1001 (1831). *Anderreggella*, Dup., "Hist. Nat.," supp. iv., pp. 197-8, no. 374, pl. lxvii., fig. 1 (1842); "Cat. Mét.," 359 (1846); Fré, "Ann. Soc. Ent. Belg.," ii., 109, no. 7 (1851).

Original description.—*Phalaena tubulosa*, elinguis, antennis filiformibus, alis griseo-fuscis nitidis, capite flavo, foemina aptera. De Geer, ii., p. 375, pl. vi., figs. 13-21. E larva tinea Lichenum (Retzius, *Genera et Sp. Insectorum*, &c., p. 44). [As Retzius' name is based on De Geer's description we give the latter: Phalene à antennes filiformes sans trompe, à ailes d'un gris-brun obscur et luisant et à tête jaunâtre; dont la femelle est sans ailes: d'une chenille-teigne des lichens. Cette Phalene n'est remarquable ni par ses couleurs, ni par sa figure, mais elle l'est beaucoup par rapport à sa femelle, qui est entierement dépourvue d'ailes et par sa façon de vivre sous la forme de chenille. Elle est petite, elle n'est gueres plus grande qu'une mouche domestique; mais les ailes sont passablement grandes et larges, elle les porte en toit au dessus du corps, et vers le derriere elles sont un peu élevées. Sa couleur est d'un gris-brun assez foncé, les ailes supérieures ont des nuances noirâtres obscures, et toutes les ailes ont un lustre ou un éclat assez agréable à la vûe, elles sont comme bronzées; leur côté intérieur est bordé d'une large frange de poils et d'écailles. La tête, qui est trés-velue, est jaunâtre en dessus. Les antennes sont à filets coniques et le bout des pieds est jaunâtre. Je ne lui ai point vû de trompe. C'est-là le mâle. La femelle est entierement dépourvue d'ailes, et son corps est gros et lourd ou comme difforme, elle n'a gueres l'air d'une Phalene; elle se donne fort peu de mouvement et reste toujours dans la même place, au moins ne l'ai-je point vû marcher. Elle est longue de deux lignes et le diamètre de sa grosseur est d'une ligne, de sorte qu'elle est courte et grosse. Sa couleur est obscure d'un brun noirâtre, c'est-à-dire sur le dessus du corps, mais les côtés et le dessous sont d'un gris blancheâtre. Le corps est divisé en anneaux, dont les trois premiers, qui forment le corcelet, sont plus lisses et plus luisans que les autres. Le dessus du corps est entierement ras, mais sur les côtés on voit des poils et des écailles. La tête est petite, recourbée en dessous, et deux antennes en filets peu longues y sont attachées; les pattes ne sont pas longues non-plus. Les deux derniers anneaux du ventre sont tout converts ou entourés de poils en forme de laine d'un gris luisant, qui y forment comme une grosse touffe. Le bout du ventre a une partie allongée, pointue à l'extrémité, qui ressemble à une espece de queue. C'est le tuyau qu'elle fait sortir du corps et qui est destiné à donner passage aux œufs; il est garni de beaucoup de poil en forme de laine, et la Phalene l'allonge et le retire alternativement. La forme singuliere de cette femelle lui donne plus de ressemblance à un ver hexapode qu'à une Phalene, et on est tout étonné de la différence de figure qu'il y a entre les deux sexes; la femelle est d'une indolence extrême, et le mâle, garni de bonnes ailes, est très-vif. Les chenilles d'où ces Phalenes tirent leur origine, sont des teignes qui habitent de longs fourreaux lisses, cylindriques dans la plus grande partie de leur étendue, mais prismatiques au bout ou dont la coupe est triangulaire et qui vivent des lichens des mur et des clotures de bois. Ce fut an mois de Mai de l'année 1752, que je les découvris en quantité sur la cloture d'un jardin faite de planches, qui étoient vielles et toutes couvertes de petits lichens. . . . Quand elles veulent marcher, elles avancent hors du fourreau la partie antérieure du corps, où sont attachées les pattes écailleuses, et elles trainent le fourreau partout où elles se promenent, à la façon des autres teignes. On ne voit alors à découvert que la tête et les trois premiers anneaux du corps, le reste est caché dans le fourreau. Pour faire la déscription de la chenille, il fallut la chasser hors de son logement; je vis alors comme elle étoit embarassée, dès qu'elle ne se trouvoit plus dans son fourreau. Elle marche assez vite et avec aisance étant chargée de son fourreau, mais dès qu'elle en est séparée, elle ne sçait presque plus faire un pas; elle tache bien d'avancer au moyen des pattes écailleuses, mais le reste du corps lui semble être à charge, elle ne fait que le trainer et il ne lui aide en rien dans sa marche. Elle avance alors fort lentement et comme en chancellant; le derriere du corps se trouve plus ou moins courbé en arc. . . . Ce fut le 28 Mai que la premiere Phalene mâle naquit chez moi; elle fut bientôt suivie par d'autres, et au bout de quelques jours les Phalenes femelles sortirent. Elles se sont jour par le bout postérieur du fourreau, et elles entrainent toujours la dépouille de crisalide à moitié hors de l'ouverture de ce bout, et cette dépouille y reste engagée. Ces Phalenes se sont accouplées ensemble dans le poudrier où elles se trouverent enfermées, quoique le moment de l'accouplement m'ait échappé: car j'y découvris dans la suite un grand nombre de jeunes chenilles-teignes, qui sans doute étoient nées des œufs pondus par les femelles. Toutes ces petites teignes étoient déjà enfermées dans de petits fourreaux, qu'elles s'étoient faits de parcelles détachées des vieux fourreaux qu'elles trouverent à leur portée, et tous ces petits fragmens étoient liés ensemble avec de la soie; mais faute de nourriture, que je négligeai de leur donner, elles ne vécurent que peu de temps. On voit donc, que dès le moment de leur naissance elles songent d'abord à se vétir ou à se faire des fourreaux portatifs (De Geer, *Mémoires pour servir à l'Histoire des Insectes*, &c., vol. ii., pt. 1, pp. 375-380)].

Imago.—Anterior wings 16mm.-18mm. in expanse; greyish- or brownish-fuscous, with numerous pale yellowish specklings between the nervures, larger spots on inner margin, and well marked short transverse costal streaks, just beyond centre of wing; cilia greyish-fuscous. Posterior wings and cilia grey.

Sexual dimorphism.—The *male*, with ample, well-developed wings, has been already described. The *female* is yellow-brown, the eyes black, anal tuft thick, grey-brown, dorsal thoracic plates very shiny, the 1st abdominal segment less so (Zeller). 3-4 lines long; dirty-yellow in colour; long, grey, segmented antennæ and legs; head blackish-grey with black faceted eyes; thoracic segments with light brown shining plates; a brown oblong spot on the dorsum, and two small triangular spots on the venter, of abdominal segments 1-7, the ventral points almost touching in the median line; anal tuft greyish-white; the long ovipositor brownish (Hofmann). Chapman notes the following points of structure: The tarsi are 5-jointed; antennæ with 28 to 31 joints, the 1st large, the 2nd smaller, the 3rd (which appears to be the first of the clavola) is tapering, the last three joints vary, the last may be large, or it may be small and the two preceding larger, *i.e.*, they may be of apparently single joints, or two may be welded together (probably this accounts for the varying number of joints). The ovipositor consists of two joints and an intervening membrane which, when stretched, has precisely the same appearance as the joints, and accounts for the ovipositor of this and other species being described as 3-jointed, as all these araneiform-Psychids appear to have the same structure of ovipositor. In *T. tubulosa* the rods of the terminal joints are four—two ventral not larger than the joint, and two dorsal nearly 5mm. in length, so that when the ovipositor is retracted, their proximal extremities are in the thorax, when exserted, near the base of 1st joint. The ventral rods of the 1st joint are not much more than 1mm. in length, and the dorsal (bifurcated) about 1·5mm.

Variation.—There is some difference in the depth of the colour of the males, in the distinctness of the reticulation, and in size. Peyerimhoff notes that the Alsatian examples vary from pale yellow, hardly reticulated, to blackish-grey. Freer observes a rare colour aberration distinctly flushed with purple. Nolcken states that both sexes received from Mann and taken in the Vienna district differ from those of the Baltic provinces, in that the males of the latter are somewhat darker and more distinctly reticulated, whilst the cases are longer, &c. Zeller notes that a male which he captured, and at first considered to be *Incurvaria argillella*, has almost as elongate forewings as Spanish examples ; the ground colour is unicolorous, of the tint of the spots of the ordinary examples, only greyer towards the base. The hindwings are also clear yellowish-grey. He also mentions a male in his collection with shorter and blunter forewings than usual ; whilst Guénée referred to this species, a (?) form with the head-hairs of the same tint as the thorax ; Zeller refused to consider this the same species and named it *guénéi*.

a. ab. *guénéi*, Zell., "Linn. Ent.," vii., p. 342 (1852) ; H.-Sch., "Sys. Bearb.," v., p. 113 (1854); Snell., "De Vlind.," p. 447 (1882).—Var. an spec. diversa ? Obscurior, absque flavo, alæ anticæ vix conspicuè tessellatæ, fronte concolori (Guénée, *Ann. Soc. Ent. Fr.*, iv., 1846, p. 14).

Zeller notes that he has bred hundreds of specimens and never saw one without the red head-hairs. We observe in Healy's MS. notes a record that on July 17th, 1860, many imagines were bred, some of which had dark (not yellow) heads, the larvæ of these came from West Wickham. Snellen notes that ab. *guénéi*, has been found in a pine-wood at Breda.

β. ab. *minor*, n. ab.—A very small male, 15mm. in expanse, the forewings rather pointed, almost unicolorous, and under a lens almost without any trace of the normal pale specklings. It was bred by Mr. Prout from Coombe Lane, near Croydon.

Reported parthenogenesis in T. tubulosa.—Parthenogenesis has been recorded in this species by Freer (*Ent. Record*, vi., p. 89). He writes (*in litt.*) that he calculates about one in ten of the females to be parthenogenetic, and that a batch of females left in a box will usually produce some fertile eggs. [Freer calls the insect *bombycella*.]

Comparison of T. tubulosa with T. politella, etc.—In size, this species is generally less than *T. politella*, and the pale, yellow, reticulated forewings make it easily distinguishable from the two preceding species (*pubicornis* and *politella*) (Zeller). Bruand also notes the male as being a little smaller than *T. politella*, and adds that the female is similar to that of *T. politella*, except that it also is smaller. The original description of *T. politella* reads as follows:

Taleporia politella, Ochs. (=*lefebvriella*, Dup. =*minorella*, Dup. =*clandestinella*, Zell.—Alis anticis oblongis lividis immaculatis: posticis cinereis, ciliis albidis. ♀ with brown antennæ and feet; head, thorax and abdomen dark reddish-brown; anal tuft yellow-grey. Cases near Vienna in May (Ochsenheimer, *Die Schmett.*, iv., p. 200).—The cases are generally found on palings, walls, &c., in May; the imagines emerge during June. It has a wide distribution throughout central Europe, being recorded from:—Austro-Hungary: Vienna (Ochsenheimer), Hungary (Fischer), Trieste (Zeller), Croatia (Frey), Dalmatia, Tyrol (Mann). France: Eure-Bouchevilliers, Paris (Duponchel), Besançon (Bruand), Indre—Nohant (Sand). Germany: Bavaria (Herrich-Schäffer), Freiberg, Lahr (Frey). Roumania: Slanic (Caradja). Russia: St. Petersburg (Erschoff and Feild). Switzerland: Lausanne (Frey).

Only two other true Taleporias appear to be known, *viz.*, *T. borealis* and *T. improvisella*, the former a Scandinavian, the latter a Spanish, species, but also recorded from Asia Minor. The synonymy and original description of these species are as follows:

T. borealis, Wocke, "Stett. Ent. Zeit.," xxiii., pp. 66-7 (1862); xxv., p. 209 (1864); Staud. and Wocke, "Cat.," p. 266, no. 1328 (1871); Wlgrn., "Bih. Svensk. Vet.-Ak. Handl.," iii. (5), p. 32, no. 1 (1875).—♂. Capillis dilutissime ferrugineis, alis anterioribus fuscescenti-griseis immaculatis. ♀ fusco-grisea, lana anali albida. Exp. alar. ♂ 19mm. Sack 18mm.-19mm. long. Bossekop pupæ—May 25th, emerged commencement of July; Skaaddavara, July 15th, 1861, ♂. Hammerfest, empty cases, August (Wocke, *Stett. Ent. Zeitung*, xxiii., pp. 66-7).

T. improvisella, Staud., "Stett. Ent. Zeit.," xx., p. 234 (1859); "Hor. Soc. Ent. Ross.," xv., pp. 267-8 (1879); Sta., "Tin. S. Eur.," pp. 140, 143, 322 (1869); Staud. and Wocke, "Cat.," p. 105, no. 1158 (1861); 2nd ed., p. 266, no. 1326 (1871).—*Talaeporia improvisella*.—Capite flavo; alis griseis subsplendentibus. ♂ 20mm. Kopf gelb, Flügel grau mit mattem Glanze. Bei *T. pubicornis*, aber viel grösser und mit viel matterem Glanze. Nur eine ♂ bei Granada (Staudinger, *Stett. Ent. Zeitung*, xx., p. 234). The Asia Minor localities are Kerasdere and Amasia, where it was captured in May.

Egg-laying.—Until fertilised the ♀ hangs on the outer part of the case, its ovipositor downwards, its body forming a straight cylinder, its abrupt anal end being made more pronounced by the anal tuft. It bends round its body for oviposition, pushing the ovipositor between the larval case and the empty pnpa-skin, and filling the larval case with eggs and the silky wool from the anal tuft, some of the silk often overflowing around the edge of the case. The deposition of eggs outside the case is quite abnormal. Zeller notes that the eggs are laid in the free end of the case and mixed with the anal hairs; he also notices that the wandering habit of the larva before pupation necessarily carries them at times to some distance from their food and suggests that this is probably the cause of the rarity of the insect in some seasons. Healy states that even when the eggs are not laid in the case they are always covered with down, the female moving the anal segments rapidly over the eggs; Freer states that when laid loosely they are invested with hair like those of *Porthetria dispar*. Chapman says that the female lays her eggs within 2 hours, most of them in $1\frac{1}{2}$ hours, after copulation. As she completes the process she inflates her body with air so as to maintain something of her previous bulk, and portions of her body are quite transparent. She is previously very white and opaque at the intersegmental membrane areas where the eggs shine through. In this habit of inflation, the ♀ *T. tubulosa* resembles those of *Solenobia*, the Fumeas do not so inflate themselves. The eggs are placed in the case throughout its whole length, except the small portion at end, occupied by the larval skin and a little *débris;* altogether, a length of $\frac{7}{16}$in., measuring from the slit of the case (in which she inserts the ovipositor) to the base, is so occupied. The eggs are quite separate and each lies loosely in a mass of entangled hairs, the eggs and hairs being very uniformly distributed throughout the whole length of the case. The hairs are individualised, that is teased asunder most absolutely and completely, and form a mesh of elastic springs amongst which the eggs are distributed. Considering that the ovipositor of *T. tubulosa* is barely $\frac{3}{16}$in. long and that the eggs are placed $\frac{7}{16}$in. from the opening, it is clear that the hairs also act in carrying the eggs upwards to the base of the case, as more eggs and hairs are added below; they are in fact distributed in the case as an elastic mass forced into a hollow, the ovipositor being hardly longer than enough to convey them past the pupa-skin into the case.

Ovum.—The eggs are oval (egg-shaped), the narrow end being fuller and rounder than in a hen's egg, but still a distinct narrow end; the long diameter is 0·63mm., the transverse 0·42mm. They are very white and (under a $\frac{1}{4}$in.) no structure, surface-network, &c., can be detected. They number about (or over) 200 (Chapman). Irregularly oval, differing much in shape individually and in the relative length to width, white, smooth and glossy, apparently soft and delicate, but not mere bags of fluid as in the Macro-Psychids, *Whittleia reticella*, &c. (Bacot).

Case.—The *newly-formed* case of the larva on the day the latter is hatched is naturally in an unfinished state. It appears to be formed entirely of fine silk, or silk hairs, probably from those used by the ♀ to cover the eggs. It is loose and fluffy at the ends, cylindrical, and not even tapering to any noticeable extent, carried erect when the larva is crawling (as in other small Psychids), although the young larvæ without cases were not observed to erect their abdominal segments as in the higher Psychids, *e.g.*, *A. opacella* (Bacot). Some fifty *full-grown* cases examined averaged 17mm.-19mm. in length, and 2mm. wide. Each case is perfectly straight, has two open ends, one composed of three flaps, fitting somewhat closely against each other, the other rounded, with a somewhat long loose extension of silk, of a greyish-white colour. The three flaps at the one end are the terminations of the three sides of the case, which appears to be always more or less triangular in section, but centrally, and at the terminal end, more rounded and cylindrical in outline. The case itself is spun of extremely tough silk, difficult to tear and cut, covered externally with minute particles of disintegrated rock-dust and grey-green with lichen dust. The inside is apparently smooth to the naked eye (somewhat coarse under a lens) but very thickly lined with greyish-white or pale brownish silk of exactly the same character as the continued silk tube that extends beyond the end by which it is fixed at pupation. The three flaps of the end by which the imago emerges are so arranged as to have smaller flaps inside, at their bases, whose three apices meet centrally, and close the opening effectually from the outside, although readily pushed apart from the inside, when the imago is ready to emerge. These flaps are somewhat papery in texture and readily torn, differing much in these respects from the body of the case. So hard is the case when fresh that it is very difficult to press it with the fingers so as to injure the larva, without using considerable force.

Although in old cases only minute pieces of stone and lichen are attached to the outside of the case, yet in fresh cases there appear to be innumerable scraps of chitin and organic remains. The loose silk, seen in cases that have been detached, is, therefore, at the end by which the case is attached when in the pupal condition, the moth emerging from the valvular end. [Described April 3rd, 1899, from cases collected by Hamm at Wellington College]. Zeller notes that the immature case bears on its front half powdered particles of lichen, and it is, as far as the anterior end, three-cornered, and shows three moderately sharp edges. It narrows from the head outwards to the tip. The mature case is somewhat different, 8''' long, tubular, somewhat thinned towards both ends, more so towards the three-valved anal end. From just before the centre three edges become somewhat conspicuous, each running back to the depression between two of the terminal "valves," or "flaps." The colour is grey mixed with brown, the upper surface covered with particles of dirt, which increase in number and size towards the anterior end, and are here mixed with minute pieces of devoured insects. Bacot says that near the anterior opening of the adult case there is a kind of necklet, formed of sundry scraps of insect *débris*, corneous plates, appendage-covers, cast heads, &c., probably from the exuvia of the larva itself, others certainly extraneous (in one case the elytra of a small beetle), but these are comparatively few compared with the number of similar pieces used by *D. herminata*. The opening from which the larva protrudes its head is somewhat ventral in position.

Comparison of the cases of T. tubulosa and T. politella.—The case of *T. tubulosa* is a little smaller and less smooth than that of *T. politella*, but it is so near that it is difficult to distinguish them. That of *T. tubulosa*, however, has, throughout its length, three slight ridges, which give it a slightly triangular form, whilst in *T. politella* only one is noticeable, and that slightly (Bruand). According to Ochsenheimer the case of *T. politella* "is of the same shape, size and colour as that of *T. tubulosa*, only generally rather brighter, less covered with dirt, and towards the head end with three distinct edges." The difference in the appearance of cases of the same species is often due to the external material having been more or less removed.

Habits of larva.—The young larvæ hatch in July (from eggs laid June 21st, 1860, larvæ appeared July 11th), and immediately make cases of the down with which the eggs are enveloped. Later, Ver Huell says, they use particles of moss, &c. Freer says that when newly hatched the larvæ are extremely lively, making for themselves a minute but almost perfectly cylindrical case, refusing in confinement to feed on lichens, and in nature never ascending the trees (on Cannock Chase) until March; they pupate in May (from beginning to middle of the month), and appear not to feed at all during the last month of their existence, for there never seems any difference in size between the early and later collected cases. The larva is rather rare in alternate years, and may possibly take two years to come to maturity; the cases abounded in 1895 and 1897. In Silesia, the larvæ live somewhat gregariously in old open firwoods, at the foot of thick trunks, on the lichens that cover the soil round the same. Sometimes they are so abundant that many cases may be found round almost every fir. It also lives in damp places, and one birch-trunk on the marshy ground near Glogau, once provided 33 larvæ, which were crawling up the stem. The young larvæ are to be found on the lichens in summer, autumn and early spring, being fullfed in May, when they climb up fences, tree-trunks, &c., for pupation. In some years (*e.g.*, 1850) they are very abundant. The pupal stage lasts about three weeks (Zeller). It appears to us certain that the larvæ are almost (? always) entirely ground feeders, coming up on trees, fences and walls, only at the time of pupation. Alderson notes that from March until June 3rd, 1899, he regularly searched the fences near Farnborough without success, when, on the latter date, he found no less than a dozen on a fence at about a foot from the ground, although a couple were up 4ft. or more. They also appear to be most abundant where there is a strip of herbage at the bottom of the fence, and very scarce where the ground is clear. He considers that they must come to the fences only for pupation.

Larva.—Emerged July 5th, 1899. *As soon as hatched*, 1·25mm.-1·5mm. in length when crawling (when at rest about 1·125mm.), about ·25mm. in width. Head and thorax large, a slight constriction between thorax and abdomen; body round and nearly cylindrical when contracted, but flattened and showing a strongly developed lateral flange when stretched, in crawling. Head large, carried rather horizontally, pale, but bright, brown, glossy; prothorax large, well covered by a corneous plate, coloured as head; mesothorax shorter, also covered dorsally by corneous plate; metathorax with central dorsal plate of triangular shape, and two subdorsal plates, all pale brown; anal plate large and showing up clearly. The plates at the bases of hairs on the abdominal segments are large and well developed, looking comparatively larger and more prominent than in adult larva (this probably will be less noticeable when the larva has fed and the skin has been stretched); the hairs longest on head, the thoracic and anal segments. The true legs strong; segmental incisions sharply defined, though not deep. The abdomen broadens laterally at 4th and 5th segments and then tapers again. The prolegs are very short. On front edge of prothorax is a loose fold of soft white skin, showing the head to be fairly retractile. The tubercular plates are very large and pronounced; those at base of i so nearly join in median line that they appear at first sight to form one central triangle, as on metathoracic segment; the suture is especially difficult to detect on the 1st abdominal; the arrangement is as in the adult larva, i inner, ii slightly outer, iii with the hair not quite so prominent as is usually the case in Psychid larvæ, iv and v (subspiracular) appear to be in about the same horizontal plane, hair on anterior (v) is very small; the exact bases of hairs (especially dorsal) are difficult to locate, possibly i and ii are on the outer and inner edges of plates, as in adult larva. The *full-fed larva* is somewhat long compared with its bulk, about 9mm.-10mm. in length, and 1·5mm. in greatest thickness. The head, legs, and thorax rather weak compared with the abdomen; the head and thorax form about one-quarter of the length of the larva. The abdomen is of more even bulk, and less grub-like than those of any other Psychid larvæ examined. It curves its abdomen ventrally almost as much as some sawfly larvæ. In the proportions of length and comparative slenderness it resembles *P. villosella* and *C. unicolor* rather than the Solenobiids and Luffiids. If touched on the head it executes a rapid backward movement, like that of a Tortricid larva, it can also drop by a thread if disturbed (a feature apparently common to all young Psychid larvæ). Head and thorax black, or very dark brown; abdomen pale yellow or whitish; anus dark, apparently due to internal matter. *Head*.—Small, black, glossy, carried rather flat (horizontal), sutures of clypeus* faint, carried far back towards crown of head. Looked at from above, the outline of the head appears to be somewhat square; the setæ, in about usual numbers; the antennæ rather long and conspicuous. The thoracic and abdominal segments increase gradually in width, to the 4th abdominal segment. Between the head and prothorax there are folds of whitish skin. The head, prothorax and mesothorax are all retractile (the thoracic segments are also somewhat retractile in the Macro-Psychid larvæ, but not in the marked manner observable in *T. tubulosa*). The thoracic segments all taper backwards considerably to allow of their being retracted; they have conspicuous shiny corneous shields, but there is a gap between the dorsal and lateral plates of the meso- and metathorax; the prothorax is black, like the head, the meso- and metathorax are dark brown. The true legs are corneous, brown, bearing some relation to the size of the thoracic segments. *Abdomen*.—The abdominal segments increase from 1 to 4, the 4th-7th are about equal, the posterior segments tapering to anus less rapidly than in the higher Psychid larvæ. The skin of the abdomen is rather shiny, and bears rather large chitinous plates at bases of tubercles, but these are not very apparent on account of their transparency. The prolegs themselves are short, but the hooks are large and strong; the hooks are arranged as in the larger Psychid larvæ, except that on the anal claspers, the arrangement is not so circular, but rather that of a portion of a narrow oval, similar to the arrangement on the 1st, 2nd, 3rd and 4th pairs, but not nearly so complete. The segments appear to be divided into two subsegments, but the separation is not distinct. The tubercles themselves are rather more conspicuous than is usual in Psychid larvæ. They are small, dark in colour (not black), the plates at base are large, the setæ fairly distinct, i is small, ii larger, i and ii of almost equal distance from the medio-dorsal. The way in which i and ii are situated on the plates is interesting; the plate on which i is placed is on the 1st subsegment, long, placed transversely, and narrow, the edges of the right and left plates nearly meeting in the medio-dorsal line; that on which ii is placed is on the second subsegment, triangular in outline, with its point towards the medio-dorsal line, but the inner point is not much nearer to centre than the outer edge of plate i. Tubercle i is placed on the extreme outer edge of its plate (*i.e.*, as far out as it can be and still remain on the plate), ii is placed on the extreme inner edge of its plate (*i.e.*, as near the middle of the dorsum as it can be without going off the plate). (The phylogenetic value of these tubercles has been discussed, *ante*, pp. 132-3.) Tubercle iii is supraspiracular, the two subspiraculars iv and v are present, v anterior to iv and much smaller. The spiracles are small, round, slightly raised and standing out rather distinctly. The lateral flanges are well developed [Bacot. Described April 30th, 1899, from

* Between the clypeus and epicranium, on either side, is a somewhat narrow quadrangular piece, which is preserved in the Luffiids, but hardly noticeable in higher Psychids.

larvæ received from the Rev. G. H. Raynor]. Bruand describes the larva as "dirty white, or livid grey; the head of a very shiny deep-brown; the corneous shield of the prothorax, which is a little less dark (brown tint of horn), occupies all the dorsal and subdorsal areas almost to the base of the true legs. It is edged before and behind with livid grey, and one can just distinguish a slight trace of the dorsal vessel in the posterior portion, the mesothoracic shield is paler than that of the prothorax, it is traversed by dirty white dorsal and subdorsal lines; the shield of the metathorax is still paler, and does not descend below the subdorsal area, although there is, lower down, a longitudinal, slightly corneous and brownish, spot, with another at the base of the leg. The anterior and posterior edges of the meso- and metathorax are whitish. The ventral area of the larva is livid grey. The true legs are horn-colour and ringed with whitish. The trapezoidal points are indicated by a slight darkening on the thoracic segments, and from each point a fine grey-brown hair arises. There are also some short and very fine hairs on the head and around the legs."

Pupation.—The larva climbs to some fence, trunk, or wall, on which to pupate; its case usually hangs vertically; and the period of pupation lasts about three weeks. When near emergence the pupa projects for some distance out of the larval case, and after the imago has emerged the pupa-skin of both sexes remains sticking out in this manner.

Pupa.—The *male* pupa is of nearly uniform width down to, and including, the 7th abdominal segment, and thence ends in a length less than one of the preceding segments in a short blunt cone. It averages about 7·5mm. in length and 1·6mm. in width. The 3rd pair of legs in the ♂ pupa extends to the end of the 7th abdominal segment, the wings and 2nd pair of legs to the end of the 5th, and the 1st pair to the end of the 3rd abdominal; the 1st femur is well-developed, the patches of dorsal spines are anterior to i on the 3rd, 4th, 5th, 6th, 7th, and 8th abdominals, the spines themselves very small and six or seven deep (from front to back); there is an extra pre-spiracular tubercle, ii is almost directly behind i dorsally, iii is large, iv and v are both subspiracular, vi single, vii double, and a single ventral one just below, all with fine setæ (so that each abdominal segment has 20 setæ, ten on either side). The *female* pupa is not bent forwards in the same way as those of almost all other Psychids, its straightness and truncation being a marked feature. It averages about 8mm. in length and 1·9mm. in width. The labrum is very round, the two hairs at base also prominent; mandibles also round and not projecting much; maxillary palpi continuous with maxillæ, a slight line marking off the extreme point of the maxilla itself; the labium large, roughly rectangular, and divided into sections (as in *B. staintoni*); the labial palpi small, and separated from labium and from each other; the femora of 1st pair of legs showing centrally below the labial palpi (Tutt). *Male*.—The maxillary palpi look separate; the labial palpi and labium are continuous; the femora of 1st pair of legs show as a very long piece; the wings to end of the 5th abdominal; the 3rd pair of legs to end of the 7th; the 2nd pair to the end of the wings, and the 1st pair to the end of the 3rd abdominal; the antennæ very nearly to the end of the wings (about one segment short thereof). In both sexes the patch of dorsal spines reaches beyond i medially; ii is placed at anterior margin of intersegmental membrane. There are five recurved hairs on each side of the 8th abdominal, six on each side of the 9th, and one on each side of the 10th. The dorso-anal spines are very minute; the spiracles large. The eye goes with the face-parts and antennæ, on dehiscence, and the legs also in the ♀ but not in the ♂ (Chapman). The *female* pupa is of a clear brown colour dorsally, inclining to blackish where the segments overlap at the incisions, the abdominal segments 7-10 paler, almost yellowish; ventrally the whole area of the pale yellowish tint, the 7-10 abdominal segments almost glossy in appearance. The skin of the thoracic segments and 1st abdominal smooth and shiny, also the front part of the 2nd abdominal; the skin on the other segments finely pitted, and with transverse foldings posteriorly. *Dorsally.*—The prothorax is frontal, ill-developed, but with several tiny pointed hairs and two longer setæ; the mesothorax well-developed, with a distinct median mesothoracic ridge, which is less marked on the metathorax, the latter segment being also well-developed. There are two strong setæ on either side of the mesothorax, one near median line, the other towards the base of the wing and slightly anterior to middle of segment; two similar setæ are on either side of metathorax. The 1st and 2nd abdominal segments are slightly narrowed, the 4th and 5th are the widest, the cremastral area is rounded. The abdominal segments have, on the posterior margin and at some distance on either side of the medio-dorsal line, a tiny chitinous button with a long pale brown seta (ii), in front of which, and almost in line with it, is the less-developed i; a similar button, but with a shorter seta (iii), is placed at the outer margin of the dorsum at the middle of the segment; ii and iii are almost in a line transversely on the 8th abdominal, on the 9th are 14 setæ with recurved points forming a circle around the segment, on the 10th are two similar setæ, and between them two small chitinous spikes pointed backwards and slightly upwards. The recurved setæ appear to have but little holding power. The dark intersegmental areas commence at that between abdominal segments 1-2. Each segment appears to be divisible into four areas: (1) Finely shagreened. (2) With minute dark spines. (3) Shagreened more finely than 1. (4) Like 3, but more delicate in texture, and forming the intersegmental membrane. The spinous points are only present on abdominal segments 3-8, and evanescent on the latter. *Ventrally.*—The ventral area is pale in colour, much flattened throughout its length, and so delicate in structure that the separate parts are almost indistinguishable. The clypeus and headpiece continuous, the latter forming a rounded frontal piece directly below the prothorax, the dorsal headpiece occupying a small triangular area between them; the antennæ form an outside bow extending to not quite the end of the 2nd pair of legs. The glazed eye and the eye-area are not at all readily distinguishable in the living pupa (but in the dehisced pupa, a transparent line represents the former, and a punctuated area outside it, the latter); the labrum forms a distinct rounded upper lip; the labium appears to form a lower lip, and bears two rounded projections, the labial palpi, whilst the maxillæ (as usually recognised in most pupæ) are reduced to a triangular lappet on either side of the labium, which are connected above (in front of) the labium by a transverse piece; the maxillary palpi form small buttons at the outer extremity of each of the maxillæ;

the three pairs of legs are blunt-tipped, the 2nd and 3rd pairs extending beyond the antennæ, the tarsi only of the 3rd pair being visible. The abdominal skin is so thin that one can see, as it were, a vast number of tiny white cells (? ova) within the pupa, especially in the upper abdominal area. The scars of the prolegs are just observable on abdominal segments 3-6 (much more obvious on the empty pupa); the 9th and 10th abdominal segments are dark ventrally, with several conspicuous long brown setæ on their surface. The skin of the 7th abdominal is practically transparent, and large well-developed ova are visible through it. The genital organs on the 8th and 9th abdominal segments are represented by a longitudinal scar on the 8th abdominal. *Laterally*.—The forewings are moderately well-developed, extending ventrally to the anterior edge of the 3rd abdominal segment, the hindwings, even at the base, scarcely noticeable. There is a conspicuous longitudinal subspiracular flange, which is continued ventrally on abdominal segment 8, posterior to which the ventral area is dark-coloured, like the dorsum. The spiracles are slightly depressed, inconspicuous and well above the subspiracular flange; there is, below each spiracle, a conspicuous seta (iv), and a second less prominent one (v). The 9th and 10th abdominal segments, dark laterally and ventrally, bear several recurved setæ. [Described April 20th, 1899, from ♀ pupa, taken by Rev. G. H. Raynor, at Hazeleigh.] Ver Huell notes the *male* pupa as having the "head slightly prominent, the wing-, leg-, and antenna-cases yellow, the hindwings projecting somewhat behind those of the forewings; the colour of the rest of the body greyish ochre-yellow, of the back brownish." The *female* pupa is noted as "cylindrical, blunt in front, ochreous-yellow in colour, the posterior segments whitish, the dorsum light brown with interrupted black transverse stripes; the antenna- and wing-cases projecting, small wing-cases being present (although the ♀ moth is wingless)."

Food-plants.—The powdery lichens growing on palings, &c. (Edleston), on tree-lichens (Heinemann), lichens on tree-trunks (Bankes), on lichens growing on rocks, as well as on trees (Bruand), moss (Ver Huell). [Healy notes that larvæ of *T. tubulosa* that were in a jar, where four female *Diplodoma herminata* emerged during the last week of April, 1860, ate the *D. herminata* and afterwards other small moths that he offered them. Later, another larva ate house-flies and a male of its own species, fixing a wing of the latter upright on the top of its case, whilst others fed on moribund woodlice, flies, &c.] Rössler says that the larva as a rule eats lichens, but can be reared on lettuce, whereby the imago obtains a lighter colour.

Parasites.—*Cryptus spiralis*, Gr., *Hemiteles elongatus*, Rtzb., *Hemiteles* sp.? bred by von Siebold (Hofmann).

Habits and Habitat.—The male flies (but not very actively) in the sunshine, whilst the female, after its exclusion, sits in an almost perfectly straight position, *i.e.*, not curved as in Solenobiids, Fumeids, &c., on its case, and there awaits the male, the abdomen hanging downwards when the case is in its normal vertical position. Zeller states that the male hides, and may be beaten out of the herbage; Stainton has beaten the males out as late as 9 p.m. The imagines are generally bred or caught at rest on the fences and tree-trunks to which the larvæ attach their cases before pupation, but the early habits of the insect, until the larvæ climb to their pupating-places, are almost unknown. No place seems to be amiss to it. Beech and fir woods, roadsides, dry ground and marshes, cemeteries, &c., are all recorded as its haunts. Wilkinson notes the cases as very abundant at Scarborough, on sycamore trunks; and Cambridge notes them as common at Bloxworth, on Scotch fir-trunks. Bower notices that all the cases he has found contained pupæ or larvæ that had already fixed their cases, or full-fed larvæ wandering about to find a place in which to spin up; the larvæ appear to prefer a fence to a tree-trunk, to which to fix their cases, but few things seem to escape attention. Atmore says that the cases are most frequently found in Norfolk on trunks of oaks, or on palings near oaks; the imagines fly high in bright, still and warm weather, frequently in sunshine. The cases common near Doncaster on beech, ash, sycamore and old palings, both sexes are freely bred (Corbett). The cases are to be found all over Cannock Chase, but they prefer Scotch fir, although also to be found on alder, and less commonly on birches and palings, usually about 3ft.-4ft. from the ground. Only about 15 per cent. of those bred are males (Freer). Nolcken found the cases on birch stems, and Lienig on poplar stems, in April and early May, in the Baltic provinces. In Brandenburg, Sorhagen records it as almost everywhere in woods and gardens on tree-trunks. In Alsace it frequents shady woods (Peyerimhoff). At Arnhem the cases are found most frequently on beech-trunks (Ver Huell). Along the Alpes-Maritimes the cases are to be found on mossy rocks and old stone walls exposed to the east and west; the larva lives on the lichen growing in such places, and fixes its long case, ridged and papery, a month before the emergence of the imago. It is unknown in the neighbourhood of Cannes (Millière). At Ratisbon the cases are more generally found on birch-trunks, sometimes, however, on rocks; whilst at Erlangen they are usually found on oak-trunks (Hofmann).

Time of appearance.—Stephens notes the end of May, near London, which is unusually early, the first fortnight of June being the average time of emergence. June 30th, 1849, resting on Dartford Heath palings, 5-6 p.m.; June 4th, 1850, bred from cases on Dartford Heath fence; June 21st, 1850, beaten out of elm, at Lewisham, at 9 p.m.; June 15th, 1857, bred from collected cases; June 6th, 1858, at Lewisham and Beckenham, at rest on palings; June 10th, 1858, bred from a case found by Vaughan on *Aster tripolium*, at Bristol (Stainton); June 6th, 1858, near Bristol (Wallace); May 6th, 1860, larvæ on fence, at West Wickham, spun up May 12th; other cases May 20th, 1860, on fences and trees (some beaten out of birch), many on Addington fence; further cases on May 27th, 1860, on fence at West Wickham, all pupated by this date, the first male appeared June 9th, others June 10th, males and females June 11th, others on the 14th, 17th, 20th (many), July 4th, 5th, 6th, &c.; larvæ on fence at Norwood, May 12th, 1861 (Healy); cases on fences and trees on April 26th, 1871, April 7th-May 15th, 1894, imagines bred June 7th, 1886, June 15th, 1888, "assembled" June 27th, 1893, at Rainham (Burrows); cases on oak-trunks July 16th, 1898, at Hockley (Whittle); April 5th, 1886, cases on fences, at Bexley, May 20th, 1887, cases on fences at same place, the imagines bred June 16th-18th, 1887; June 18th, 1890, five imagines on fences, at Bexley, May 28th, 1891, cases at same place, imagines bred June 16th, 1891; June 30th, 1891, imagines on fences, May 22nd, 1894, nineteen cases, imagines bred June 13th-25th; June 20th, 1894, imagines on fences; June 3rd, 1896, six cases, imagines bred June 8th-15th; June 17th, 1896, imagines on fences, worn; May 27th, 1897, cases, all at Bexley; June 10th, 1897, imagines flying in afternoon, at Eltham; April 23rd, 1898, cases on tree-trunks, at Chislehurst (Bower); imagines on July 10th, 1875, at Leicester (Sang); captured June 8th, 10th, and 14th, 1884, June 10th, 15th, 18th, 1896, June 16th, 1897, and bred June 13th and 18th, 1898, at King's Lynn (Atmore); June 6th, 1891, May 16th, 1893, June 3rd, 1895, June 7th, 1896, June 13th, 1897, at Rugeley (Freer); imagines going over at Aldeburgh, July 10th, 1892 (Cruttwell); bred on June 2nd, 1892, from case found on April 19th, a ♂ caught June 20th, 1892, imagines captured June 23rd, 1886, June 28th, 1892, in the Isle of Purbeck, bred May 30th, 1890, from cases found May 27th, imagines captured May 28th-31st, 1884, near Brockenhurst, several bred May 25th and June 10th, 1890, from cases found at Gosport on May 14th (Bankes); several males and females bred June 19th-24th, 1899, from cases from Farnborough (Tutt). In May and June, in Germany (Heinemann), in mid-June in the mountains of Silesia (Zeller); in June in Alsace (Peyerimhoff); from the end of May to commencement of July in Baden (Reutti); the larvæ in April and May, the imagines from end of May on through June, in Brandenburg (Sorhagen); larvæ in April and early May, the imagines fine from June 2nd-11th, the females later from June 17th-23rd, in the Baltic provinces (Nolcken); from the commencement to the middle of July in Finland (Tengström); from June 10th-25th, in the Doubs district (Bruand); common in May (the larvæ in April) in Auvergne (Sand); in May and June on all the mountains, from 800-1200 mètres in the Alpes-Maritimes (Millière); imagines appeared June 18th, 1896, from cases found near Le Havre (Dupont); imagines May 19th, 1849, in the marshes near Pisa, and many in May, 1854, at Gradischa, in Upper Carniola, also in July, 1863, at Brussa (Mann) [Staudinger notes this latter record as a very late one]; on June 11th, 1870, in abundance at Königswater, near Drachenfels (Jordan); July 10th, 1876, a ♂ on wing in evening, at Trafoi (Wocke); larvæ on Dartford Heath palings April 4th, emerged May 24th-June 1st, 1867; larvæ at Merton, April 14th, emerged May 24th, 1867; larvæ at Napoule on lichens on willow March 31st, imagines emerged May 6th, 1892; also larvæ on April 11th, emerged April 21st-29th, 1896; larvæ at St. Aygulph, on lichens on willow, April 24th, emerged June 5th, 1896; larvæ at Lucerne on May 12th, imagines emerged June 3rd, 1893 (Walsingham); imagines June 6th, 10th and 18th, 1867, at Preth, June 9th, 27th, 1870, at Grünhof near Stettin, July 16th, 1871, July 11th, 1873, June 26th, July 2nd, 16th, 1875, at Bergün, June 13th-15th, 1880, at Swinemund (Zeller *teste* Walsingham).

LOCALITIES.—BERKS: Wellington College, Wokingham, Reading, Crowthorne, Bagley Wood (Hamm). CAMBRIDGE: Cambridge (Stainton). CHESHIRE: local (Ellis), Birkenhead (Stainton), Bowdon (Edleston), Bidston Hill (Gregson), Bidston Heath (Brockholes), Delamere Forest (Hodgkinson), Dunham Park (Chappell), Knutsford (Corbett). CUMBERLAND: Lake District (Stainton). DEVON: Oxton (Studd). DORSET: Bloxworth (Cambridge), Purbeck (Bankes), Portland (Richardson). ESSEX: Hazeleigh near Maldon (Raynor), Eastwood, Hockley (Whittle), Wanstead, Brentwood, Rainham, Mucking (Burrows), Epping (Healy), Colchester (Harwood), Ilford (Mera). GLOUCESTER: Bristol (Wallace), Stapleton (Harding). HANTS:

New Forest, common, Isle of Wight (Fletcher), Sandown (Prout), Gosport, near Brockenhurst (Bankes), Bournemouth (Cowl), Basingstoke, Pamber Forest (Hamm), Ringwood (Fowler), Southampton (Curtis). Hereford: Tarrington (Wood). Hertford: Hertford (Stephens). Kent: Pembury (Weir), Bromley, Farnborough (Alderson), Lee (Turner), Bexley, Eltham, Chislehurst (Bower), Chatham (Edwards), Strood (Tutt), Norwood (Healy), Dartford Heath, Lewisham, Beckenham (Stainton), Darenth Lane and Wood (Curtis). Lancashire: near Manchester (Stainton). Leicester: Leicester (Sang *teste* Gardner). Middlesex: North London (Healy), Kingsbury (Stainton). Norfolk: general in west and north-west—Kings Lynn, &c. (Atmore), Norwich, Rackheath (Barrett), Merton (Walsingham). Northumberland: Newcastle-on-Tyne (Stainton). Somerset: Brislington (Vaughan). Stafford: Cannock Chase near Rugeley (Freer). Suffolk: Thorpe, Aldeburgh (Cruttwell). Surrey: Kingston-on-Thames (Lucas), Addington, West Wickham (Healy), Shirley, very common (Warren), Coombe Wood (Curtis), Ripley (Stephens), Croydon (Prout). Sussex: Hastings (Ford), common, Worthing, Hayling, Charmandean (Fletcher). Yorks: generally distributed, Doncaster (Corbett), Scarborough (Wilkinson), York (Stainton), Selby (Ash).

Distribution.—Asia Minor: Bithynia (Staudinger), Brussa (Mann). Austro Hungary: Innsbruck (Weiler), Brünn (Gartner), New Sandec (Klemensiewicz), Galicia—Radowlice, Dobrowlany, Lemberg, common (Nowicki), Croatia, Dalmatia, Tyrol, Gradischa in Upper Carniola, near Vienna (Mann), Buda (Treitschke), Lavantthal (Höfner), Preth (Zeller), Trafoi (Wocke), S. Tyrol—Bozen (Rebel). Belgium: generally distributed and common (Fré), Brussels, &c. (Lambillion). Denmark: common (Bang-Haas). Finland: near Helsingfors, Abo, Uleaborg (Tengström). France: Dept. Saone-et-Loire in mts. (Constant), Aube (Jourdheuille), Douai (Foucart), Nohant, St. Florent (Sand), near Le Havre, Pyrénées-Orientales (Dupont), Alpes-Maritimes, mts. 800-1200 mètres (Millière), Doubs—Jougne, Chevigney, d'Andeux (Bruand), Cambrai (Constant), Cannes (Chapman), St. Aygulph, Napoule (Walsingham). Germany: generally distributed (Heinemann), Mulhausen, Sömmerda, Quedlinburg, Göttingen, Aix, Krefeld (Jordan), Wetterau, Frankfort, Wiesbaden, Cassel (Koch), German Alps—between Prad and Gormagoi, Waldeck, Arolsen (Speyer), Erfurt (Keferstein), Berlin, Silesia, general in the plains, Glogau, common, Probsthain Peak, singly, Lähr (Zeller), near Dantzig (Tiedemann), Lower Elbe dist.—the Haake (Schmeltz), Nassau (Rössler), Würtemberg (Hofmann), Ratisbon (Schmid), Upper Lusatia (Moeschler), Pomerania (Hering), Dessau (Richter), general in Baden, the Rhine Palatinate (Reutti), generally distributed and common in Brandenburg (Sorhagen), Munich—Hirschgarten, Nymphenberg, Hartmannshofen, Schleissheim, Sternberg (Hartmann), Königswinter near Drachenfels (Jordan), Alsace—La Schlucht (Peyerimhoff), Hanover (Glitz), Frankfort-on-Oder (Kretschmer), Dresden (Fischer), Erlangen (Hofmann), Brunswick (Nowicki), Swinemund, Grunhöf, near Stettin (*teste* Durrant). Italy: Northern and Central Italy generally (Curò), Tuscany, marshes near Pisa (Mann), Piedmont (Ghiliani), Milan (Turati). Netherlands: very common in drier parts of country, occurs in most provinces and Friesland (Snellen), Arnhem (Ver Huell), South Holland—Noordwijk, Wassenaar, Gelderland, Oostenbeck, Ede, Velp (Graaf), Lichtenbach, near Arnhem (Grebner). Roumania: Grumazesti, Neamtz, Slanic (Caradja). Russia: Baltic Provinces—Werro (Sintenis), Livonia (Lienig), Neuhof, Pichtendahl (Nolcken), Dubbeln, very common (Teich), St. Petersburg, Esthonia, Astrachan (Erschoff). Scandinavia: Scania, West Gothland, Gothland, Upland (Wallengren). Spain: Castile (Staudinger), Bilbao (Seebold). Switzerland: up to 4,500ft., Zürich (Frey), Valais—Gamsen (Duponchel), Lausanne (Laharpe), St. Blaise-Neuveville (Couleru), highlands of Bergün (Zeller), Arolla, Fusio, Locarno (Chapman), Lucerne (Walsingham).

Family: LUFFIIDAE.

This family is one of the most interesting of those belonging to the Psychids, although previously no attempt has been made to work out the details of the life-histories of the species included herein, nor to define its relationships with the allied Psychid families. Many difficulties still remain to be cleared up in connection with the economy of the species, but we have a very fair knowledge of their affinities. At present we are able to refer two genera only to the family—*Luffia* and *Bacotia*. In the first genus we have been able to study the life-history of *L. lapidella*, and to make some progress towards a knowledge of that of the remarkable parthenogenetic *L. ferchaultella* (*pomonae*), whilst in the second we have been able to clear up most of the difficulties connected with *B. sepium*. As to its affiinities, the great interest that the family presents, lies in the fact that it is intermediate, in many points of structure, between the Micro- and Macro-Psychids. The eggs, laid in the pupal-skin, are of the same delicate structure as those of the Macro-Psychids, whilst the larva structurally (and in habit) is also Macro-Psychid, the dorsal tubercles being arranged so that ii is nearer the median line than i, whilst in walking the young larva holds the abdominal segments high in the air (the prolegs being entirely useless if the larva be taken from the case), but the mature larva often drags its body helplessly on the ground. The female pupa also is largely Macro-Psychid, inasmuch as it does not emerge from the larval case immediately before the appearance of the imago ; it has also lost the dorso-anal spikes and the recurved hairs of the terminal segments, which Micro-Psychid characters are still both retained by the male pupa, the pupa also being characterised by the small size of the united abdominal segments 8-10. The case is rather Micro-Psychid in its general appearance, although the more or less vertical conical structure is peculiarly characteristic of this group. The male imagines bear perhaps more resemblance to the Taleporiids than to the Fumeids (yet *Bacotia* has been generally located with the latter), and the female has the habit of these groups in emerging from the larval case for copulation, and remaining on the outside thereof during oviposition. This combination of Micro- and Macro-Psychid characters makes it quite clear that there is no sharp line of separation between these two divisions, into which we have, for convenience, separated the superfamily, and makes it impossible for us to include these satisfactorily in either division. Besides the general characters of the family already given, the following imaginal characters relating to the antennæ, neuration, genital organs, &c., have been worked out by Chapman :

♂. *Antennæ :* Pedicel (1 joint), scape (1 joint), and 1 joint of clavola without pectinations ; pectinations moderately long (1-1½ length of joints at centre of antennæ), without scales, flattened beyond middle (spathulate). *Mouth-parts :* Labial palpi short, 2-jointed, hairy. *Legs :* 1st tibiæ with spur of half its length, starting from middle (like Micro-Psychids). *Neuration* :* Forewings—subcostal accessory cell present as in all Micro-Psychids, this cell is always absent in the Macro-Pyschids. 7 and 8 separate, 7 to costa. Hindwings—4 absent. *Shape :* Both wings elongated with sharp apex, but costa curved downwards towards apex. *Genital organs :* The valve is cylindrical (in *Fumea* bulbous), the harpe with a long neck (in *Fumea* with a short neck).

♀. *Antennæ :* Joints 12-16, scaleless. *Legs :* 4- (or less) jointed. *Mouth-parts :* Maxillæ represented by a conical projection. *Scales :* Abdominal segments scaled, the scales rather broad, narrower on the last segment. *Plates :* The thoracic segments well chitinised, chitinous plates on abdominal segments divided medially.

The female, owing to the great specialisation that it has undergone, probably affords more valuable classificatory characters, among the Psychids, than any other stage of the insect. For this reason, we would more particularly draw the attention of students to the detailed descrip-

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* The neuration is very variable—sometimes 3 is absent on the forewing, the secondary cell differs in size, whilst 10 may be bifurcate. In the hindwing 5 may be bifurcate, &c. Two of these aberrant examples show tendency for 4 to disappear in forewing and to appear in hindwing (Chapman).

tions of this sex, given under each species. The Luffiid females are especially characterised by the highly-developed scales that surround the abdominal segments. The comparison of the scales presented by the females of this and the allied families has been worked out by Chapman as follows:

1. In *L. lapidella*, ♀, the scales cover the whole abdomen, except the anterior border of the 1st segment, down to the commencement of the anal wool; broader forward and dorsally, they are yet of more uniform size and form throughout than those of *L. ferchaultella*, triangular, broad at tip, narrowing regularly to base, extreme breadth one-fourth to one-fifth of length, and cut off rather squarely at end without any definite toothing.

2. In *L. ferchaultella*, ♀, the scales are very variable in form and size, not only do those on examples from different localities vary, but those from the same locality also show great differences in different individuals, some presenting scales very like those of *L. lapidella*, others extremely broad ones. The broadest are usually dorsal and anterior, but the very broadest are sometimes lateral. On one specimen the scales are not very broad, and are rounded as in *S. lichenella*. In most they are much like those of *L. lapidella*, but broader, and with various irregular toothings at extremity. In a few the scales (or some of them) are so broad as to be fan-like, or like the leaves of *Salisburia adiantifolia*, broader at the extremity than they are long, but preserving the straight sides, so as still to be triangular in shape, the extremity somewhat irregular, with toothings that look rather as if the ends were broken off than trimly serrate as in most toothed scales.

3. In *B. sepium*, ♀, the scales are a shade larger, and narrower in proportion to width, than those of *L. lapidella*, usually rounded at end, or with one indentation, and rather more variable.

4. In *Solenobia* ♀ and *Taleporia* ♀ the scales are more variable—extending from scales to hairs—narrower than in *L. lapidella* in most species (some broader on *T. tubulosa*), all that are obviously scales narrow somewhat to tip, and are there rounded.

It would appear that the tendency for the chitinous plates of the ♀ Luffiid abdomen (especially dorsally) to be divided into two by a median division, is characteristic of this group and does not appear elsewhere. It is so far developed that in ♀ *B. sepium* there appear to be two dorsal and one ventral plate, in ♀ *L. ferchaultella* two dorsal and two ventral.

There is one species (generally referred to this group) that must be considered obsolete, *viz.*, the *Psyche lichenum* of Schrank (*Fauna Boica*, ii., p. 92), and referred to by Zeller (*Isis*, 1838, p. 718 and *Linn. Ent.*, vii., p. 358). This species is founded on the following description:

Wohnort: an Eichen und Föhrenstämmen, wo die Raupe ihren Sack mit den Trümmern kleiner Schuppenflechten und Warzenflechten überkleidet, denen sie auch nach der Länge gelegte dünne Splitter oder Trümmer von Föhrennadeln einmengt. Den Schmetterling sah ich nicht (Schrank, *Fauna Boica*, ii., p. 92).

It is difficult to know what species can be said to "cover its case longitudinally with thin chips or fragments of pine needles," and Schrank's identification of Réaumur and Fuessly's species as cospecific does not make the matter any clearer. Réaumur's pl. xv., figs. viii and ix, are distinctly Luffiid, one might even suspect them to be bad figures of the cases of *sepium* or *ferchaultella*, but the description of the larva that is said to inhabit them disagrees entirely, for all the known Luffiid larvæ are very dark, whereas this is said to be "yellow or greenish-white." Fuessly's *Archiv*, ii., pl. xii., figs. 8-9, appear referable to *P. betulina*, and might even represent an immature case of *Sterrhopterix hirsutella* (*calvella*), as Werneburg suggests. It appears to us, therefore, that *Psyche lichenum*, Schrank, cannot at present be referred to any known species.

Subfam.: LUFFIINAE.
Tribe: LUFFIIDI.

With regard to the tribe in which *Luffia* and *Bacotia* are placed, it may be pointed out that it offers in its genera considerable differences from the Taleporiids and Fumeids, with which, in different ways, it appears to be most closely allied. The general characters already dealt with, such as the difference of the larvæ, pupæ and imagines, may be supplemented by differences in the genera themselves. Thus we find the following difference of neuration:

Luffia.—Forewing: 1c present. Hindwing: transverse nervure 5-7 straight.
Bacotia.—Forewing: 1c absent. Hindwing: transverse nervure 5-7 angled.

Not only do the ♂ antennæ of the Luffiids differ markedly from those of the allied families, but they differ much *inter se*, agreeing with those of *Whittleia reticella*, in having the 1st joint of flagellum (3rd of antenna) without pectinations and in the pectinations being free from scales. The antennæ of the two genera, however, differ considerably *inter se*, as may be seen from the following:

1. *Luffia* (*lapidella*).—1st segment short, thick (but smaller than in *F. casta*), and not globular; 2nd segment short, thick, square; 4th segment with short pectinations (one-half the length of the segment); 5th-12th segments, pectinations rather longer than segments; 18th-19th segments (final two) without pectinations. Scales on dorsum of segments long, one from base of segment nearly as long as segment, one from apex extends halfway along the next segment. Pectinations apparently scaleless, hairs pale (more numerous and shorter than in *F. casta*), about one-fourth length of (say the 9th) segment.

2. *Bacotia* (*sepium*).—1st segment large, rounded, wingshaped; 2nd segment large, square; 3rd segment belongs to flagellum, short, square, without pectinations; 4th segment short, square, without pectinations; longest segments about 10th-14th; pectinations longer than segments, broad and flat at about two-thirds of their length; terminal joints shorter, last two very short, but wide and spathulate, the last one without pectinations. Scales on dorsum of segments in two rows, two-thirds length of segments. Pectinations scaleless.

Genus: LUFFIA, Tutt.

SYNONYMY.—Genus: *Luffia*, Tutt, "Ent. Record," xi., p. 191 (1899); Ibid., p. 207; Chapmn., Ibid., pp. 201, 293; Luff, Ibid., p. 223; Walsm., Ibid., p. 257; Bankes, "Ent. Mo. Mag.," xxxv., p. 278 (1899). *Tinaea*, Geoff., "Hist. des Ins.," ii., p. 204 (1762). *Tinea*, Goeze, "Ent. Beit.," iii., (4), p. 168 (1783); Geoff., "Fourc. Ent. Paris.," p. 336, no. 53 (1785); Jung, "Alph. Verz. Schmett.," p. 306 (1791). *Talaeporia*, Zell., "Isis," 1838, pp. 717-8; Ibid., 1847, pp. 801-2; "Stett. Ent. Zeit.," xi., p. 60 (1850); Stphs., "Zool.," viii., p. cix (1850); Hdrch.. "Lep. Eur. Cat.," p. 78 (1851); Staud. and Wocke, "Cat.," p. 105 (1861); 2nd ed., p. 266 (1871); Sta., "Tin. S. Eur.," 2, pp. 283, 322 (1869); Mill., "Cat. Lép. Alp.-Mar.," p. 295 (1875); "Nat. Sic.," v., p. 130 (1886); Foucart, "Pet. Nouv. Ent.," i., pp. 523-4 (1875); Hartmn., "Mitt. Münch. Ent. Ver.," iii., 195 (1879); Turati, "Bull. Soc. Ent. Ital.," xi., p. 198 (1879); Curò and Tur., Ibid., xv., p. 3 (1882); Rebel, "Ann. K. K. Hofms.," vii., pp. 266-7, 282 (1892); Ibid., ix., pp. 17-18 (1894). *Solenobia*, Dup., "Hist. Nat.," supp. iv., p. 512 (1842); "Cat. Mét.," p. 358 (1846); Ghil., "Fn. Ent. It.," p. 78 (1852); Zell., "Linn. Ent.," vii., p. 357 (1852); Edl., "Ent. W. Int.," v., p. 147 (1859); Ibid., vi., p. 28; "Zool.," xvii., p. 6463 (1859); Sta., "Ent. W. Int.," vi., p. 28 (1859); "Ent. Ann.," 1870, p. 2 (1869); 1874, p. 2 (1874); Hardg., "Ent. Mo. Mag.," vi., pp. 91-3 (1869); xii., p. 208 (1876); Jourd., "Ann. Soc. Ent. Fr.," 4th ser. x., p. 115 (1870); Boyd, "Ent. Mo. Mag.," xii., p. 163 (1875); Hudd., "Cat. Lep. Brist.," pp. 68-9 (1884); Bankes, "Pr. Dors. N. H. Club," x., p. 206 (1889); Rich., "List. Port. Lep.," p. 180 (1896). *Taloeporia*, Gn., "Ann. Soc. Ent. Fr.," 2nd ser. iv., pp. 11, 14-15 (1846). *Psyche*, Brd., "Mon. des Psych.," pp. 90-1 (1853); Weav., "Zool.," xv., p. 5540 (1857); Birch., "Ent. Mo. Mag.," iii., p. 147 (1866); Morris, "N. H. Brit. Moths," iv., p. 11 (1870); Gregs., "Ent.," vi., p. 409 (1873). *Fumea*, Luff, "Mic.-Lep. Guernsey," p. 9 (1899).

This genus was named *Luffia* in the *Ent. Record*, vol, xi., p. 191, for the purpose of ensuring priority when it appeared in this volume, and *lapidella* was cited as the type. The following summary gives the principal characters of the genus:

Ovum.—Eggs laid in pupa-skin, proportionally large, irregularly oval, pale pearly-white or yellow, shiny, somewhat smooth, exceedingly delicate.

Case.—Conical, carried more or less uprightly, covered with minute pieces of earth or lichen.

Larva.—Head black, comparatively large, retractile; thoracic segments narrow, pro- and mesothorax corneous, metathorax with lateral plates only; abdominal segments bulky; true legs dark with pale terminal hook; prolegs short, hooks arranged in horseshoe form (oval broken on inner edge), anal prolegs well-developed; segmental incisions strongly marked; lateral flange distinct; dorsal tubercles as in Macro-Psychids—i external to ii.

Pupa.—♂. Thorax large; abdomen small; wings to end of 6th abdominal segment; 3rd pair of legs to beginning of 8th; abdominal segments 8-10 fused; movable segments 2 (dorsally)-7; two dorso-anal spikes (as in Micro-Psychids); setæ as in larva; row of anterior dorsal spines on 3-8 (bolder and more regular than in *Bacotia*); no intersegmental spines but rough skin processes; antennæ large and well-developed; mouth-parts—labia short, divided into two rounded ends without definite division; maxillæ two-thirds length of labium, somewhat triangular. ♀. Head and thorax very small; skin coarse; abdominal incisions deeply cut; wings very small, to middle of 1st abdominal segment, 2nd legs nearly to end of wings, 3rd legs beyond; movable segments 2-6; anterior dorsal spines 3-7; no dorso-anal spikes or recurved hairs; several rows of sharp conical points on intersegmental membrane; antennæ very short; mouth-parts—jaws very large, maxillæ rounded (without definite palpi), labium short (no division into palpi), length hardly exceeding labrum.

Imago.—♂. Anterior wings long narrow, apex pointed; reticulated; hindwings unicolorous; antennæ 20-jointed, 4th very short and with short pectinations, 5 twice as long as 4, with equally long pectinations; joints 6-11 long and with rather large pectinations, thence joints shorter, but pectinations shorten more rapidly, on joint 16 pectinations shorter than joint, on 19 about half length, 20 simple, each joint with two rows of long narrow scales dorsally, one at middle and one at apex of joint, pectinations arise close to base of joint, basal joint densely scaled; eyes large, black; labrum square, below clypeus, with maxillæ forming two tubercles at either side; labial palpi short, 2-jointed, clothed with long hairs; 1st tibia with spur from middle, half length of tibia; 2nd tibia with two spurs from extremity, less than half the length of tibia; 3rd tibia, two pairs of spines one-third length of tibia; genital appendages—valve cylindrical, harpe with narrow neck for more than one-third of its length, ending in 3 (? 4) claws. ♀. Not so curved as in *Solenobia* or *Fumea*, nor so straight as *Taleporia*; head and thorax dark, plate on metathorax somewhat narrowed dorsally; 1st abdominal pale except anterior margin; large, square, chitinous plate on either side of dorsum from 2-7; anal tuft at extremity of 7; antennæ 12- or 14-jointed; ? labium with two setæ; tarsi 4-jointed; scales cover whole abdomen; ovipositor 2-jointed with long intersegmental membrane.

Neuration.—♂. *Anterior wings* with secondary cell small, 1c represented basally. *Posterior wings.*—The transverse vein 5-7 across median straight, 1b a faint line (Chapman).

There are only two known species in *Luffia*, the parthenogenetic *L. ferchaultella* and *L. lapidella*. One feels inclined to suppose that each of these may be names that cover a group of closely allied forms. The facts collected by Chapman tend to prove either that there is such a group included in the parthenogenetic species, or that each colony has become so specialised by isolation that differences peculiar to each may readily be recognised. Compared with *lapidella* the following facts are instructive:

♀ *lapidella*—Antennæ 14-jointed; tarsi 4-jointed (3-4 partly anchylosed in 1st legs); scales one-fourth of length in breadth, usually truncate.

♀ *ferchaultella*—*a*. Antennæ 12-jointed; tarsi 3-, 4-, and 4-jointed respectively; scales narrower than those of *lapidella*, one-fifth of length in breadth, truncate and very rarely rounded; forewings narrow but long; metathorax partly pale (examples from Broxbourne, Horsham).

b. Antennæ 12-jointed; tarsal joints 3-, 4-, and 4-jointed respectively; scales variable from those in which length = breadth, to those in which length = five times breadth, truncate, very rarely rounded (Bignasco).

c. Antennæ 12-jointed; tarsi 3-, 3-, 3-jointed respectively; scales very broad, length only twice the breadth; metathorax dark brown (Bowers-Gifford).

d. Antennæ with fewer than twelve joints; tarsi 3-, 3-, 3-jointed respectively; scales varying from those in which the length is twice the breadth, to others in which the length equals breadth (Deal).

We have already noted the peculiarities of the conical larval case presented by *Luffia*, but might add that when the Luffiid larva spins itself up for pupation, the mouth of the case is contracted and applied flatly to the surface or in a crack, so that the pupa-containing, and empty, case is much more like that of *Solenobia* than one containing a feeding larva. Its larva is equally characteristic (although very similar to *Bacotia*) when compared with those of *Fumea*, &c. It is almost entirely dark fuscous, the head and thoracic plates black, with a paler shade in middle of these, not apparently dividing that of prothorax into two plates, but although it apparently divides the mesothorax (and really, probably, divides both as observed under the microscope). The trapezoidal tubercles are not only reversed, but ii has advanced to be almost in a line with i. The abdominal segments have a dark dorsal line, the dorsal surface of the segments with little or no sculpture (subsegments, &c.), but, although impressions of the lateral flange can be made out, the larva is really very smooth and rounded. The third thoracic segment is very large ventrally, allowing of the peculiar method of walking (with the abdominal segments raised in the air) characteristic of this and certain young Macro-Psychid larvæ. The larva of *Bacotia* is especially like that of *L. ferchaultella* (the latter is, however, somewhat paler). Compared with the larvæ of *Pachythelia villosella*, *Fumea saxicolella*, and *Whittleia reticella*, the larva is shorter, stouter, and more grub-like, with a relatively large head and thorax in comparison with the abdomen. The prolegs are structurally very like those of the Macro-Psychids, the ring of hooks incomplete on the inner margin with a dark central pit, as in *P. villosella* (Bacot). The pupal structure is practically identical in *Bacotia* and *Luffia*, although the former is larger and more bulky.

Luffia lapidella, Goeze.

Synonymy.—Species: *Lapidella*, Goeze, "Ent. Beit.," iii. (4), p. 168, no. 289 [with reference to Réaum., "Mém.," iii., pl. xv., figs. 1-3, and Geoff., "Hist. Ins.," p. 204, no. 53] (1783); Jung, "Alph. Verz. Schmett.," p. 306 (1791); Zell., "Linn. Ent.," vii., pp. 357-8, Anm. *a* (1852); Staud. and Wocke, "Cat.," pp. 266, 425, no. 1332 (1871); Mill., "Cat. Lép. Alp.-Mar.," p. 295 (1875); "Nat. Sic.," v., p. 130, no. 1332 (1886); Hrtmn., "Mitt. Münch. Ent. Ver.," iii., p. 195, no. 1332 (1879); [? Turati, "Bull. Soc. Ent. It.," xi., p. 198 (1879)]; Curò and Tur., Ibid., xv., p. 3 (1882); Rebel, "Ann. K. K. Hofms.," vii., pp. 266-7, 282 (1892); Ibid., ix., pp. 17, 88 (1894); Tutt, "Ent. Rec.," xi., pp. 191, 207 (1899); Chapmn., Ibid., pp. 201, 294 (1899); Walsm., Ibid., pp. 257, 259 (1899). *Lichenosa*, Geoff., "Fourc. Ent. Paris.," ii., p. 336, no. 53 (1785). *Lapicidella*, Zell., "Isis," 1838, pp. 717-8; Ibid., 1847, pp. 801-2, no. 356. *Pectinella*, Dup., "Hist. Nat.," supp. iv., 512, no. 621, pl. lxxxix., fig. 6 (1842); Gn., "Ann. Soc. Ent. Fr.," xv., 2nd ser. iv., pp. 11, 14-15 (1846); Zell., "Stett. Ent. Zeit.," xi., p. 60 (1850); Staud. and Wocke, "Cat.," p. 105, no. 1169 (1861); Jourd., "Ann. Soc. Ent. Fr.," xxxix., 4 ser. x., p. 115 (1870). *Lapidicella*, Dup., "Cat. Méth.," p. 358 (1846); Gn., "Ann. Soc. Ent. Fr.," xv., 2nd ser. iv., pp. 11, 14 (1846); Zell., "Stett. Ent. Zeit.," xi., p. 60 (1850); Hdrch., "Lep. Eur. Cat.," p. 78, no. 20 (1851); Ghil., "Fn. Ent. It.," p. 78 (1852); Brd., "Mon. des Psych.," pp. 90-1, 118, no. 66, pl. ii., figs. 66*a-b* (1853); Sta., "Tin. S. Eur.," 2, pp. 283, 322 (1869); Luff, "Mic.-Lep. Guernsey," p. 9 (1899). *Pectina-*

tella, Dup., "Cat. Méth.," p. 359 (1846). *Roboricolella*, Birch., "Ent. Mo. Mag.," iii., p. 147 (1866). [? *Intermediella*, Morris, "N. H. Brit. Moths," iv., p. 11, pl., xcvii (lcvii), p. 19 (1870)]. *Hibernicella*, Gregs., "Ent.," vi., pp. 409-10 (1873). *Conspurcatella*, in part, Mill., "Lép. Cat. Alp.-Mar.," p. 295 (1875). *Triquetrella*, Dale, "Lep. Dors.," p. 47 (1886); Bankes, "Pr. Dors. N. H. Club.," x., p. 206 (1889).

Original description.—*Phalaena Tinea lapidella*, die Steinmossmotte, Geoff., *Ins.*, ii., p. 204, no. 53. La teigne des pierres à fourreau rond en capuchon (Noch nie zur Verwandlung gebracht). Réaum., *Ins.*, iii., pl. xv., figs. 1, 2, 3 [Goeze, *Ent. Beyträge* (zu Lin., *S.N.*, xii), iii., 4, p. 168].

[N.B.—Geoffroy's description referred to by Goeze reads as follows: *Tinaea* lapidum, involucro conico recurvo (Réaum., *Ins.*, iii., pl. xv., figs. 1-3). La teigne des pierres à fourreau rond en capuchon. J'ai ramassé plusieurs fois la chenille de cette teigne qui est très-commune; elle est toujours morte sans me donner l'insecte aîlé. M. de Réaumur n'a jamais pû l'avoir non plus. Cette chenille est petite, brune, couverte d'un fourreau qu'elle se file. Ce fourreau est conique, pointu et un peu recourbé comme un capuchon. Le dessus est tout couvert de poussiere de pierres que l'insecte sait-y attacher. La chenille se trouve sur les pierres. Elle se nourrit d'un petit lichen qui recouvre les vieux murs et les rend tout verts (*Histoire des Insectes*, p. 204).]

Historical note on Luffia lapidella.—This insect was first noticed by M. de la Voye, who, on August 28th, 1666, communicated to the Academie des Sciences (France) a paper on the species. His account of the insect is a very satisfactory one, although he considered that the larvæ ate stones. The cases that he described had been found on the old walls of the Benedictine Abbey of Caen, a locality not very far removed from the Channel Islands, where Mr. Luff has this year (1899) found and reared them so abundantly. Réaumur corrected and amplified this description in the *Mémoires*, iii., pp. 179 *et seq.*, and gave figures of the case, larva and female (Pl. xv., figs 1-6, 17-19). It was afterwards described by Geoffroy (*Hist. des Ins.*, p. 204), and later named *lichenosa* by him in *Fourcroy's Ent. Paris.*, p. 336. Just previous to this, however, Goeze had named the insect *lapidella*, whilst in 1838, Zeller named it *lapicidella*, both the latter authors taking as their types the same bibliographical references to Réaumur and Geoffroy. Duponchel, however, independently described the male insect as *pectinella*, and Guénée averred (*Ann. Soc. Ent. France*, 2nd ser., iv., p. 11) that it was the most common Micro-Psychid, the cases occurring in hundreds, and the imago entering the rooms even in the middle of Paris. It was Guénée, too, who referred Duponchel's *pectinella* to this species, although he himself adopted Zeller's name, changing its form, however, to *lapidicella*. The male has not yet been bred in Britain, although we refer cases obtained by Bankes in Purbeck, and by Richardson in Portland, hereto, and suspect that the cases obtained by Edleston, on an old limestone wall between Conway and Llandudno, as well as Gregson's *Psyche hibernicella*, should also be so referred, but until the male is bred there must always be the suspicion that the British insects may be *L. ferchaultella* (*pomonae*).

Imago.—Anterior wings 9mm.-12·25mm. in expanse; dark grey or leaden in colour, with irregular fuscous reticulations; a black line (broken) on hind margin, a curved discoidal mark, and two others basal to it; fringes unicolorous (although marginal spots sometimes enter basal part). Posterior wings pale leaden grey; no reticulations; nervures rather darker, ending in fairly developed marginal dots that enter the otherwise unicolorous fringes.

Sexual dimorphism.—*Male*: The anterior wings have the dark and light reticulation of the *Taleporiidae*, and their outline is very like that of *T. tubulosa*, *i.e.*, that whilst the wing is long and narrow, and with a pointed apex, and the distal portion of the costa curved, the proximal portion is also curved slightly as in *T. tubulosa*, and not straight as in *B. sepium*, nevertheless the intermediate portion is straighter than in the former. The general tone of colour is a leaden or dove-colour, rather than the yellow-brown or -grey so frequent in Micro-Psychids, but some have a yellowish tendency. The reticulations are less distinct than in *Bankesia*, nearer a somewhat suffused *T. tubulosa*, and very nearly as much as *W. reticella* in actual pattern. The forewings have a black line along the hind margin usually broken up into a series of spots (occasionally almost evanescent), and rarely affecting the fringes, into which, however, the dots sometimes run. There is usually a curved mark at end of cell (as there is often also in *T. tubulosa*) and two others basal to it. All the markings are scraps of transverse lines, or bands, and are too irregular for description, though one, often marked just inside apex, may be noted; all are somewhat curved with concavity basal. The hindwings are pale dove-colour, and, being free from the reticulations of the forewings, look paler. There is a tendency to darker scaling along the nervures, which is usually pronounced into actual black spots at the margins of the wings and into the fringes. *Female*: The anterior winglet is narrow, forming a nearly black filament eight or ten times as long as broad, longer and narrower than 1st tibia, hanging directly ventrally, and having the appearance of being jointed at its base; the posterior wing parallel to it, about one-third its length, rather broader and decidedly paler. Head and thorax dark [in *B. sepium* there are two (one on either side) pale square patches on mesothorax whilst in *L. lapidella*, the hind margin of the dark plate is a little scooped out at the same place, but with no distinct pale patch]; the metathorax is also dark, but the plate is narrower dorsally (although wider than in *B. sepium*); the 1st abdominal segment is pale except a chitinous strip at the anterior margin, but the following abdominal segments have a large, square, chitinous (brown) plate (dorsally) on either side, with a serrated darker anterior margin; these are progressively smaller to the 6th, but that on the 7th is again large, and is followed by the woolly zone; there are similarly, on the ventral aspect, smaller plates (one on each side) on abdominal segments 2-6. The antennæ are 14-jointed, appear to possess a few scales (though these may have adhered from other parts). The mouth-parts present a conical projection (which one cannot clearly assert to be the labium) with two setæ. The tarsi are 4-jointed on all legs, though actual or commencing anchylosis appears to obtain between 3 and 4 on the 1st leg. The scales were described *ante*, pp. 233-4. Réaumur describes the female as being almost devoid of wings, but adds that "under a powerful microscope one sees on the segments some thoroughly lepidopterous brown-black scales. These would make the insect dark were it not that there are spaces left between them, and that the segmental incisions are quite naked. The scaleless areas are whitish, so that the insect appears grey to the naked eye. The anus is surrounded by a fringe of yellowish scales, forming a sort of band, these scales being much longer than those on the rest of the body. The legs are brown, corneous, and large for the size of the body; the head is black or brown, turned ventrally, and looks little like the head of a lepidopterous insect. The antennæ are of moderate length, thread-like. The body is arched, the dorsum convex. The insect moves little, and awaits the male on its case. The ovipositor is 3-jointed, surrounded by a ring of scales, and is as long as the body. This is lengthened and shortened alternately to obtain the eggs to place them in the case. The body itself appears to be full of eggs." Bacot says that the female of this species reminds one somewhat, especially in the character of its anal tuft, of that of *T. tubulosa*. The banded appearance of the abdominal segments is due to bands of small, dark, narrow scales, and not to the presence of corneous plates as in *Fumea*.

Variation.—The males exhibit considerable variation in size, four examples from Guernsey measuring 11mm. (2), 12·25mm. and 12·5mm. in expanse, whilst the examples forming the series in the "Stainton" and "Frey" collections, from Lyons, vary from 9mm.-12·1mm. in expanse. Those from Guernsey are rather dark grey in colour, and perhaps more distinctly marked than the French specimens, which are not only smaller (average) but browner in tint, the cases, too, being lighter owing to their outer surfaces being covered with minute particles of light-coloured sand and mica. We suspected that these paler examples might be distinct from the Guernsey species, but careful examination does not tend to support this view. It is, however, worthy perhaps of a special name and hence we term it:

a. var. *pectinella*, Dup., "Hist. Nat.," supp. iv., p. 512, no. 621 (1844). *Lapidicella*, Gn., "Ann. Soc. Ent. Fr.," 2nd ser., iv., pp. 11-14 (1846).—6‴. Forewings above and below glossy grey, slightly reticulated with brown. Hindwings above and beneath unicolorous whitish-grey, as also the fringes. Head, body, legs, and antennæ brown-grey, the latter with long widely separated pectinations, on which account they are not numerous (Duponchel).

Guénée notes its colour as shining whitish-grey irregularly striated, with a cellular lunule and apical spot darker; the posterior wings whitish and the body ashy. This French form was obtained in abundance by Millière at Lyons. Guénée, as we have already observed, also states that it occurred in hundreds around Paris, whilst Duponchel found it many times flying at night around the light in his rooms. The supposition that this may be distinct from the Guernsey insect has been held, and the lighter colour of moth and case support this, but Bacot has noted (*vide*, *posteà*) that a Guernsey ♂ paired with a Brione ♀ that came from a case of the pale *pectinella* type. The late appearance of Walsingham's Corsican examples (mentioned later) is also puzzling. Stainton made the following description of the Lyons larva:

Solenobia lapidicella (Stn., MS., F. 608, fig. B, 13). Larva: Black. Head and 2nd segment shining black; front of 3rd and part of 4th segments also shining black. Long. 7mm. Feeds on lichens on old walls facing north, at Lyon (Millière, June 14th, 1857) [Durrant, *in litt.*].

Durrant notes that Stainton made a rough sketch of the case which could not be distinguished from that of *lapidella*, Goeze.

Comparison of Luffia lapidella with its allies.—The female is very similar in structure to that of *L. ferchaultella* (*pomonae*), but very different in its habits. Both have fairly well-developed antennæ and conspicuous scales on the abdominal segments. The ♀ *Bacotia sepium* has almost exactly similar habits to those of the ♀ *L. lapidella*, for both remain in a similar "calling" position on the case, awaiting a male, and finally die there if not fertilised, whilst *L. ferchaultella* commences to lay her eggs directly after emergence, without waiting for a male, the eggs hatching in due course. Stainton described a species from Morocco, which, he suggests, closely resembles *L. lapidella*. This appears to be the *Sciopetris technica*, Meyr., *Ent. Mo. Mag.*, xxvii., p. 58, from Phillipeville, Algiers. Stainton describes it as follows:

Solenobia pretiosa, Sta., "Ent. Mo. Mag.," viii., p. 233 (1872).—A very neat and delicate-looking insect, in form of wing closely resembling *S. lapidicella*, but much paler, with the reticulations of the anterior wings more neatly expressed, and with the head pale yellow; the antennæ not pectinated, but slightly pubescent. Exp. al. 5 lin. One specimen taken among low plants on the Marshen, April 26th, 1870 (Stainton).

As the specimen cannot be found in the "Stainton" continental collection its exact relationship with *L. lapidella* cannot be determined. The reference to the antennæ is suspicious that the insect is not really very closely allied thereto. One might here note that Constant describes (*Ent. Rec.*, xi., p. 256) the antennæ of *T. defoliella* in almost the same terms.

Egg-laying.—The eggs are packed into the empty pupa-skin, the ruptured end of which is stopped with a wad of silken material from the anal tuft. Eggs laid on June 30th, hatched July 27th, 1899.

Ovum.—The egg is pale yellowish-white in colour, irregularly oval, slightly over ·5mm. in length and ·375mm. in width (a very large egg for so small a species). It is soft and fragile, a mere bag of fluid, perhaps a shade firmer than the egg of *Whittleia reticella*, though this is doubtful. The shell is shiny, not very smooth and appears to be roughly and irregularly faceted. The case possibly would not hold more than fifty eggs, but to find out the actual number would certainly result in the fracture of all the eggs (Bacot, July 9th, 1899).

Case.—The cases vary from 5mm.-7mm. in length, and average about 2mm. in width, some, however, are less than 4mm. in length. The case is roughly conical, pointed somewhat bluntly at its posterior end, but with a very wide elliptical mouth, from which the larva protrudes its head, prothorax, mesothorax and the sides of the metathorax. It is able also to protrude the metathorax and 1st abdominal segment, but as a matter of fact rarely does so normally. The case is composed of white silk, to which are attached minute pieces of stone and lichen. This gives a considerable range of variation in the colour of the cases, evidently depending on the colour of the lichens which the larvæ mix with the silk to form the case. The case is so made that the upper surface is much more rounded than the lower, and although the smaller cases appear to be held up at about an angle of 30°-45° when the larva is walking, the larger cases are held somewhat flatly, often quite on the surface upon which the larva crawls, and are only raised when the larva takes a step forward and pulls the case after it [Described March 20th, 1899, from cases sent from Guernsey]. Zeller describes the case as 3''' long, conical, broadest before the middle, becoming gradually pointed towards the end, thinner at the anterior (head) end, entirely without keels, slightly bent, dark grey, covered with fine particles of chalk, most plentifully towards the anterior end. Bacot notes the case as being short, shaped like a cow-horn, and covered with small scraps of lichen, grains of sand, mortar, &c., and dark grey in colour. M. de la Voye describes the case as "grisâtre et grosse comme un grain d'orge, plus pointue d'un côté que de l'autre, à peu près comme une chauffe d'hypocras. . . . toute parsemée de petites pierres et de petits œufs verdâtres ; il y a dans l'extrémité la plus pointue un petit trou par où ces vers jettent leurs excrémens ; et que, dans l'autre extrémité, il y en a un plus grand par où ces vers passent leur tête, et s'attachent à la pierre qu'ils rongent." Réaumur says that de la Voye has well compared the case to a "chauffe d'hypocras, curved and open at both ends." He states that the large opening from which the larva protrudes its head and legs is oval in outline, and forms a plane cut obliquely to the axis of the cone, so that when this opening is fitted down on a stone, the cone stands at an angle of about 45°. The case is made of silk, covered externally with an infinite number of minute particles of stone. The new cases made by some larvæ extracted from the old cases were somewhat like a truncated cone in general appearance. These larvæ spun a certain amount of silk, and then, with the jaws, picked up a minute particle of stone and attached it to the silk, as the case was extended anteriorly the particles of material were added to the silk. The colour of the case, he adds, is ordinarily ashy-grey, but some of these new cases were covered with yellow grains, possibly from morsels of lichen or stone. Voye's "greenish eggs," with which, he says, the cases were covered, Réaumur considers, were probably little scraps of moss, mixed with the stone. Two cases sent by Luff from Guernsey had each a very small piece of stick attached longitudinally to the case ; this appears to be a mere matter of chance, and not a tendency to adopt the habit of the Fumeas.

Habits of larva.—In its habitat, on old walls and rocks, the larva moves somewhat freely from place to place. It spins a great deal of silk on which it walks, and, in confinement, this is especially noticeable. A number of larvæ, sent from Guernsey, covered the inside of a box, in which they had travelled, with a layer of white silk. They hang freely by a silk thread, if disturbed, and regain their lost position by means of it ; they also frequently come out of the case and re-enter it. When drawn from the case, the larva can make very little use of the prolegs on abdominal segments 3-6, the young larva holding its abdominal segments up in the air, the adult larva looping considerably without attempting to use these prolegs in walking. De la Voye observed the peculiar walking habit of the young larva, whilst Réaumur mentions that the larva has the power of leaving its case and hanging by a silk thread, and Gregson remarks (*Entom.*, vi., p. 409) that the larvæ of the Howth *hibernicella* (probably this species) left their cases at pleasure and roamed about freely, some with the abdomen raised, others dragging the body along, but never using the abdominal feet ; they often suspended themselves by a silken thread, and two or three constructed new cases of lichens. Réaumur notes that when the larva is nearly ready to pupate it fastens the anterior (wide) end of the case to the surface chosen, generally on the wall on which it has lived, or in the hollows thereof, and spins a thick silken web of the same size as the opening of the case, so as to fill up the latter completely.

Larva.—The larva is, when extended, about $3\frac{1}{2}$mm. long (probably not quite two-thirds grown), but when contracted not much more than half that length, and 1mm. wide at the broadest segment (the 4th abdominal). Its head is comparatively large, partly retractile within the prothorax, the head is deep brown-black, glossy, with a few scattered colourless bristles, mouth-parts pale brown, ocelli black, the lenses flattened and surrounded by a slightly raised rim ; the chitin of the head covered with a polygonal reticulation as of close fitting cells ; the prothorax wider than the head, dull black, almost entirely covered from the legs upwards with a glossy blackish-brown corneous shield, subdivided medially by a narrow triangular patch of the ground colour, the apex of the triangle placed anteriorly ; the mesothorax is rather wider than the prothorax, dirty white in colour, but almost covered with a similar, but much narrower, corneous shield, divided medially by a pale line (a continuation of the prothoracic triangular patch) ; the metathorax and 1st abdominal segments slightly less than the mesothorax (under certain aspects there looks a distinct waist), the metathorax carries a small glossy corneous plate on each side, but no dorsal one ; the abdominal segments gradually enlarge until they obtain their greatest width at the 4th abdominal segment, and then gradually decrease to the somewhat rounded anal segment, which is surmounted by a black corneous anal plate. The true legs are brown-black, corneous, very strong, each carrying a pale brownish claw, the joints furnished with a ring of rather long whitish hairs. The abdominal segments are of a dirty yellowish or brownish colour,* the skin appears to be finely shagreened, the segments somewhat darker posteriorly, the segmental incisions very strongly marked, each segment more or less capable of being drawn for a short distance into that preceding it. The prolegs are very short on abdominal segments 3-6, the anal pair moderately large and strong ; all are provided with an almost complete oval of black hooks (17 or 18 in number), much wider and stronger on the anterior half, the oval broken on the inner edge (hence somewhat horseshoe-shaped) ; those on the anal prolegs stronger, have almost twice the diameter of the others, and are placed much nearer together, not more than half their diameter apart. Each of the dorsal tubercles consists of a very minute leaden-coloured, shiny, chitinous button, carrying a large, shiny, glassy-looking seta, the anterior (i) considerably farther from the median line than the posterior (ii), but so far as the abdominal segments are divisible into two subsegments, i is on the anterior subsegment, and ii on the posterior ; iii is supraspiracular ; iv and v are both subspiracular, and vi below the latter. The anal segment carries eight long, glassy-looking hairs (setæ), and suggests a double segmental origin. The spiracles are very small, and form a little black ring with a pale centre and surrounded by a paler area, and appear to be situated well on the protuberant lateral flange ; the latter is very conspicuous. [Larvæ sent by Mr. Luff, March 18th, 1899 ; obtained on lichen-covered stone walls in Guernsey. Described March 20th, 1899.] Bacot adds that the larva has a slight constriction between the thorax and abdomen when viewed laterally, and the thorax and head make up half of the total length of the larva. The head is partly retractile within the prothorax, the latter being longer from front to back than the meso- or metathorax. The skin of the abdominal segment is much wrinkled and granulated, a well-marked lateral ridge extending to the meta-

* De la Voye and de Réaumur give the colour of the full-grown larva as black or blackish-brown, occasionally pale brown. To the naked eye this would be so, but under a microscope the ground-colour appears to be much paler.

thoracic segment. The supraspiracular hair, iii, is the longest, and situated low down on the lateral area above the spiracles, the latter slightly raised, nearly circular, and situated close down to the lateral flange, or ridge, rather anterior on the segment, that on the 8th abdominal being larger and more posterior in position. The lateral ridge is really triple, the central one is the true flange, the upper and lower ridges forming the distinct skin folds of the higher Psychids. The upper ridge rises gradually from the subdorsal area, descends abruptly into the lateral area, forming a deep groove between it and the true lateral flange. The supraspiracular hairs are on the upper ridge and the spiracles at its base, *i.e.*, in the valley or groove. The lower ridge borders the ventral area. The ocelli are obscured by the 1st pair of legs ; there appears to be a line of three large ocelli on the subdorsal area of the head, one on the edge between the lateral and dorsal areas, and others beneath on the ventral aspect, but the arrangement is very difficult to make out at all clearly, although apparently similar to those in the true Psychids. According to de la Voye* the larvæ are " tout noirs, longs de près de deux lignes et larges de trois quarts de ligne ; leur corps est divisé en plusieurs replis, et ils ont proche de la tête trois pieds de chaque côté, qui n'ont que deux jointures . . . . Quand ils marchent, le reste de leur corps est ordinairement en l'air, la gueule contre la pierre ; leur tête est fort grosse, un peu plate et unie, de couleur d'écaille de tortue brune, avec quelques petits points blancs ; la gueule est grande, où l'on voit quatre especes de mentibules en croix, qu'ils remuent continuellement, et qu'ils ouvrent et ferment comme un compas qui auroit quatre branches ; les mentibules des deux côtés de la gueule sont toutes noires, l'inférieure et la supérieure sont grisâtres, entremêlées de rouge pâle ; la mentibule inférieure a une longue pointe, semblable à l'éguillon d'une mouche à miel, excepté qu'elle n'a aucuns petits arrêts, mais qu'elle est uniforme ; ils tirent les fils de leur gueule avec les quatre pieds de devant, et se servent de cette pointe pour les arranger, et pour faire leurs cônes. Ils ont des yeux fort noirs et ronds, qui paroissent bien plus gros qu'un tête d'épingle ; il y en a cinq de chaque côté de la tête, disposés comme dans la figure." Réaumur describes the larva as having sixteen feet, and adds : " Je ne suis point étonné que M. de la Voye n'ait pas apperçu les huit jambes membraneuses, quoiqu'il ait observé les teignes des murs au microscope. . . . je ne les leur eusse pas vûes, si je n'avois cru que je devois les voir, et si je ne me fusse obstiné à mettre l'insecte dans les positions les plus favorables pour les découvrir ; souvent je ne parvenois à voir que les couronnes completes de crochets qui les terminent. D'ailleurs M. de la Voye les a très-bien décrites ; il a très-bien donné la position de leurs yeux ; ce qu'il a appellé leurs mentibules des côtés, est ce que nous nommons les dents ; et ce qu'il a appellé la mentibule supérieure et la mentibule inférieure, est ce que nous nommons la lévre supérieure et la lévre inférieure ; l'espece d'aiguillon dont il a parlé, qui part de celle-ci, et dont il a cru que l'usage étoit d'arranger les fils de soye dont le fourreau est composé, est la filiere d'où le fil de soye sort. M. de la Voye paroît avoir cru que ce fil étoit fourni par la bouche ; mais la filiere est si près de la

* This description, although apparently minute in some details, must not be considered too literally, for de la Voye failed to find the prolegs, as also did Gregson (*Ent.*, vi., p. 409).

bouche, et le fil est si fin, qu'il n'est pas étonnant qu'on se soit mépris sur la partie d'où cette teigne le tire, quand on ignoroit qu'elle est une chenille, et quand on n'a pas eu besoin d'examiner sur de grandes chenilles, comment toutes les chenilles filent." Of their colour Réaumur notes that of six larvæ taken from their cases, five had the body black or blackish-brown, the other (the smallest) very pale brown. Réaumur adds that he should have suspected this to have been due to a difference of age, had he not at other times found much smaller larvæ black in colour, and concludes: "Il y en a donc de brunes et de noires, à moins que les brunes ne soient celles qui ont changé de peau depuis peu. Il m'est arrivé d'en trouver plusieurs fois de brunes." In our opinion it certainly is largely a matter of age, the young larvæ being paler.

Pupa.—*Male*: The living male pupa is about one-eighth of an inch in length, stout and stumpy, with very large wing-cases and thorax, and comparatively small abdomen; a distinct constriction dorsally between the 1st and 2nd abdominal segments; the wing-cases extend to the end of the 6th abdominal segment, the 2nd pair of legs to the beginning of the 7th, and the 3rd pair of legs to the beginning of the 8th. The prothorax is short and small, the mesothorax very large and long, the metathorax larger than any of the abdominal segments but barely more than half the length of the mesothorax. The abdomen tapers from the 2nd to 7th abdominal, 8-10 being fused together. The abdominal segments 2-7 appear to be free dorsally, but the wing-cases appear to be soldered to the ventral surface as far down as the 4th abdominal. A large strip of the hindwings shows behind the forewings as far down as the end of the 3rd abdominal. The anal armature consists of two short stout spines of triangular outline (very similar to those of other Psychid pupæ), but are placed dorsally not ventrally, and seem to point outwards in a lateral direction. Hairs are present on the ? dorsal head-piece, and are also present on all segments from the metathorax to the 7th abdominal. So far as can be made out they are placed as in the larva and have the same relative size, i, however, is either exceedingly small or absent. Well-developed anterior rows of dorsal spines are present on abdominal segments 3-8, and point backwards. The skin-surface is smooth and shiny, the abdomen pale brown, the wing-cases whitish (Bacot. June 9th, 1899). Chapman further notes that the dorsal row of spines is bolder than in *B. sepium* and more regular; the labium short ·3mm. (the antennæ being 3·5mm.), it terminates in two rounded ends without a definite division (rather merely a hollow); maxillæ two-thirds length of labium, somewhat triangular; two dorso-anal spikes. *Female:* The empty female pupa-case is about 4·7mm. long and barely 1·5mm. in width. It tapers to either end, is of a bright red-brown colour, the surface covered with a coat of rather coarse spicules; the segmental incisions most marked; the spiracles raised and distinct; the ridges of spines on dorsal area of abdominal segments 3-7 strongly developed and pointed backwards, placed rather anteriorly on segments; the thoracic segments, head, and wing-cases very small; fine hairs are present on abdominal segments, apparently in same situation as in the larvæ, the anus smooth, without dorso-anal spikes or recurved hairs (Bacot. June 11th, 1899). Chapman notes the ♀ pupa as being about 3·5mm. long; of the same form as that of *B. sepium*, narrow in front (viewed dorsally), no anal hooks or hairs, the dorsal spines similar to those noted under *B. sepium*; the long six-sided minute plates of the intersegmental membrane carry several rows of sharp conical points. Antennæ very short, two-thirds (or less) length of wings, not reaching end of 1st legs. Jaws very large; maxillæ rounded (can hardly be called triangular having no angles), no definite palpi; labium short, wider at end, no division into palpi; length hardly exceeds labrum; 2nd legs nearly to end of wing, 3rd beyond; wings half way down 1st abdominal segment.

The male pupa is partly extruded on emergence from the larval case; the female pupa is not extruded and the female lays her eggs within the empty pupal skin. The upper end of the pupal skin appears to be closed by a wad of silky hairs when the eggs have been laid (Bacot). The larva pupates in its ordinary case. The pupæ which have been extracted from their cases appear to be very similar to those obtained from ordinary lepidopterous larvæ. When the imago is ready to emerge, the pupa protrudes itself from the case for rather more than half its length (Réaumur). As Réaumur notes that he bred nothing but females, this statement is rather remarkable.

Food-plants.—The larvæ feed principally upon a common whitish lichen on walls and rocks named *Lecidea canescens*, numbers also are to be found on walls quite bare of lichens, but covered with the common *Pleurococcus vulgaris* (Luff). A minute powdery grey lichen on rocks (Bankes). The smallest lichens on rocks and old walls (Millière).

Time of appearance.—The last fortnight of June and first fortnight of July, in Guernsey. June and July, in Piedmont (Ghiliani), July, at Paris (Duponchel). Luff notes the first emergence in Guernsey, in confinement, on June 22nd, 1899 (although empty male pupa-cases were observed on the walls on June 17th), several females on 24th and 25th, two males on the 26th, four or five males and several females from June 27th-30th, four males and two females on July 2nd, one male on July 3rd, and three males and several females on July 4th; they kept coming out until July 15th, when one male was bred. This proved to be the last, and altogether 34 males and about the same number of females were bred. Bacot notes the following dates—one female June 28th, one male and one female June 29th, one male June 30th, one male July 1st, two males July 5th, and another male on July 13th, whilst on intermediate dates not noted, at least half-a-dozen more males and the same number of females emerged, all from Guernsey larvæ. He also states that from Brione larvæ no males were obtained, but females emerged on July 5th, 8th and 9th. Female imagines emerged August 17th, 20th, 23rd, 26th, 30th, and males on September 4th, 8th, 1898, from larvæ obtained on lichens on rocks at Corté in Corsica (Walsingham), imagines in April, 1885, at Tenerife in the Canaries (Rebel).

Habits and Habitat.—The female emerges from the free end of the larval-case, leaving the pupal skin within; the male pupal skin is, however, drawn out for some distance (nearly to the wing-cases), and remains attached to the case. The female clings to the free end of the case, remains perfectly still with the ovipositor extruded (to a length rather greater than that of the body) for some days or until copulation takes place. The male is very active (reminds one somewhat of a small *T. tubulosa* or *F. casta*), but appears to remain quite still at night, resting with its wings sloping roof-wise, becoming active again in early morning (about 6.30 a.m.). A pair that were together copulated between 6.30 a.m. and 7 a.m. on June 30th, at which time the female was observed to have shifted her position, and, having thrust her ovipositor into the case on which she still rested, was depositing eggs therein. Later on the same day she released her hold of the case and fell to the ground. The normal position taken up by the newly-emerged female is somewhat similar to that adopted by that of *B. sepium*, but although some sit across the top of the case, others have the body almost in line with the longitudinal axis of it; in clinging to the case the body scarcely touches it, and a perfectly rigid attitude is sometimes maintained for two days. In one case a ♀ laid unfertilised eggs but these did not hatch. Cases agreeing with those of the lighter var. *pectinella*, Dup., were obtained at Brione (Locarno), and Bacot notes the pairing of a Guernsey male with a Brione female, at 6.30 a.m. on July 14th, although the former would not pair with a female *L. ferchaultella*. He also states that the males of *L. lapidella* emerge at a different time from that of the female, the latter leaving the pupæ between 11 p.m. and 6 a.m., the males between 8 a.m. and 8 p.m., possibly in the late afternoon. In pairing, the male clasps the body of the female and rests on her, curving his abdomen in order to effect copulation. Pairing lasts but a short time and oviposition takes place almost immediately. This species appears to be confined to lichen-covered walls in comparatively warm districts, either in a moderate southern latitude with very warm summers or otherwise near the sea with a high average temperature. The first observer of the species, M. de la Voye, thought that the larvæ fed on stones, but Réaumur corrected this view, and showed that the larva fed on lichens, using particles of stone to cover its case. He stated that in Paris the little wall of the terrace of the Tuileries was densely inhabited by the larvæ, whilst the wall of the park of Bercy, on the high road between Charenton and Paris, the stones of which are bound together by earth covered with lichens and moss, also produced large numbers; as late as Duponchel's time it was also exceedingly abundant in Paris. Zeller records that he found two cases on the walls of the tower of St. Peter's, at Rome. Millière notes that the larva lives, in the Alpes-Maritimes, on the smallest lichens on rocks and old walls facing east, whilst near Lyons the species inhabits the rocks at the foot of the hills and in the plains. The larvæ are active all the winter in Guernsey, cases occurring abundantly on the lichen-covered walls in January, and larvæ were still feeding June 4th, 1899, although many had already pupated. When full-fed the larvæ fasten their cases with silk to the surface of the wall, usually under a little projection, but in many cases without any protection whatever; the empty pupa-cases, later in the year, show that both sexes are very abundant. In Britain, Bankes notes cases of what appear to be this species as occurring very locally, on rocks, on the Dorset coast, where apparently empty cases have been found in June and July, from which numbers of newly-hatched larvæ appear about August, and at once try to make themselves cases with any particles of grit, &c., at hand. He also records cases (*E.M.M.*, xxxv., p. 270) from the large stone pillars covered with a minute grey powdery lichen at Stonehenge. We are inclined to believe that the *hibernicella* of Gregson, and the *roboricolella* of Birchall, from Howth, as well as the cases that Edleston obtained on an old limestone wall between Conway and Llandudno, and Weaver on rocks at Conway, are also referable to this species.

LOCALITIES.—? CARNARVON: between Conway and Llandudno (Edleston). DORSET: various parts of coast—Purbeck, Portland, Swanage (Bankes). ? DUBLIN: Howth (Gregson). WILTSHIRE: Stonehenge (Bankes).

DISTRIBUTION.—CANARY ISLANDS: Tenerife (Rebel). CHANNEL ISLANDS: Guernsey, Alderney, and Sark (Luff). FRANCE: Mouans Sartoux, near Cannes (Chapman), Vallées de Thorenc, du Loup, de Lantosque, Lyons, the Estérels, &c. (Millière), Paris (Duponchel), Parc du Bercy, between Charenton and Paris (Réaumur), Caen (de la Voye). CORSICA: Corté (Walsingham). ITALY: Piedmont (Ghiliani), Rome (Zeller), Lombardy—Milan (Turati). SPAIN: Gibraltar (Rebel). SWITZERLAND: Locarno—Brione (Chapman).

LUFFIA FERCHAULTELLA, Stephens.

SYNONYMY.—Species: *Ferchaultella*, Stephs., "Zool.," viii., p. cix (1850); Chap., "Ent. Rec.," xi., p. 293 (1899). *Pomonae*, Sta., "Ent. Wk. Int.," vi., p. 28 (1859); "Ent. Ann.," 1870, p. 2 (1869); 1874, p. 2 (1874); Harding, "Ent. Mo. Mag.," vi., pp. 91-93 (1869); xii., pp. 208-9 (1876); Boyd, Ibid., xii., p. 163 (1875); Hudd, "Cat. Lep. Brist.," pp. 68-69 (1884); Tutt, "Ent. Record," xi., p. 207 (1899). [*? Pineti*, Mill., "Cat. Lép. Alp.-Mar.," pp. 295-6 (1875)]. *Lapidella*, Foucart, "Pet. Nouv. Ent.," i., pp. 523-4 (1875); [? Turati, "Bull. Soc. Ent. It.," xi., p. 198 (1879)].

ORIGINAL DESCRIPTION.—Towards the end of May last (1850) in searching for the larvæ of *Psyche nitidella*, which abound in the neighbourhood of Camberwell, I observed on some old palings a quantity of oval, green larva-cases, resembling small specimens of *Turbo littoralis*; they were in constant motion, which called my attention to them, and I secured several dozens in the hope of ascertaining the species to which they belonged. In this I was disappointed, for the whole of them changed about the middle of July and proved to be the females of a new species (at least to us) of *Talaeporia*, closely resembling, but not identical with, *T. tabulella*, and figured by Bruand in the *Ann. de la Soc. Ent. de France*, 2nd ser., ii., pl. vi., fig. E, under the name of *Solenobia clathrella*. The insect so closely resembles the figs. 17, 18, 19, in pl. xv., vol. iii., of Réaumur, that I believe it to be identical, and propose to call it *T. ferchaultella*, after one of that celebrated writer's names; it is, however, somewhat more attenuated posteriorly than in the figures, but that form might have escaped notice at the time they were executed. In colour, the living insect was dull ochreous, annulated with brown; but in the dried specimens wholly of the latter colour, and the length of the largest specimen is scarcely two lines (Stephens, *Zoologist*, viii., p. cix).

IMAGO.—The female (no male is known), beyond being smaller, looks very like that of *L. lapidella*; the colouring is perhaps rather blacker. The emargination of the mesothoracic plate is greater than in *L. lapidella*, whilst that of the metathoracic is very great, so that it almost resembles that of the 1st abdominal; it differs from it by having a dark chitinous portion centrally that is little more than a dorsal line, and the border is a little wider and darker; the 1st abdominal has a narrow dark chitinous anterior border, little more than a line, prolonged at the spiracular region as a curved line to the posterior margin of segment; the 2nd-6th abdominal segments have a dark plate on either side not very different on the several segments but smallest on the 5th, a larger one on the 7th, followed by the anal tuft; these plates have a rough anterior margin, as if minute circular portions were excised leaving sharp points where the circles meet, they fade into the colourless surface posteriorly; the anterior plates (one on each side) of the 6th abdominal are very faint, on 2-7 very marked, in width about one-fourth of the segment when fully stretched. The scales cover the whole zone of each abdominal segment, *i.e.*, the plates, the intervals between them, and a line or two of scales further back. When fully stretched the intersegmental membrane (free from scales) is dorsally about equal to the scaled area, ventrally it is decidedly greater. The ovipositor is long and very similar to those of all the araneiform Psychids, consisting of two segments and a long intermediate intersegmental membrane (so often described as a 3rd segment) with the usual rods. The eyes are large and black; the antennæ are 12-jointed, there is a square plate between the eyes that is almost certainly the labrum, a conical projection lower (the labium) and two lateral elevations (maxillæ ?). The tarsi have three joints on anterior legs, four on others, but in some races the third joint is anchylosed to the fourth and in others the process is complete and there are only three tarsal joints to all the legs. The ♀ of *L. ferchaultella* like those of *B. sepium* and *L. lapidella*, has the hooks of all the legs extremely strong and more curved or hooked than in any other of these apterous ♀ s, in which the character of the hooks, has been compared with them (Chapman). Bacot notes the legs as "very long, the thorax bright brown, polished, and without scales, the abdomen, soft, yellowish, with bands of rather broad dark grey scales (very dissimilar from the hair-like scales of *Fumea*); small membranous lappets on the meso- and metathorax represent the wings. The scales on the 7th abdominal segment are longer, narrower, and more hair-like than those on the preceding segments (still much less so than in *Fumea*). The abdominal fringe appears to be at the extremity of the 7th abdominal segment and is composed of long silky yellowish-white hairs [Described July 6th, 1899, from female newly-emerged from a Broxbourne pupa].

Historical notes on Luffia ferchaultella.—No notice of this insect seems to have been published prior to that of Stephens (already quoted at length), unless the cases figured by Réaumur (*Mém.*, iii., pl. xv., figs. viii-ix) are to be so referred. His description of the larva said to inhabit these cases, however, is not applicable to the larva of this or any known Luffiid. There can be no question that the insect found by Stephens, near Camberwell, is referable to the parthenogenetic insect we now know so well, his statement that the specimens he bred were like those of *L. lapidella* figured by Réaumur (*loc. cit.*, figs 17-19) but somewhat more attenuated, points clearly to its being a *Luffia* smaller than *L. lapidella*, and since we have cases of *L. ferchaultella* found as late as 1881 in the Camberwell and Peckham districts, by Coverdale, we know that *L. ferchaultella* is an inhabitant of this district, and have no doubt that it is the same species that Stainton afterwards named *pomonae*. Of this, Stainton writes (*Ent. Weekly Intelligencer*, vi., p. 28) that he took a case-bearer on the stem of a plum-tree, at Lewisham, and bred therefrom an apterous female. The case was noted as being rounder than that of *S. inconspicuella*, and it was suggested that it might be cospecific with the insect found on fruit-trees at Bristol, and for such a frequenter of orchards he proposed the name *Solenobia pomonae*. Harding wrote (*Ent. Mo. Mag.*, vi., pp. 91-93) a most interesting account of *S. pomonae*. This was dated July 13th, 1869, and he observes that some ten or twelve years before that date, he first met with a large number of cases, apparently belonging to a *Solenobia*, on fruit and other trees in the neighbourhood. He at first supposed them to be those of *S. inconspicuella*, but on comparison found a decided difference of form, the cases of *S. inconspicuella* being generally three-sided, straight, and grey in colour, whilst these were round, slightly curved, and generally green. Towards the end of June, the moths began to emerge, all apterous females, something like, but easily separable from, those of *S. inconspicuella*, being much yellower in colour and with the ovipositor very much longer. The species was bred every year in large numbers, but no males appeared, although the cylinders in which the females emerged afterwards swarmed with immense numbers of young larvæ, proving that the insect was freely parthenogenetic. Cases sent to Doubleday, Stainton, and Edleston, also only produced females. It was in this communication that Harding suggested (under the nomenclature then in vogue) that this parthenogenetic *L. ferchaultella* was an apterous form of *N. monilifera*. [Before, however, these communications of Stainton and Harding had been published, Weaver had recorded (*Zoologist*, 1857, p. 5540) his finding, on rocks at Conway, in North Wales, several small cases that were covered with the lichen upon which the larvæ were feeding, the case round and a little curved, these produced only females "bearing a close resemblance to those of *S. inconspicuella*." These we suspect were cases of *L. lapidella*; they must, of course, have been this or *L. ferchaultella*.] Boyd discusses (*Ent. Mo. Mag.*, xii., p. 163) Harding's views, and states his belief that the latter had confused the cases of two distinct species, of which the imagines are really different though somewhat similar. He points out that Mr. Harding's description of the case as "round, slightly curved, and generally green," does not quite agree with that of *N. monilifera* (*melanella*) which, "slightly curved at the mouth, where the case is circular, has the hinder end decidedly three-sided, and the case has, when viewed laterally, a truncated appearance. The colour of the case seems to be always green, and when the perfect insect emerges, the pupa-skin is left sticking out." From these Boyd states that he had bred both sexes (winged) of *N. monilifera* and nothing else. On the same trees, on which these cases of *N. monilifera* were found, other cases occurred, of about the same size, but circular throughout their whole length, and pointed at the hinder end. They are not always green, but frequently show circular bands of green and grey, and the pupa-skin is always left inside. From these latter Boyd says he has bred only apterous females of the genus *Solenobia* and nothing else. Boyd's note brought (*Ent. Mo. Mag.*, xii., p. 208) a further contribution from Mr. Harding. He states that he had some thousands of cases between 1855-1868, that large numbers were sent to the leading lepidopterists, and that nothing ever emerged from them but apterous females with a singularly long ovipositor, that left the pupa-skin within the larval-case (used as a puparium), on emergence. In 1869, the trees which had hitherto produced only the apterous *pomonae*, suddenly produced many winged males and females of *N. monilifera* (*melanella*), as well as a fewer number of the apterous form. In 1870, the winged *N. monilifera* were few, the apterous insect more plentiful. In 1871 and 1875 *N. monilifera* was not bred, although plenty of the apterous forms occurred. He states that he had found the cases of both forms on oak, pear, apple, plum, cherry, ash, beech, elm and poplar, at from 2ft.-6ft. from the ground. [Gregson's more or less unintelligible note (*Ent.*, vi., p. 409) might refer to this species; the description, however, rather suggests *L. lapidella*. If he really collected larvæ and these produced "larvæ" as he says, then the insect may be *ferchaultella*, but we suspect he first collected cases, which possibly contained eggs, as he says "no perfect insects were obtained." There should be no difficulty in the way of Irish collectors now to correctly place the Howth *hibernicella*.] Hudd writes (*Cat. Lep. Bristol*, pp. 68-69): "Larvæ of this peculiar insect, in cases that are shorter and rounder than those of *Solenobia inconspicuella*, used to be plentiful on some old trees in Mr. Harding's garden, at Stapleton, on ground now covered by the Bristol gas-works. Messrs. Harding, Vaughan, and myself bred hundreds of specimens, all apterous females, not a single male appearing during several years. Though numerous larvæ were turned out by Mr. Vaughan and others, on old fruit-trees, at Redland and elsewhere, the species seems to have quite died out in this neighbourhood, and there seems to be now little hope of our discovering the male, or of solving the mystery connected with this curious species." Some doubt has since been expressed as to Boyd's accuracy. It is now clearly proved that his descriptions of the cases are critical and may be relied upon. His evidence thoroughly cleared up the error of observation which Harding had made. Not only was the supposed apterous ♀ *N. monilifera*, not a Naryciid, it was not even a Solenobiid, and exhibited characters otherwise restricted to the Macro-Psychids. There can be no doubt that Foucart's note (*Pet. Nouv. Ent.*, i., pp. 523-4) refers to this species. He states that in the commencement of July, 1875, he collected a large number of cases of *L. lapidella*, Goeze, containing pupæ, on the trunks of trees (on the fortifications and in woods), and, some days after, bred a number of females, no males appearing from some 300 cases. He isolated the females, and found that the eggs laid were quite fertile, the parthenogenetic young forming cases from the material of which those of the parents were composed. Foucart adds that he examined some "milliers" of cases on the trees, and convinced himself that these also had produced only females, observing that the ♀ pupa of this species does not come out of its case on the emergence of the pupa.

Parthenogenesis in L. ferchaultella.—Larvæ were received during June, from Horsham (Fletcher), Deal (Dadd), Bowers-Gifford (Whittle), and others obtained by myself at Broxbourne. I have bred many examples from these larvæ, all females, but have seen no males, and there can be no doubt that many (probably all) unquestionably lay fertile eggs, young larvæ having appeared in the separated as well as the unseparated cases, the results (as well as the habits of the insects themselves) suggesting strongly that parthenogenesis is the normal mode of reproduction for this species. The eggs laid by the female that first emerged from Broxbourne cases, and that was at once isolated, hatched about August 7th. The females that emerged from the cases sent by Mr. Whittle, were isolated throughout, laid eggs on July 16th that hatched on August 14th. Eggs laid by females, from cases sent by Fletcher, in July, also hatched on August 14th. I am quite certain that all these batches of eggs were unfertilised (Bacot). Fletcher himself adds that he has over and over again proved to his own satisfaction that the insect is parthenogenetic. He states that he has taken them as larvæ, kept them closely confined, has never bred a ♂, and yet, in due course, swarms of newly hatched larvæ have been observed in the breeding-cases.

Egg-laying.—The eggs are packed inside the empty pupal-skin (which is not protruded from the larval-case), and are mixed with hairs from the anal tuft. Oviposition seems almost always to take place in the early morning (6 a.m.-8 a.m.). Eggs laid on July 7th hatched August 5th, on July 16th hatched August 12th, on July 14th hatched August 14th.

Ovum.—The eggs have a smooth surface, their colour whitish and shiny, and they are broadly oval in outline; exceedingly delicate and easily ruptured (the touch of a camel-hair brush destroys them, and they appear to be more delicate than the eggs of *L. lapidella*); large for the size of the imago (almost as large as those of *L. lapidella*, but their fragility prevents exact measurement) [Bacot. Described from Broxbourne eggs, July 9th, 1899]. The eggs appear as if varnished, covered with fine hairs, length about ·5mm., breadth about ·375mm., great variation as to shape, some oval, others brick-shaped, some quite irregular (Described from Fletcher's eggs July 15th, 1899).

Case.—The case is composed of fine whitish silk, rather loosely spun, so that it is soft and flexible; covered on the outside with small fragments of algæ, lichen, and what appear to be particles of frass. The cases are often parti-coloured, pale grey and dark green-grey (almost black), whilst others are entirely dark greenish-grey or pale grey. They are of the same form as those of *L. lapidella* from Guernsey, conical, but curved towards apex. Their length varies from 4·75mm.-6mm. Found in crevices of the bark of old willow trees, at Broxbourne (Bacot. Described June 11th, 1899). Apart from a slight curve, the cases of this species are conical, expanding regularly from the pointed apex to the open end. This form is preserved so long as the larva is active; when it is fixed up for pupation, the open end is somewhat drawn together and contracted, and the case laid somewhat flattened to the bark, &c., and is not then so very different in general aspect from that of *S. lichenella*, to which previously it bore no resemblance whatever (Chapman).

Habits of larva.—The young larva, after the fashion of those of most Macro-Psychids when young, walks with its abdominal segments raised in the air, even when removed from its case; the latter is always raised considerably when the larva is walking, although the angle varies greatly according to the character of the surface and its position. Whittle observes that at Bowers-Gifford, cases that were spun and contained pupæ on July 14th, 1899, were found firmly attached to the wood forming the fences and not to the lichens thereon. He further notes that the lichens and scrapings (from the fence on which this species occurred) placed at the bottom of a fern-case, yielded, on August 6th, 1899, scores of young larvæ, many of which when first observed were hanging by fine threads from the roof of the case.

Larva.—The larva measured is 4·75mm. in length, stout, with the abdomen relatively large compared with the size of thorax. (In these proportions it appears to differ from the larva of *L. lapidella.*) The head and thorax together form about one-third the length, but comprise less than one-fourth the bulk, of the larva. The head and plates on the thoracic segments are shiny black; the abdomen and soft skin surfaces of thoracic segments are dark grey or smoke-coloured. The head is rounded, set rather vertically (Macro-Psychid type), and bears some scattered, but rather long, brown hairs. The thorax is small, the prothorax smaller than the mesothorax, and the latter smaller than the metathorax; the segments taper towards the head and anus from the 2nd and 3rd abdominal segments (which are the largest); the anus is rounded. The abdominal segmental incisions are distinct, and there are traces of the subdivision of the segments into two subsegments. The lateral ridges are well marked (but do not appear to be nearly so prominent as in *L. lapidella*). The skin on the dorsal area is finely granular. The dorsal plate on prothorax complete, on the mesothorax narrow and separated from the lateral plates by a narrow gap; both these segments have a continuous dorsal plate, but a broad, pale, smoke-coloured, V-shaped mark crosses them, its apex just touching the anterior edge of the prothoracic plate and its base the posterior edge of the mesothoracic where it joins the unplated skin-surface of the metathorax; the latter bears only a comparatively small subdorsal plate on either side, and is but little better armoured than the 1st abdominal. The rather raised hair-bearing surfaces of the lateral ridge (at base of iii) carry horny or chitinous plates that are not noticeably darker in colour than the general skin-surface, but the dorsal hairs either have very small basal plates or they are entirely absent. The legs are large and strong, but look small to bear the weight of the abdomen and case when crawling. The prolegs are short, stumpy, of usual Psychid pattern, bearing an incomplete oval of hooks with a pit or depression in centre. The spiracles are small and dark in colour. The lateral tubercular setæ are placed as in the Macro-Psychids—iii is supraspiracular and larger and longer than the others, iv is smaller and v very small, both subspiracular and rather close together; the dorsal setæ have very small inconspicuous chitinous basal plates, the setæ are just as in Macro-Psychid larvæ, i small and outer, ii very much larger and nearer the median line. The anus has a large dark-coloured (but not quite black) dorsal plate and the hairs on it are rather long, the anal prolegs have a larger but less perfect ring of crochets than the abdominal prolegs. [Bacot. Described June 11th, 1899, from larva obtained at Broxbourne, and probably half-starved for want of proper food.] Stainton's description (M.S., F. 605, fig. B, 14) of the Bristol *pomonae* reads as follows: "Dark grey; head and second segment shining black; a shining blotch on sides of 3rd and 4th segments; mouth and anterior legs pale brownish. Long. 4mm. Constructs a soft, green, lichen-covered case.* Long. 5·5mm. From Bristol, on lichen on fruit trees, July 7th, 1859."

Pupa.—The pupa measured is 6mm. long; pale red-brown in colour paling to yellow on ventral area, and darkening almost to black on the dorsum of the thoracic segments. It is widest at the 4th and 5th

* Durrant notes that Stainton made a rough sketch of the case, which could only be compared with those of *L. lapidella* and *L. ferchaultella*, but as Stainton knew the larva and case of *L. lapidella*, it is obvious that his *pomonae* was not that species.

abdominal segments, tapering to a smooth bluntly rounded anus posteriorly, and to a small head and thorax anteriorly, the latter end being rather the more pointed. The pupal skin looks stout and horny considering the size of the pupa, and the surface smooth and shiny although it is covered with a coat of rather fine spicules. The pro- and meso-thorax are narrow and form a median ridge. The abdominal segments 4-7 free and 3 also dorsally. The anus is smooth and without armature. Transverse rows of dorsal spines are present on abdominal segments 3-7, placed quite anteriorly on the segment, but point backwards in the usual manner, looking remarkably stout for so small a pupa. The tubercular setæ are present as in larva—i outer, ii inner (the subsegmental division clearly marked between them), iii is supraspiracular and bears the largest hair, iv and v subspiracular nearly in the same horizontal line and only a short distance apart (v anterior and much smaller than iv). The spiracles are somewhat large and conspicuous and appear to be almost on small tubes they are so raised, that on the 1st abdominal segment being the most prominent. There appear to be no posterior (intersegmental) spines, but the minute corneous plates of the membrane have acute points. Distinct scars of the prolegs are visible ventrally. The wings are very small; the forewings folded ventrally in the usual way, but their apices reach only to the anterior edge of the second abdominal segment; the hind-wings show a comparatively large corner but disappear under the fore-wings before the end of the 1st abdominal is reached. The legs are prominent, the tips of the 3rd pair nearly reach the middle of the 2nd abdominal, of the 2nd pair as far as the apices of the forewings, of the 1st pair to the middle of the 1st abdominal segment. The antennæ are very broad compared with their length, and show large pectinations. The sexual organs are well-marked. The femora (really coxæ ?) of the 1st legs very large, filling up the space between the front legs. The head is remarkable for what appears to be the labrum, so that its base extends upwards to the upper margin of eyes which are large. If the head were divided into four equal zones by three transverse lines the first two would consist of the face (clypeus ?) carrying the antennæ, the next would be the labrum and two eyes, the three nearly equal in size but the labrum largest; the third would be the labrum and maxilla. The face carries one antenna-basal bristle and one just above labrum on either side. The labrum has one bristle on either side. The jaws are very large, underlapping the labrum and carrying (or rather carried by) a basal process extending upwards between eyes and labrum. Labium in one piece, somewhat square, with lower angles cut off, and a shallow central notch on lower margin, a small process at bottom of notch as though remains of a spinneret.

Habits and Habitat.—No male of this species is yet known, and the female is parthenogenetic. It appears to emerge at night or in the early morning, and, apparently without waiting for copulation, commences to lay its eggs in the pupal skin, which is wholly retained within the larval case on emergence. Some cases that Chapman obtained at Bignasco produced ♀s that were, however, peculiar in their habits, for, although undoubted *ferchaultella*, they had, Bacot observed, the ordinary "calling" habit of the ♀ of *L. lapidella*. Chapman considers, therefore, that *ferchaultella* is possibly, in some of its continental localities, less exclusively parthenogenetic than it appears to be in Britain. It rests much like a Fumeid when ovipositing, the body curved and the abdomen, as far as the yellowish-white anal fringe, inserted in the case. The insect appears to be found on lichen-covered fences, palings, and tree-trunks, whilst, on the other hand, *L. lapidella* appears to be more particularly attached to rocks, stone walls, and similar situations. Bacot discovered cases in the crannies of the bark of old willow trees at Broxbourne, situated from a few inches to a height of 6ft. up the trunks of the trees, the greater number being obtained from the crevices; they were particularly active one day when a soft south-west wind was blowing (after a hot, dry north-east wind had been prevalent for some days previously); Stainton found the cases on a plum-tree at Lewisham, and Harding on the trunks of various trees at Bristol; Dadd discovered cases on the old fences that cross the Deal sandhills; Fletcher on old poplars at Horsham, on wooden sheds at Shoreham, on park palings at Arundel, and on a larch paling at Hayling; whilst Whittle found them on an old weather-worn, green, railway fence, on which there is much lichen, at Bowers-Gifford. Chapman says that when the larvæ fasten themselves up they like to do so with the apex of the case pointing upwards (*i.e.*, the contrary way to *L. lapidella*), and Fletcher observes that the colour of the cases does not count for much, since it varies with the lichen, whilst parti-coloured and banded cases are common enough.

Time of appearance.—The imagines appear in July—July 7th-July 27th, 1899. Actual dates of emergence were—July 7th, 12th, 13th, 18th, 20th from Broxbourne, July 14th, 20th, 26th, 27th from Hayling, July 16th (2) from Bowers-Gifford, July 20th from Deal (Bacot); July 17th-20th from Bowers-Gifford (Whittle); July 20th-23rd from Fusio, near Locarno (Bacot). Bacot notes that it is quite possible that the imagines commence to emerge in June, as he obtained newly-hatched larvæ on July 13th, 1899, which he suspected hatched from cases brought from Broxbourne, and which were supposed to contain larvæ or pupæ.

Localities.—Essex: Bowers-Gifford (Whittle). Gloucester: Bristol (Harding). Hereford: Tarrington (Wood). Herts: Cheshunt (Boyd). Kent: Deal (Dadd), Lewisham (Stainton). Surrey: ? Claremont Park (*teste* Cowl), Camberwell (Stephens), Peckham (Coverdale). Sussex: Shoreham, Arundel, Hayling, Horsham (Fletcher).

Distribution.—Unknown, possibly widely distributed. France: Paris (Foucart), Cannes, empty cases ? *lapidella* (Chapman). ? Italy: Milan (Turati). Switzerland: Bignasco, Val Maggia, abundant, Locarno, empty cases not infrequent, Fusio, near Locarno, abundant (Chapman).

Genus: BACOTIA, Tutt.

Synonymy.—Genus: *Bacotia*, Tutt, "Ent. Record," xi., pp. 207-8 (1899). [? *Bombyx*, Bork., "Schmett. Eur.," iii., p. 283 (1790).] *Psyche* [? Ochs., "Die Schmett.," iii., p. 169 (1810)]; Speyer, "Isis," 1846, pp. 31-2; Brd., "Ann. Soc. Ent. France," xiii., 2nd ser. ii., p. 195 (1844); "Mon. des Psych.," p. 102 (1853). *Psiche*, Brd., "Cat. Lép. Doubs," p. 64 (1847). *Taloeporia*, Gn., "Ann. Soc. Ent. Fr.," xv., 2nd ser. iv., p. 15 (1846). *Talaeporia*, Heydrch., "Lep. Eur. Cat.," p. 78 (1851); Koch, "Schmett. S.-W. Deutsch.," p. 372 (1856); Fré, "Ann. Soc. Ent. Belg.," ii., p. 110 (1858); Staud. and Wocke, "Cat.," 1st ed., p. 105 (1861); 2nd ed., p. 266 (1871); Hartmn., "Mitt. Münch. Ent. Ver.," iii., p. 195 (1879). *Solenobia*, Zell., "Linn. Ent.," vii., p. 358 (1852). *Epichnopteryx*, H.-Sch., "Sys. Bearb.," v., p. 62 (1855); "Neu. Schmett.," p. 7 (1856); Hofmn., "Berl. Ent. Zeits.," iv., p. 34 (1860); Staud. and Wocke, "Cat.," p. 28, no. 189 (1861); Knaggs, "Ent. Ann.," 1870, p. 136, *by error* (1869); Snell., "Tijd. v. Ent.," xiii., p. 226 (1870); Hrtmn., "Kleinsch. Münch.," pp. 7, 10 (1870). *Epichnopherix*, Breyer, "Ann. Soc. Ent. Belg.," v., pp. 5, 6-11 (1861). *Fumea*, Spey., "Geog. Verb. Schmett.," i., pp. 312, 460 (1858), p. 280 (1862); Hein., "Schmett. Deutsch.," i., pp. 188-9 (1859); Staud., "Cat.," 2nd ed., p. 65 (1871); Rehbg., "Abh. Nat. Ver. Brem.," vi., p. 468 (1879); Peyer., "Cat. Lép. Als.," 2nd ed., p. 59 (1880); Frey, "Lep. der Schweiz," p. 92 (1880); Heyl., "Ann. Soc. Ent. Belg.," xxv., p. 73 (1881); Snell., "De Vlinders," p. 443 (1882); Bang-Haas, "Nat. Tids.," 3, xiii., p. 172 (1883); Lampa, "Ent. Tids.," vi., p. 39 (1885); Kirby, "Cat. Lep. Het.," p. 524 (1892); Barr., "Ent. Mo. Mag.," xxxi., p. 268 (1894); "Brit. Lep.," ii., p. 365 (1895); Meyr., "Handbook," &c., p. 774 (1895); Caradja, "Iris," viii., p. 88 (1895); Reutti, "Lep. Bad.," 2nd ed., p. 306 (1898); Tutt, "Ent. Record," xi., p. 178 (1899).

The name *Bacotia* was first used in the *Entomologist's Record*, vol. xi., p, 207, where *sepium* is cited as the type. The chief characters of the genus may be summarised as follows:

Ovum.—Oval in outline; surface smooth, pale yellowish in colour; eggs laid in pupal skin.

Case.—Upright, conical with blunt rounded top; composed of whitish silk, covered with minute particles of lichen, or bark.

Larva.—Head entirely black; third legs well developed, even for a Psychid; plates in pro- and mesothorax entirely black, interrupted by a narrow, white (rough-edged) median line on prothorax, slightly broader on mesothorax; on metathorax two very small plates, wide apart; clypeus terminates definitely far from vertex (as in *Psyche*), not stretching up to it (as in *Taleporia*); the plate between clypeus and epicranium extremely wide (more so than in almost any other larva).

Pupa.—♂. Head depressed in front; prothorax very small, frontal; head-piece large, prominent, protruding frontally before the prothorax; waist dorsally at metathorax and 1st abdominal; terminal abdominal segments narrowed ventrally, but not bent round; anal segment blunt; the forewings well-developed, hindwings to end of 3rd abdominal; antennæ broad, marked with pectinations; second legs partly hidden, 1st pair of legs shorter than antennæ; the second and third pairs beyond antennæ; labium very short, without a central division, ends in two large rounded lobes; maxillæ triangular, jaws well marked; abdominal segments 3-8 with a row of large dorsal spines, bent backwards, placed close to anterior edge of segment; 3-6 with very fine spines on posterior border of intersegmental membrane; tubercles i, ii, iii with setæ, ii nearer middle line than i; hairs indistinct ventrally; two round knobs on either side of genital slit on abdominal segment 8; two small dorso-anal slightly recurved spikes; abdominal segments 3-7 free. ♀. Somewhat arched, venter slightly concave, dorsum convex, tapers to either end slightly, ends rounded; abdominal segments 3 (dorsally)-6 free; anterior row of dorsal spines on 3-7; intersegmental spines 6-7; no dorso-anal hooks; proleg scars very pronounced; wings, legs and mouth-parts distinct; labrum angulated, mandibles distinct, rounded; maxillæ short, rounded, no definite palpus; labium with transverse joint; antennæ half length of wings, wings to end of 2nd abdominal.

Imago.—♂. Anterior wings rather pointed; thinly scaled; antennæ third joint without pectinations (present in *Fumea*), pectinations scaleless (scaled in *Fumea*) somewhat spathulate. First leg with spine arising at middle, and equals half length of tibia (in *Fumea* spine arises at base and equals length of tibia). ♀. Head ventral, black; compound eyes large, black; prothorax small, black, chitinous; mesothorax black, chitinous, well-developed; metathorax narrow, chitinous, frontally only black-margined; abdominal segments 1-6 with a dark band of black scales centrally, breadth of scales one-eighth to one-sixth of their length, ends rounded, the ring on the 7th much darker, and a brown corneous plate dorsally; the 8th surrounded by the yellow-grey silk of anal tuft, from which extruded ovipositor projects; antennæ long, slender, 15 or 16-jointed (number probably varies), penultimate two or three swollen, last very small; legs slender, black with paler joints and claws; tarsi 4-jointed (*Fumea* is 5-jointed), no tibial spines on any leg; ovipositor with 2 segments.

Neuration.—As in *Fumea* (*casta*), except that in forewing, there is a secondary cell cut off the apex of cell, this varies much in size; nervures of forewings all separate (in one example 10 is forked at apex of the wing, simple on other); nervures of hindwings as in *F. casta* (4 is, in one example bifurcated on one side only); the variability of the neuration is seen in frequent bifurcations of the terminal nervures.

Bacotia sepium, Speyer.

Synonymy.—Species: *Sepium*, A. and O. Speyer, "Isis," 1846, pp. 31-34 (January, 1846); "Geog. Verb. Schmett.," i., pp. 312, 461 (1858), ii., p. 280 (1862); Heydrch., "Lep. Eur.," p. 78, no. 27 (1851); Reutti, "Lep. Bad.," 1st ed., p. 175 (1853); 2nd ed., p. 306 (1898); H.-Sch., "Sys. Bearb.," v., p. 62 (1853); "Neu. Schmett.," p. 7, pl. [9], fig. 10 (1856); Koch, "Schmett. S.-W. Deutsch.," p. 372 (1856); Fré, "Ann. Soc. Ent. Belg.," ii., p. 110 (1858); Hein., "Schmett. Deutsch.," i., pp. 188-9 (1859); Hofmann, "Berl. Ent. Zeits.," iv., p. 34 (1860); Breyer, "Ann. Soc. Ent. Belge," v., pl. iii., p. 6 (1861); Staud., "Cat.," p. 28, no. 189 (1861); 2nd ed., p. 65, no. 872 (1871); Snell., "Tijd. v. Ent.," xiii., p. 226 (1870); "De Vlinders," p. 443 (1882); Knaggs, "Ent. Ann.," 1870, p. 136, *in error*; Rehberg, "Abh. Nat. Ver. Brem.," vi., p. 468 (1879); Peyer., "Cat. Lép. Als.," 2nd ed., i., p. 59 (1880); Frey, "Lep. der Schweiz," p. 92 (1880); Heyl., "Ann. Soc. Ent. Belg.," xxv., p. 73 (1881); Bang-Haas, "Nat. Tids.," 3, xiii., p. 172 (1883); Lampa, "Ent. Tidsk.," vi.,p. 39 (1885); Schmid, "C. B. Nat. Ver. Regensb., xxxix., p. 85 (1885); Rühl, "Soc. Ent.," v., p. 154 (1891); Kirby, "Cat. Lep. Het.," p. 524 (1892); Carad., "Iris," viii., p. 88 (1895); Meyr., "Handbook," p. 774 (1895); Paux, "Lép. Dép. du Nord," p. 322 (1893); Tutt, "Ent. Record," xi., pp. 178, 207 (1899); Chapmn., Ibid., p. 201 (1899). [? *Nana*, Bkh., "Schmett. Eur.," iii., p. 283, *nec* ref. to larv. and case (1790).] [? *Nitidella*, Ochs., in part, "Die Schmett.," iii., p. 169 (1810); iv., p, 198 (1816).] *Clathrella* (an sp. n.?), Bruand, "Ann. Soc. Ent. Fr.," xiii., 2nd ser. ii., pp. 195-7, pl. vi., figs. E *a-e* (1844). *Tabulella*, Gn., "Ann. Soc. Ent. Fr.," xv., 2nd ser. iv., pp. 11-12, no. 8, p. 15 (June 15th, 1846); Heydrch., "Lep. Eur. Cat.," p. 78, no. 26 (1851); Zell., "Linn. Ent.," vii., pp. 358-9, Anm. *c* (1852); Brnd., "Cat. Lép. Doubs," pt. 2, p. 64, no. 1182 (1847); "Mon. des Psych.," pp. 102-3, pl. ii., figs. 75 *a-b* (1853); Spey., "Geog. Verb. Schmett.," i., p. 460 (1858); Tomp., "Zool.," p. 6464 (1859); Staud. and Wocke, "Cat.," 1st ed., p. 105, no. 1170 (1861), 2nd ed., p. 266, no. 1333 (1871); Hartmn., "Mitt. Münch. Ent. Ver.," iii., p. 195, no. 1333 (1879); Barr., "Ent. Mo. Mag.," xxx., p. 268 (1894); "Brit. Lep.," ii., p. 365 (1895). *Betulina*, Barr., "Ent. Mo. Mag.," xxx., p. 267; xxxi., p. 275 (1895). [Speyer says (*Geog. Verb. Schmett.*, i., p. 460) that *tabulella*, Gn. = *sepium*, Speyer, according to originals sent. He also complains that his article (*Isis*, 1846, pp. 31-4) was altered during publication.]

Original description.*—*Psyche sepium*, nob.—In völlig ausgebildetem Zustande erreicht *P. sepium* ziemlich die Grösse von *P. nitidella* und *P. betulina*, und ist nur wenig schmalflügeliger als letztere. Die Fühler sind halb so lang als die Vorderflügel, 24gliedrig, doppelt gekämmt, der Schaft dünn, auf der Rückseite grobschuppig, das Wurzelglied dick. Kammzähne mässig zusammengeneigt, kurz, unbeschuppt, in der Mitte des Fühlers ohngefähr um ein Drittel länger als die Glieder, auf welchen sie sitzen. Nach oben nehmen sie allmählich an Länge ab, so dass sie am siebenten Gliede (von der

* Some authors consider that Borkhausen's *nana* (description of imago, but not the case) applies to this species. If this were so, Ochsenheimer's *nitidella* would also in part belong to the species. Borkhausen's description reads as follows: *Phalaena Bombyx nana*, der braune regenbogenfarbig schielende Sackträger. Er gehört zu den kleinsten dieser Linie und hat kaum die Grösse einer Stubenfliege. Die Vorderflügel sind am Vorderwinkel sehr spitzig, die hintern aber gerundet. Die Farbe des ganzen Schmetterlings ist braun, und die Adern, so wie ein Mittelflecken, zeigen sich besonders stark. Er ist sehr dünn mit Schuppen belegt und die nakte Membrane leuchtet beinahe aller Orten herfür. Hält man ihn in die Sonne, so erblikt man auf den Flügeln einen schönen Schiller, welcher den Augen die Farben des Regenbogens darstellt. Die vier Flügel sind mit dunkelgrauen Franzen besezt, welche einen schönen Saum bilden. Die Fühlhörner sind gekämmt. Das Weibchen ist flügellos und madenförmig gestaltet. Es ist gelblich, der Kopf ganz und die zwei ersten Ringe des Leibes zum Theil am Rücken kastanienbraun, und dergleichen Flecken hat es bis zur Hälfte des Leibes an allen Einschnitten. Am Ende des Leibes hat es einen starken Legestachel, welcher oben am Leib wie mit einer Klappe versehen ist. Wenn es aus dem Gespinnste genommen ist, so bleibt es immer in einer gekrümmten Stellung (Borkhausen, *Naturgeschichte der Europ. Schmetterlinge*, &c., iii., pp. 283-284). [The part following the description of the imago certainly appears to refer to *Fumea casta* (*nitidella*).]

Fühlerspitze an gerechnet) mit diesem ziemlich gleiche Länge besitzen und weiter gegen das Ende sich zu blossen Zähnen verkürzen. Jeder Kammzahn ist an der Wurzel dünn und schwillt nach oben in eine spindelförmige, vorwärtsgebogene, Kolbe an. Sie sind mit feinen, abstehenden Härchen, nicht sehr dicht, besetzt, ohne deutliches Endbörstchen. Augen halbkugelig, weit auseinander stehend, schwarz (im Tode), grob gekörnelt (facettiert). Nebenaugen nicht sichtbar. Von Palpen und Sauger ist nichts zu erkennen; an ihrer Stelle langes, abwärts gerichtetes Schuppenhaar. Kopf überhaupt mit ziemlich glatt anliegenden, dichten Haarschuppen bekleidet. Beine dünn, glatschuppig, bräunlichgrau, an den Fussgliedern gelblichweiss gefleckt. Vorderschienen so lang als die beiden ersten Tarsalglieder zusammen, in der Mitte verengt und gelblichweiss gefleckt. Schienenblättchen von der Mitte bis etwas über das Ende der Schiene hinausreichend, angedrückt, dünn, fast linienförmig, überall beschuppt. Das erste Fussglied den drey folgenden an Länge gleich. Mittelschienen kürzer als ihr Fuss, mit einem Paar langer stumpfer, ganz beschuppter Spornen. Hinterschienen um $\frac{1}{4}$ länger als die Mittelschienen, durch weissliches Schuppenhaar erweitert, etwas länger als ihr Fuss, mit zwey Paar Spornen: das eine, etwas längere, unter der Mitte, das andere am Ende der Schiene; die Dornen denen der Mittelschienen ähnlich, ziemlich gleichlang. Krallen, selbst unter der Loupe, nirgends deutlich zu unterscheiden. Der ganze Körper dünn, ziemlich glattschuppig, einfarbig braungrau; der Kopf gleichfarbig. Das Hinterleibsende in gleicher Linie mit dem Aussenrande der ausgespannten Hinterflügel. Die Flügel zart, länglich, mit abgerundeten Winkeln. Die Bestäubung fein und ziemlich dicht, aber lose, so dass sie sich leicht abwischt, mit gelblichem Metallglanze, besonders auf den Vorderflügeln. Der Metallglanz ist übrigens bey frischen Exemplaren dem der beiden andern Arten ziemlich gleich, so dass eine oberflächliche Betrachtung alle drey wohl verwechseln kann. Die verschiedenen Fühler machen indess allein schon jede Vermengung bei genauerer Untersuchung unmöglich. Die Grundfarbe der Vorderflügel ist, namentlich bey frischen Exemplaren, meistens schwärzlich braungrau. Auf den Vorderflügeln sieht man denselben an Färbung gleiche, sehr schwach ausgedrückte Querlinien, welche gegen den Hinterrand deutlicher werden. Mit den gleichfalls dunkeln Adern entsteht dadurch ein schwaches Gitter. Diese ganze Zeichnung ist überhaupt nur auf der äussern Flügelhälfte kenntlich, bey manchen Stücken auch hier so schwach ausgedrückt, dass die ganze Fläche fast einfarbig braungrau erscheint. Die rücklaufende Ader, gerade im Anfange des letzten Drittels der Vorderflügel, ist durch einen, nicht scharf begränzten, aber stets sichtbaren, schwärzlichen Punct bezeichnet. Längs dem Vorder- und Hinterrande ist die Grundfarbe am tiefsten. Hinterflügel einfarbig bräunlich aschgrau, dünn beschuppt. Die Franzen aller Flügel mässig lang, einfarbig, ein wenig dunkler als der Grund. Unterseite zeichnungslos, glänzend bräunlichgrau, mit dunklern Schatten am Vorder- und Hinterrande der Vorder- und am Aussenrande der Hinterflügel. Die ausgebreiteten Flügel messen 6 Linien, der Körper $1\frac{3}{4}$ Linie. Das Weibchen hat die Gestalt desjenigen von *Nitidella*, bleibt aber kleiner. Es ist kurz, dick, walzenförmig, gegen beide Enden verdünnt. Kopf klein, schwarz, glänzend, hornig, wie die Brustringe. Fühler kurz, borstenförmig, nackt, durchsichtig.

Augen rund, ziemlich grob gekörnelt. Von Mundtheilen nichts zu erkennen. Beine kurz, nackt. Der erste Brustring ist sehr schmal, halskragenförmig, der zweyte am breitesten, glänzend schwarzbraun mit zwey weissen Seitenflecken, der dritte gelblichweiss, fein schwarzbraun gerandet. Die beiden ersten sind oberwärts spärlich behaart. Ihre Färbung ist bey getrockneten Exemplaren nicht mehr deutlich zu erkennen; sie erscheinen dann ganz schwarzbraun. Bauchringe weich, in den Seiten dünn wollig, um den After mit dichter, langer, feiner, graugelblicher Wolle, gerade wie bey *Nitidella* fem. Die sechs freyen Hinterleibsringe tragen oberwärts je einen länglich viereckigen, dunkelbraunen Fleck aus etwas festerer Hornsubstanz. Die übrigen drey Ringe setzen die lange, aus ebensoviel fernrohrartig in einander geschobenen Stücken bestehende, Legeröhre zusammen; das erste derselben ist kegelförmig, die beiden andern dünn, cylindrisch. Die Legeröhre ist besonders lang und pflegt auch nach dem Tode noch in zwey Dritteln ihrer Länge (welche der des Körpers gleichkommt) vorzuragen. Die Farbe des Hinterleibs ist überall, bis auf die dunkele Gürtelfarbe, schmutzig gelblichweiss (beinfarbig), nie röthlichgelb, wie bey *Betulina*. Die Gürtelflecke sind schmäler als bey den andern Arten. Das Ey ist länglichrund (breit elliptisch), glatt und gelblichweiss. Nur ein einziges unter einem Dutzend dieser Art legte ein Paar derselben nach dem Anspiessen an der Nadel. &c. [Speyer, *Isis*, pp. 31-32 (1846)].

Imago.—Anterior wings 14mm. in expanse; colour (when fine and fresh) deep grey-brown, polished and shining; almost unicolorous, indistinct discoidal lunule and slightly darkened nervures, fringes in two rows, the shorter rather darker. Posterior wings unicolorous deep grey-brown, appear rather paler than anterior wings, nervures rather darker, fringes also slightly darker.

Sexual dimorphism.—The *male* has antennæ about half as long as the wings, 24-jointed, bipectinate, the shaft slender, coarsely-scaled on its dorsal side, the basal joint thick. The pectinations rather close, short, unscaled; at the middle of the antennæ the pectinations are about a third longer than the joints on which they are placed, but towards the tip they gradually decrease in size until at the tip they are reduced to mere teeth. Each pectination has a fine base, and swells out into a spindle-shaped knob, bent forwards. They are lightly covered with fine hairs. The eyes, widely apart, black (in dead specimens), with coarse facets. No ocelli, palpi, or tongue. Head densely scaled. Legs slender, brownish-grey, on the tarsi spotted with yellowish-white. . . . Body, thin, unicolorous brown-grey, the head concolorous. The wings delicate, somewhat extended. The scales fine, dense, easily rubbed off, with yellowish metallic gloss (especially the forewings). This gloss is much like that of *nitidella* and *betulina*, but the different antennæ prevent confusion. The colour of the forewings is blackish brown-grey, darkest along the costa and hind margin, with very faint transverse lines, rather more distinct towards the hind margin, the lines and slightly darkened nervures forming a sort of lattice, but this is so ill-developed that the wings appear almost unicolorous brown-grey; a faint discoidal lunule; the hind wings unicolorous brownish ash-grey, thinly scaled. Fringes of all wings rather long, unicolorous, slightly darker than ground colour. The forewings are six lines in expanse (Speyer). The forewings rather long, somewhat similar to those of *T. tubulosa* in shape. Except close to the base, the costa for the basal two-thirds is very straight, then curves down to a very definite apex; the inner margin three-fourths of costa in length. Colour (when fine and fresh) of a deep grey-brown, polished and shining, varying, however, to rather paler brownish, whilst the darkest specimen is not quite entitled to be called black. In some lights the wings are unicolorous, in others, there is a definite black mark at the end of the cell. Under a lens, the nervures are usually seen to be darker, especially the transverse ones and those beyond the cell, so that the dark mark is not purely a light effect on glistening scales. (A little fading or rubbing reduces the insect to a very indefinite aspect.) The fringes in two rows of scales, the shorter very slightly darker. All the scales are darker at their tips [a loss of scales, therefore, at once exposes their paler bases, and a difference of flatness of scales (such as might be produced by a difference of setting) alters the aspect for similar reasons]. Antennæ with 26 joints, pectinated from 4th to 25th, pectinations spathulate and scaleless. Legs dark, unicolorous, spur on 1st tibia $\frac{2}{5}$ths length of latter. The fore-wings look fairly solid. The hindwings are less closely scaled, and hence are more transparent, and appear paler and greyer than fore-wings, though really of apparently the same colouring; the nervures are very visible on hindwings (not on forewings), and are darker owing to the scaling being denser on them (and possibly are a little darker in reality), the fringes also darker (Chapman). *Female:* The female is similar to that of *nitidella*, but smaller. It is short, thick "bug-shaped," slender at each end. The head and thoracic segments are small, black and horny. The antennæ, short, setiform, naked, and transparent. The eyes round, rather coarsely faceted. Nothing can be made out concerning the mouth-parts. Legs short, naked. The prothorax narrow (collar-like), the mesothorax broader, glossy black-brown, with two white lateral spots, the metathorax yellowish-white, finely margined with black. The pro- and mesothorax sparsely haired above. The colour of dried females appears quite black-brown. The abdominal segments weak, the sides thinly haired, with dense, long, fine grey-yellow wool (as in *nitidella* ♀) about the anus. The six free abdominal segments each carry dorsally a rather long, quadrangular, dark-brown, corneous spot, the three terminal segments form the ovipositor, which is as long as the body. The colour of the body is dirty yellowish-white, never reddish-yellow as in *betulina*. The "girdle-spots" are narrower than in *betulina* and *nitidella* (Speyer). The head ventral, black; prothorax small, black, chitinous, its front edge with a coronet of upright, stiff, whitish-grey hairs, separating it from the head, a few similar hairs appearing to rise from the black chitin towards the front of the mesothorax, the latter black, chitinous, strongly developed; the metathorax black frontally, and pale posteriorly, appears to present no hairs; the abdominal segments 1-6 divisible, dorsally, into three parts, (1) a dark coloured front edge (remains of chitinous plate), (2) a depressed central yellowish area with a ring of black scales (greyer ventrally) towards its front edge, (3) a raised posterior edge, slightly flesh-coloured; the intersegmental membranes bright yellow; the 7th abdominal segment darker than the preceding; the 8th appears to be surrounded with the close and dense fringe of yellow-grey, silky hairs forming the anal tuft; there is a distinctly lateral depression directly below the spiracles which separates the dorsal and ventral areas (the ventral area less covered with scales than the dorsal). The antennæ are long, slender (about seventeen joints), and almost colourless; the legs also are long, slender, with a very strong stout terminal claw. There is a large compound eye at the base of each antenna (Tutt. Described July 7th, 1899, from a ♀ that emerged the same morning). Breyer notes also that on the second and third thoracic segments a little below the middle, are two pyriform appendages, very difficult to see although somewhat lengthened which evidently represent the amorphous wings. He also says that the "zebra-like aspect" of the abdomen is due to the distension of the abdomen that fills out the segments and stretches the naked intersegmental areas. He further notices a double crochet on each foot as well as the terminal hook.

Variation.—Heinemann says that from cases (from tree-lichens) which were three lines long, and very much broader than usual medially, he bred larger and darker specimens, in which the border before the fringes of the hind wings is somewhat abnormal.

Comparison of Bacotia sepium with Proutia betulina, Fumea casta (nitidella), &c.—*F. sepium* is about the size of *F. nitidella* and *F. betulina*, but a little narrower winged even than the latter. . . . It differs strikingly from them in the differently formed antennæ*, the narrower and faintly reticulated forewings with a dark discoidal lunule, so that it cannot be confused with them even without a knowledge of the larva (Speyer). The following are comparative diagnoses of the species by the same author:

P. nitidella, Hb. (?).—Alæ nigro-fuscæ, unicolores, nitidulæ; antennæ pectinatæ, articulis circiter 16, dentibus pectinum longioribus, squamosioribus, apice subfusiformi (♂). Femina flavida, barba anali griseo-flavescenti.

P. betulina, Zell.—Alæ nigro-fuscæ, nitidulae, unicolores; antennæ pectinatæ, articulis circ. 18, dentibus pect. filiformibus, tenuioribus (♂). Fem. fulva, barba anali nivea.

P. sepium, Sp.—Alæ oblongæ, angustiores, anteriores flavescenti seu fusco-cinereæ, subnitidæ, obsoletissime nigro-tessulatæ, macula venæ transversæ obsoleta nigra; antennæ pectinatæ, dentibus brevioribus, apice subfusiformi (♂). Fem. flavido-alba, barba anali griseo-flavescenti.

Zeller says that the male comes very near *Solenobia minorella*, Dup. (*T. politella*), but has somewhat rounder wings, is somewhat smaller, darker brown and very glossy, with strongly fringed antennæ. Bruand notes that "the male of *B. tabulella* much resembles that of *P. salicolella* in the shape of the wings but its colour is not so dark. . . . The female is similar to that of *salicolella*." Barrett compares (*Ent. Mo. Mag.*, xxx., p. 269) the insect with his *betulina*.† This comparison is rather strained, and the statement that the anal tuft of the female (of *tabulella*) is "brownish" leaves one in doubt as to whether he knew the ♀ of *B. sepium* (*tabulella*) at all.

Egg-laying.—The ovipositor (4mm. long) consists of two retractile tubes, the second of which is drawn entirely within the other to receive an egg; it is then fully extended and the egg is placed on the

* Chapman notes that *Bacotia sepium* and *Proutia betulina* are tolerably close in antennæ, *Fumea casta* (*nitidella*) is different.

† Since the above was in type, Chapman has determined (by examination of Fletcher's examples) Barrett's *betulina* as *Bacotia sepium*. Barrett's comparison, therefore, is evidently between different ♂s of *sepium*, and between *sepium* ♀ and the ♀ of some other species not yet determined.

floor of the oval case from which the insect has emerged (Zeller). The ovipositor is thrust into the cocoon after copulation, and the eggs are laid in the pupa-skin, which is filled to its upper edge with smooth eggs, piled up one on the other. This done the female fills up the orifice of the pupa-skin and the upper part of the case with a cottony down obtained from the anal tuft (Breyer).

Ovum.—Broadly oval, smooth and yellowish-white (Speyer).

Case.—The case is bluntly conical, 5·5mm. in height, 2·75mm. in width ; upright, *i.e.*, standing perpendicularly to the surface on which the larva rests; the apex rounded, the silk of which it is formed whitish, but thickly covered with minute particles of the lichen on which the larva feeds, giving the case a hoary appearance (green, yellow and white are seen to be the colours of the particles under a lens), the mouth forms an almost perfect circle (Described June 12th, 1899). Speyer notes the case as three lines long and one line broad, short, bluntly conical, not narrowed anteriorly, with wide round opening ; the fine silk of which it is composed covered outside with very fine particles of lichen and dry leaves, and, without any regular arrangement, occasionally with pieces of bark, lichen, wood, or leaf, usually greenish-grey in colour." Breyer notes the case as often ornamented with rather large pieces of lichen *débris* applied in the direction of its length, the pieces of lichen sometimes covering the free extremity of the pyramid. As a rule the colour of the case corresponds with that of the bark on the side of the tree exposed to the prevalent rains. Zeller describes the case as " oval, and having the greenish colour of the lichen on which the larva feeds."

Habits of larva.—The larvæ live on the lichen-covered trunks and branches of trees, they appear never to live on the ground nor to change from one tree to another. In this respect they differ from most of their congeners for even the trunk-haunting Fumeids and Solenobiids appear to wander freely and only come to tree-trunks to exuviate or pupate. Their food consists of tree-lichens, and Breyer says they take two years to come to maturity. They carry their cases quite perpendicularly to the surface on which they rest, walking with their true legs, the abdomen clinging tightly to the silk of the inside of the case. The slightest touch causes a larva to withdraw itself and the round mouth of the case is brought closely down to the resting-surface, but it very soon protrudes its head and thoracic segments again, pulls its case along with a slight jerk and travels exceedingly rapidly for so small a larva. In confinement the larvæ eat freely tree-lichens that have been dipped in water, and one can rear them in this way with a little care and attention. As to its mode of walking, Breyer says that the forward movement uncovers the head, pro-, meso-, and metathorax, and the lower third of the 1st abdominal. The larva fixes itself by the third pair of true legs, stretches its head as far as the thoracic segments will allow, takes up a position with the anterior legs, and draws up to them the metathorax with the case and its contents. When it walks on a smooth object, the head carries with it, in advance, a silken thread which it attaches to the object. It is this silken thread which the larva takes between its true legs and which serves as a mobile ladder or a cord which the larva grips. When many larvæ are kept for some weeks in a glass jar large flakes of silky tissue can be peeled off. Zeller says that the larva spends its life on the lichens growing on old fences without much changing its position.

Larva.—The larva is short and stout, attaining its greatest width at the 2nd and 3rd abdominal segments, tapering thence to the head and anal segment the latter being rather pointed. The head is black, (intermediate piece between clypeus and cheek brownish), shiny, rather coarsely pitted or granulated, tending to give it rather a dead or dull appearance. The thoracic plates are similar to the head in appearance and coloration, a white dorsal line with irregular margin on pro- and mesothorax, broadest on latter; the skin surface is very dark red-brown, and looks quite black to the naked eye, is granular, and studded with small blunt chitinous points; the prothorax is long and well-covered by a single plate; the mesothorax short and bears a rather narrow dorsal and lateral plates, with a distinct gap between the dorsal and lateral plates; the metathorax bears no dorsal plate, but a subdorsal one on either side leaving a wide area of exposed skin-surface on central dorsal area. The incisions of the abdominal segments are deeply and clearly cut; the setæ are as in the Macro-Psychids, with indistinct plates at bases of i and ii, and a larger conspicuous one at base of iii, which also carries a longer seta, i is smaller than and outside ii, iv and v are near each other below the spiracle, the anterior (v) being very small (Bacot). The spiracles are black, tubercles i and ii are small, iii apparently small also, but set on a considerable boss or plate; this is rather in front of the spiracle on the 8th abdominal, where ii is on a considerable brown or blackish plate; the 9th abdominal is a very narrow segment but has plates for ii and iii, i being between these without a plate; anal plate large, triangular, deep brown in colour; the thoracic plates, carrying true legs (coxa and trochanter ?) are strongly marked, the 1st joint of leg very broad, more so than is so usual in most Psychids; metathoracic pair long (owing to joints of legs being longer than those of others and also by fleshy projection of its base); prolegs small and short but with 15-16 strong hooks in a horse-shoe form with opening to middle line, the anterior horn 2-3 hooks nearer middle line than posterior; anal prolegs with 18-19 hooks in a circle, incomplete for the quarter facing inwards and backwards (which is, however, indicated though without hooks); general surface of skin studded with very minute black points of which about one in ten is very regularly distributed and larger than the others; the black colour of these points gives the dark tint to the larva (Chapman). Breyer says that the larva is black, with pro- and mesothoracic shields on which the edge of the case rests when the larva is in motion; the prolegs are rather indicated than developed, the anal prolegs being strongly developed and provided with short hooks; the anal segment also carries a small plate; the third pair of true legs are longer and stronger than the first and second pairs, the greater part of the force required for movement being exerted by them. Speyer described the larva as short and thick, narrowed towards the anal end, naked, unicolorous brownish-black. The head and scutellum glossy black, the latter traversed by a weak whitish line; prolegs rudimentary. Zeller describes it as stout, short, blackish, the head very small, glossy black; the true legs also black, as also are the two dorsal plates which are placed transversely across the pro- and mesothorax, the plates edged with whitish; the rest of the larva blackish-grey, slightly haired, with a light brown dorsal vessel. Fletcher describes the Worcester larvæ as "stout, brown in colour, with the head and corselet black." The Brussels larva, found on lichens on trunks of trees received from Fologne, May 30th, 1860, was described by Stainton (MS., F. 609), as follows :—"Blackish. Head black ; 2nd segment black above ; 3rd segment with a slender black plate above ; 4th segment with a small black plate on each side ; a smaller black plate on each side of the 2nd segment ; anal segment with a black plate. Feeds on lichens on trunks of trees, keeping its case in a vertical position." Barrett's description of the larva from New Forest (referred erroneously to *P. betulina*) in *Ent. Mo. Mag.*, xxx., p. 267, also belongs to this species.

Pupa.—*Male:* Length 4·6mm., greatest width 1·7mm., anterior extremity to end of wings = 3·6mm. The wings reach to the end of the 6th abdominal segment, the third pair of legs a little farther ; the hindwings to the middle of the 3rd abdominal, antennæ to end of 4th abdominal. Head very depressed forwards (Psychid-like) but placed a little in front of mesothorax ; abdominal segments bent forwards towards the anal end ; a waist falls in dorsally at metathorax and 1st and 2nd abdominals. The 3rd-8th abdominals carry an anterior row of dorsal spines, the 3rd-6th carry very fine spines on posterior borders on intersegmental membrane ; tubercles i, ii, iii carry setæ, i just behind the anterior row of dorsal spines, ii posterior to this, and one-third nearer the middle line ; the setæ not at all distinct ventrally, and there are more on the three anal segments ; the 8th abdominal carries ventrally two round knobs on either side of the genital slit, the 10th carries two dorso-anal spikes slightly recurved but no ventral hooks ; skin-folds above and especially below the spiracles mark the lateral flange ; the spiracle on the 8th abdominal very marked, but apparently closed. The prothoracic lip projects over the prothoracic spiracle as a definite point or ridge. The antennæ are broad, marked with pectinations, they encroach on the second pair of legs, which appear as a spindle between them and the 1st pair, whilst a portion of the tarsus projects below the antennæ, and the 3rd pair beyond this ; the 1st pair of legs falls short of the antennæ by about the width of a segment (·24mm.), the 1st femora extend to about one-half the length of the 1st leg ; the labium very short, the labial palpi suggest those of *T. tubulosa* ♀ ; the labial area widens below and without a central line of division ends in two large rounded lobes ; the maxillæ are triangular, rounded at the end, but sharply pointed at outer end but with no further indication of palpus ; jaws well-marked. *Female:* Length 5·1mm., width 1·9mm. Viewed *laterally* somewhat arched, the venter being faintly concave, the dorsum much curved from before backwards ; and tapers to either end slightly but very regularly, the ends rounded ; viewed *dorsally* the abdominal segments 3-6 are very wide, whence the pupa tapers rapidly to either end, and especially looks very narrow anteriorly, the mesothorax is, in fact, only 1·1mm. in transverse diameter ; abdominal segments 3 (dorsally), 4, 5, and 6, free ; transverse row of anterior spines dorsally on 3-7 ; intersegmental spines very fine on intersegmental membrane between abdominal segments 6-7 ; no anal spines or hairs ; proleg scars very pronounced ; dorsal tubercular hairs doubtful ; the wings, legs and mouthparts very distinct ; the labrum angulated ; the jaws very distinct and rounded ; the maxillæ very short, rounded, with no definite palpus; the labium has no median division, but the extremity, which is wider than the base, terminates in two rounded lobes; it has, however, a transverse line,* indicating an articulation (as in ♀ *B. staintoni*); antennæ half length of wings, the wings to the end of the 2nd abdominal, the 1st femur and legs well shown; the 2nd pair of legs a little short of the end of the wings, showing the tips of the 3rd tarsi beyond (Chapman). Bacot notes a *male* pupa as being dark red-brown in colour, the abdominal segments paler than the thoracic segments (which are nearly black) dorsally, the ventral area of the abdomen being still paler; also that two raised bosses on the venter of the 9th abdominal appear to be external structures connected with the genital organs, and especially well-developed considering the size of the pupa; the spiracles are rather raised, and rather conspicuous on abdominal segments 3-7, whilst a fair portion of the hindwing is shown on the 2nd abdominal, passing beneath the primaries on the 3rd. Speyer calls the pupa yellow-brown in colour, and says that it is of delicate structure, the wing-cases (♂) pointed at apex, not so long as the antennæ.

Comparison of pupæ of Bacotia sepium and Luffia lapidella.—In the pupæ of both sexes of *B. sepium* the anterior dorsal spines are properly described as a single row yet they are slightly irregular in spacing and size, and here and there one spine occurs below another (a second row not yet absolutely atrophied). The intersegmental membrane has the tegumental points rather large and rough, but one row has become distinctly spinous as noted in the description above. The dorso-anal spikes (characteristic of the Micro-Psychid pupæ) are very evident, with no trace of the ventro-anal ones of the Macro-Psychids. In the female pupa of *L. lapidella*, which is exceedingly similar to that of *B. sepium*, the dorsal anterior spines are coarser, larger and fewer, but more regularly aligned than in the latter, but there is no posterior set, although many rows of the points of the intersegmental membrane are very sharp and prominent, and of triangular shape, at least the free portion of them is. In this pupa then we see the beginning of the process by which the posterior row of spines in the Macro-Psychid pupa originates (Chapman).

Food-plants.—Lichens on the trunks and branches of *Abies excelsa* (Fletcher), lichens growing on old oak palings, and on hornbeam (Bruand), lichens on sloe (Frey), wall and tree lichens (Heinemann), lichens on tree-trunks and fences (Glitz), lichens on old fences (Zeller), *Parmelia parietina* (Paux).

Habits and Habitat.—The insect appears to be confined to woods in which there are old lichen-covered trees, the case is fixed by the larva just before pupation perpendicularly to the surface on which it rests, and on emergence the male pupa protrudes the greater part of its body, the female pupa remaining within the case. The female moth, however, comes out of the case, and one that emerged July 7th, 1899, took up a position directly above the cavity at the apex of the larval case, standing almost horizontally when at rest, but lowering herself almost in line with the case when disturbed. Zeller also notes the female as sitting closely on the upper part of the case to await

* This line is apparently hidden behind the labrum in most pupæ where there is greater development of the palpi.

copulation, falling off helpless as soon as oviposition is completed, whilst Bacot observes that it sits at the end of the case (like the ♀ of *L. lapidella*), awaiting a male with the ovipositor extended, the position being maintained until death takes place if she be not fertilised. Fletcher says that the ♀ moth stands upon its case, with its head towards the twig and its ovipositor directed outwards and prominent, the position being maintained for two or three days. Breyer, who gives a most interesting account of the insect, says that "it emerges in the early morning, clings to the case, its anal end towards the opening from which it has emerged, its head towards the base of the case; the long and transparent ovipositor is movable not only in the direction of its length, but can also be turned freely to the right and left, up and down, so that, when in this resting position, the female continually moves it in such a manner as to describe perfect circles and as if it were seeking something in the air. Two males being introduced to the presence of a newly emerged female, one of them suddenly threw itself by the side of the latter holding to the lower end of the case. During this time the female increased strongly the movement of the ovipositor, directing it towards the male and 'se saisit de lui,' so to speak; she retained her position and inserted the ovipositor a little; the male, venter up, fixed his feet under those of the female, carrying his wings 'en toit renversé.' The act of copulation did not last a minute. The male raised his wings and flew away, I had almost said, singing 'satiatus sed non lassatus abibat.' The male having gone, the female advanced a little towards the sac and deposited her eggs. After the egg-laying she is reduced to a third of her volume and spends her last energy in plucking the down and lining the case, this done she falls to the ground and dies rapidly, the last sign of life being a contraction of the ovipositor." Speyer notes that a male pupa which just showed out of the case at 8 a.m. had, by 4 p.m., pushed itself out more than half way, when it was observed to emerge suddenly, three of the wings expanding in two minutes (whilst the moth was trying to free the fourth which was attached to the pupa-skin). Zeller notes that the male is extremely active, and that one can scarcely get a specimen in fine condition unless it be pinned directly after emergence. In Upper Saxon Lusatia, Schütze says the insect appears to be exclusively confined to pinewoods; Rössler notes that, in Nassau, the green-grey, bell-shaped case is often obtained from old hedges, the trees in which are overgrown with moss; Rehberg mentions that the larvæ are gregarious on old fences, tree-trunks, &c., in Bremen; whilst Glitz says that the larvæ are common in May on tree-trunks and fences. Of its Worcestershire habitat, Fletcher says that a case was beaten from an old spruce (*Abies excelsa*) in 1858, on the Old Hills in Worcestershire, which produced a male example; in the spring of 1877 four more cases were obtained in the same locality from one of which Stainton bred a male on July 10th. (This is in the "Stainton" collection among the Solenobiids.) In the spring of 1882, five other larvæ were obtained in the same locality, one of which produced a female imago. A single male was beaten from *Cephalonica* mixed with juniper, July 31st, 1888, at Merton, by Walsingham, but the species has not been seen since. Bruand notes it on the lichens on old oak-palings at Chevigney-sur-l'Ognon and Seuley near Grand-Vaire, also on an old mossy hornbeam in the forest of Chaux. Paux says that cases are very common on the trunks of oak, elm, and poplar, in April and May in the Dept. du Nord.

Time of appearance.—The last week in June and commencement of July. July 10th, 1877, from case obtained in Worcestershire (Stainton); a male on July 31st, 1888, at Merton (Walsingham); June 20th and July 2nd, 1899, a ♀ on each day (Tutt); June 30th a male, July 1st a male, July 6th a female, July 8th a female (Bacot); June 28th a male, July 3rd two males, July 5th two females, July 14th a male (Chapman); July 15th-30th, 1869, in the Netherlands (Snellen). July in Nassau (Rössler); larvæ in May, imagines in July, in Hanover (Glitz); the larva pupates about the end of May or beginning of June, the imago emerging at the end of July (Zeller); pupates in June, the imago appearing towards the end of July (Bruand); generally distributed in Baden in July (Reutti); larvæ on lichen-covered palings in May and June, imago in July, at Munich (Hartmann).

Distribution.—Austro-Hungary: Galicia—Lemberg (Garbowski), Vienna (Lederer *teste* Speyer). Belgium: Louvain, Brussels (Fré). Denmark: (Hedeman). France: North France (Const. coll.), Dept. du Nord, common (Paux), Aube (Jourdheuille), Doubs (Bruand), Douai (Foucart), Besançon (Guénée), Chevigney-sur-l'Ognon, Seuley near Grand-Vaire, Forêt de Chaux near Fraisans (Bruand). Germany: Bavaria (Const. coll.), Munich (Hartmann), Upper Saxon Lusatia—Rachlau (Schütze), Nassau (Rössler), Arolsen, Brunswick, Silesia, Baden (Heinemann), Frankfort-on-Main, Wetterheim (Koch), Waldeck, near Rhoden, Wildungen, Bamberg, Coburg, Karlsruhe, Freiburg (Speyer), Bremen (Rehberg), Silesia, Dresden, Blasewitz (Wocke), Würtemberg, Breslau (Hofmann), Ratisbon (Schmid), Alsace (Peyerimhoff), Elberfeld, Trier (Jordan), Hanover (Glitz), Hildesheim (Grote). Netherlands: common N. Brabant, Gelderland, Betuwe, Wageningen en Keppel (Snellen), Breda (Heylaerts), Arnhem (Brants). Roumania: Kloster Neamtz, Grumazesti (Caradja). Russia: St. Petersburg (Erschoff). Switzerland: Zürich (Frey).

Localities.—Probably much more widely distributed than British collectors suspect. Essex: Epping Forest (Doubleday *teste* Tompkins). Hants: New Forest (W. H. B. Fletcher). Norfolk: Merton (Walsingham). Surrey: Mickleham (Tompkins). Worcester: Old Hills (J. E. Fletcher).

Group II: MACRO-PSYCHINA.

Having finished our study of the more generalised section of the Psychides, we have now to consider the more specialised. As we have already pointed out, there is no very sharp line of demarcation dividing the Micro- and Macro-Psychids, the *Luffiidae* and *Fumeidae* presenting characters in some ways intermediate* between them, and as we have selected the structural pupal characters and general appearance of the larval case to retain the Luffiids in the former group, so we shall maintain these characters to justify our retention of the Fumeids in the latter group; at the same time we may note that Chapman points out that there is a good neurational distinction between the two, since the Micro-Psychids always have the small cell in the apical angle of

* *Dissoctena* is another intermediate form, which Chapman considers to represent "a side branch from *Taleporia* but with some characters that might tempt one to place it a little above *Proutia* and more on the direct line to *Psyche* than *Fumea* is. It is really a Micro-Psychid, the male with a very large apical cell, within the discoidal cell. It has also the accessory cell (due to the branching median), as have *Proutia*, and the *Oiketicids*. Its antennæ have long pectinations scaled to the tips, and it has lost the anterior tibial spines (an occurrence one scarcely expected to observe in a genus still possessing an araneiform female whose pupa emerges as in the lower Micro-Psychids). One can only look upon these vagaries of evolution

the discoidal cell present whilst the Macro-Psychids never have it, though they may have remains of the secondary cell formed by the bifurcation of the median nervure (when it branches before leaving the discoidal cell), *i.e.*, the "cellula intrusa" of Heylaerts. The Macro-Psychids form Hübner's *Canephorae-verae* (*Verzeichniss*, pp. 399-400), which he subdivides into:

(1) Sterrhopterices—with *Sterrhopterix vestitella* Fab. (*graminella*, Bork., Hüb.), and *S. calvella*, Ochs. (*hirsutella*, Hb.).

(2) Leptopterices—with *Leptopterix hirsutella*, S.V. (*viciella*, Hb., fig. 3), and *L. viciella*, S.V., Hb., fig. 280.

(3) Phalacropterices—with *Phalacropterix vitrella* (*alburnea*, Esp.,), *P. fucella* (*apiformis*, Rossi), and *P. muscella*, S.V., Hb.

(4) Epichnopterices—with *Epichnopterix pennella*, Hb., *plumigerella*, Hb., *plumella*, S.V., *pectinella*, S.V., *nitidella*, Hb., and *bombycella*, S.V.

It will be noticed that the *Epichnopterices* are peculiarly heterogeneric, containing representatives of *Heterogynis*, *Epichnopterix*, *Bijugis*, *Fumea*, &c. Roughly they form Herrich-Schäffer's *Canephoridae*, in which, however, the latter includes the Lypusids. We have already pointed out (*ante*, pp. 118 *et seq.*), how, according to the views of various authors, the two genera *Epichnopterix* and *Fumea* have see-sawed between the Tineids and the Bombyces, when such authors have considered a subdivision of the superfamily into Tineid and Bombycid sections necessary, even when they have had no doubt that the other Macro-Psychids belonged to the more specialised Bombycid group. We have also shown (*loc. cit.*) that some authors have separated the Micro- and Macro-Psychid sections on grounds that they themselves regarded as superficial, and some (*e.g.*, Herrich-Schäffer) have stated plainly that the genera they have removed to the Tineids "agree in mode of life and form of ♀ almost exactly with *Psyche*," and that "the wide separation made is only due to the artificial system of classification and to the impossibility of a linear arrangement." However much may be said for the union, by these authors, of the Fumeids with the Micro-Psychid group, owing to their araneiform females, one is at a loss to understand how the Epichnopterygids, with their vermiform females, have shared the same fate.

Probably no author has had a better general grip of this superfamily than Hofmann, who in the *Berl. Ent. Zeitschrift*, 1860, published a really good account of a large number of the European species, the part least satisfactorily dealt with, perhaps, being the larger *Psychidae*. Accepting the whole superfamily Psychides as a natural group, he points out that the mode of life and the peculiar structure of the females show that they cannot be really separated, and that the great confusion in their classification has arisen from the attempt to classify them from the males and cases, whilst the females have the greatest value in exhibiting their relationships, this being

as changes that have been attained because advantageous, although the general evolutionary progress has gone no further, and the individuals are, except in these particulars, somewhat generalised forms. *Dissoctena* appears to have obtained specialised antennæ very early, and also to have become in some measure specialised as to neuration, whilst other genera that began by leaving the ♀ pupa in the puparium, have not only afterwards and separately gained their particular specialised features but have advanced beyond them. Its isolated specialisations cannot be brought into line with the similar ones of the Macro-Psychids, unless we postulate separate origins for a *Luffia-Proutia-Epichnopteryx* stem and a *Dissoctena-Fumea-Psyche* stem low down in the Micro-Psychids.

most clearly shown in the Fumeids (our Epichnopterygids and Bijugids) which exhibit a natural transition from the Tineiform to the Bombyciform Psychids. He subdivides the Macro-Psychids into two groups: (1) *Psychina*. (2) *Canephorina*. He follows Herrich-Schäffer in dividing the latter into the genera *Fumea* and *Epichnopteryx*. The males of both genera he notes as having the hind tibiæ double-spurred, the females differing considerably, those of *Fumea* (which corresponds with our *Epichnopteryx*) forming transitions between the true *Psyche* ♀ and that of *Epichnopteryx* (which corresponds with our *Fumea*). In his *Fumea*, he includes*—(1) *F. helix* (provisionally) with vermiform, naked ♀, having three pairs of leg-stumps, imperfect eyes, and no antennæ, and, therefore, less developed† than the females of *Psyche*. (2) *F. sieboldii*, the ♀ of which has distinct black eyes, short peg-like antennæ, short blunt terminal point to abdomen, at the base of which in freshly emerged specimens there is some whitish wool (a primary indication of ovipositor and anal tuft). (3) *F. pulla* which from blown examples appear to be similar to *sieboldii*. (4) *F. plumella* (=*nudella*), the ♀ with a distinct ovipositor and anal wool, distinct eyes, but from its elongate shape and rudimentary antennæ and legs very similar to *Psyche* ♀. The ♀ *suriens* (one of Reutti's species) agrees with this. (5) *F. bombycella* with the build of ♀ *Psyche*, having distinct prominent eyes, articulated antennæ and legs, distinct ovipositor with anal tuft, yet the female never leaves the case, copulation taking place by insertion of ♂ abdomen into the puparium. Hofmann's *Epichnopteryx*, as we have noted, corresponds with our *Fumea*, and contains the species that have a ♀ with six fully developed legs, segmented antennæ and distinctly faceted eyes, abdomen ending in a retractile ovipositor, the base of which is surrounded by an anal tuft. The female comes out of the case. Hofmann does not subdivide his *Psychina*, but includes all the species in the genus *Psyche*. The males, he says, have the hind tibiæ with only two terminal spurs, generally so short as to appear as if wanting, the abdomen capable of being stretched lengthwise. The females he describes as vermiform, naked, without trace of wings, the three pairs of legs, antennæ, and mouth-parts extremely rudimentary, eyes imperfectly developed, ovipositor wanting; the female never entirely leaves the larval case or even the pupal shell, but merely presses herself to the entrance of the silken tube, copulation taking place by the insertion of the abdomen of the male within the case. Hofmann's *Psyche*, therefore, includes our three subfamilies *Acanthopsychinae*, *Empedopsychinae* and *Oreopsychinae*.

Heylaert's work on the Macro-Psychids (*Ann. Soc. Ent. Belg.*, xxv., pp. 29 *et seq.*), has recently been accepted as forming a basis for their classification, but whether his knowledge of their structure, based almost absolutely on neuration, is sound, is open to question. Although he had evidently studied *Bacotia sepium* and pointed out (*loc. cit.*, p. 54) the peculiar Taleporiid details of its pupal structure, he failed entirely to detect its Taleporiid affinities and classed it as a *Fumea*. He criticises adversely the inclusion of the Micro-Psychids (even the Taleporiids) in the superfamily, and places the Macro-Psychids among

* Of these species *bombycella* belong to *Bijugis*, *nudella* to *Psychidea*, *sieboldii* and *pullâ* to *Epichnopteryx*, *helix* to *Apterona*.

† Hofmann evidently considered the most modified of the Psychid females to be the least developed.

the Bombyces. He detects, in the neuration of the Heterogynids, characters that he considers show that the family has great affinities with the Psychids, and he suggests that the former is the group from which the Macro-Psychids have sprung. He also finds in the neuration of *Orgyia*, characters that lead him to state that the Liparids have been derived directly from the Macro-Psychids. We must leave our readers to study Heylaerts' argument (*loc. cit.*, pp. 48-49) for themselves. We are quite willing to grant an affinity between the Heterogynids and the Psychids (*ante*, p. 103), but what close affinity the larvæ and imagines of the Psychids have with those of the Liparids we are at a loss to conceive, and the eggs, larvæ, pupæ and imagines of *Orgyia* (and the Liparids generally) show that Heylaerts' suggested alliance between these, based on the ground of (1) apterous females, (2) the presence of a single pair of spurs on the posterior tibiæ, and (3) the bipectinated antennæ, is entirely unsound and scientifically unwarrantable. Heylaerts further objects to the subdivision of the Psychids into their evident, natural, generic groupings. He writes (*loc. cit.*, p. 69): "On peut très bien négliger le nom des groupes ou sousgenres. Je ne les ai nommés que pour ceux qui désirent une division minutieuse. . . . En les négligeant, les Psychina seraient donc divisés en: (1) *Animula*. (2) *Acanthopsyche*. (3) *Oreopsyche*. (4) *Psyche*. (5) *Apterona*." Under this grouping we find *opacella* in the same genus as the Cingalese *doubledayi* (the latter the type of Moore's *Chalia*), *villosella* united with *unicolor* in *Pachythelia*, &c.

Heylaerts calls his main divisions subfamilies, and names them—*Oiketicina*, *Psychina*, *Psycheoidina*, and *Canephoridae*. These, under our modern terminology, would be *Oiketicinae*, *Psychinae*, *Psycheoidinae* and *Canephorinae*, and they are all united under the family name *Psychidae* (*loc. cit.*, pp. 43-4), the diagnosis of which is of a most comprehensive character. It reads as follows:

Antennes des mâles bipectinées, rarement bicrénélées. Leurs tibias postérieurs portent une ou deux paires d'éperons. Les mâles ne possèdent ni palpes, ni ocelles, ni spiritrompe. Leurs ailes antérieures ont deux nervures internes, dont la supérieure, qui est plus ou moins forte, s'anastomose quelquefois avec l'inférieure. Celle-ci est bifurquée vers le bord extérieur, ou elle ne l'est pas; quelquefois, elle donne des rameaux vers le bord interne. La cellule discoïdale, toujours fermée, est divisée par une nervure, qui est tantôt simple, tantôt double, ou, en se bifurquant (vers le bord externe), forme une cellule interposée. Les ailes inférieures sont pourvues d'un crin (frein) assez fort et ont trois nervures internes.

La femelle est aptère; elle posséde ou elle ne possède pas un oviducte et une touffe anale; elle a des antennes ou des pattes rudimentaires ou articulées. Elle quitte ou non son fourreau et sa chrysalide; cette dernière reste toujours en dedans du premier.

Les chenilles vivent et se changent en chrysalides dans des fourreaux construits par elles-mêmes.

Heylaerts congratulates himself that this definition allows him to unite the *Oiketicina*, *Animulina*, *Psychina*, *Canephoridae*, H.-Sch., and *Apterona*, Mill., and asserts that it proves that they form but one family. So far as the term "family" has a real meaning, and is not a mere matter of words, we accept it as comprising the whole of the Macro-Psychina, but surely groups (*Fumeidae*, &c.) that have females that "possess an oviduct and an anal tuft, that have articulated antennæ and legs, and which quit the case for copulation," &c., are as distinct from those (*Psychidae*, &c.) that have females "without an oviduct and anal tuft, that have aborted antennæ and legs, and which remain in the case for copulation," as are the former from the *Taleporiidae* and *Solenobiidae*, which are excluded because they have "les antennes du mâle tout autrement conformées, et dans le genre *Taleporia*, Hb., les espèces ♂ et ♀ ont des palpes et des ocelles." Surely the female *Solenobia* which has all the characters of the Fumeid female given by Heylaerts is nearer the latter (by his own definition) than is this to the female of the higher Psychids. We are quite willing to accept the positive evidence offered by the want of "the tongue, ocelli, palpi, the apterous females," &c., as showing a relationship between the various families of which the Macro-Psychids are composed, but we object to a character such as "the difference of male antennæ" being considered sufficient to separate two other groups which are evidently somewhat closely related.

We find, as might be expected from our remarks above, that Heylaerts' genera are based on the same comprehensive scale. Among other details he subdivides *Epichnopteryx* (after the withdrawal of *Bijugis*) into groups *a* and *b*, and fails to see that if the genus be the first step in grouping above a species, each of these groups must be a distinct genus. Thus he gives us:

a. Les tibias antérieurs sans épine tibiale—*mentonella, pulla, hofmanni, ardua, flavociliella, tarnierella, undulella, reticella.*

b. Les tibias antérieurs avec une épine tibiale ne dépassant pas la moitié de la longueur du tibia antérieur—*sapho, nocturnella, nudella, vestalis, staudingeri, millierei, flavescens.*

Heylaerts' system appears to us to fail in a proper appreciation of detail. Had he studied the characters offered by the species, and then grouped such of the species together as were evidently most closely allied, to form his genera, grouped these again to form his tribes, and so on to subfamilies and families, instead of (as is evidently the case) fixing his higher divisions first and then discovering the species that fitted into them, we might suppose that a more logical result would have been reached. One recognises also that this author, basing his classification almost entirely on the characters presented by the male imagines, has often failed to recognise the true relationships of some of the smaller groups, owing to his not having been able to check the results arrived at, by using the characters offered by the early stages. It must be conceded that his main divisions of the higher *Psychinae* are, on the whole, sound, and we ourselves have come to the conclusion that the *Oiketicidae* and *Psychidae* are divisible into subfamilies agreeing in the main with Heylaerts' genera, so that our family *Psychidae* subdivides naturally into the (? *Animulinae*), *Acanthopsychinae*, *Oreopsychinae*, *Empedopsychinae* (*Psychinae*), and *Apteroninae*. It is in the subdivision of his *Canephoridae* that we find ourselves in the strongest disagreement, since the structural peculiarities of *Fumea*, *Diabasis*, *Proutia*, *Bijugis*, and *Epichnopteryx* suggest, for these at least, a diphyletic origin, in which *Epichnopteryx* and *Bijugis* present Luffiid affinities, whilst *Fumea* and *Diabasis* have more definite Psychid characters. *Proutia* appears to be somewhat intermediate between Luffiids and Fumeids, with such strong Luffio-Epichnopterygid affinities as to suggest a not very distant alliance with the latter group.

Had we been able to get the material requisite for a thorough study of the genus *Bijugis* we might be less inclined to cavil with those who insist on a close alliance between *Epichnopteryx* and *Fumea*. The differences between the latter are, however, so strong that one cannot suppose that any really close alliance possibly exists between them, and more recent study would lead us [if not to separate them even more widely than our phylogenetic tree (*ante*, p. 126) suggests] to carry the Epichnopterygids over to the Luffiid side of the tree, whilst *Proutia* should be much farther removed from *Fumea* than we have there suggested. The Epichnopterygid ♀ is completely Macro-Psychid in structure and habit, and the ♂ has undergone such remarkable scale-specialisation that we have long hesitated to unite them at all closely with the Fumeids, which have an araneiform ♀ and well-scaled ♂, and Chapman's recent studies tend to show that even the assumed intermediate *Bijugis*, with its semi-vermiform ♀, has not been derived from *Fumea* but from *Luffia*, and that, therefore, so far as *Bijugis* is an intermediate form, it is intermediate between *Luffia* (or Luffiid-like Psychids) and *Epichnopteryx*, and not between *Fumea* and *Epichnopteryx*. Our reasons for these conclusions are given more at length later. We consider, therefore, that the Epichnopterygids are less related to the Fumeids than is generally supposed, and they have obviously, from the characters already enumerated, attained more distinct Macro-Psychid features than have the latter. Barrett has placed *Sterrhopterix hirsutella* among the Epichnopterygids, without, however, giving any reason. Its structure altogether forbids the association, as it is quite a typical Empedopsychid in structure and habits. The supposed similarity of the Fumeid and Epichnopterygid males is entirely superficial, the former having large well-formed scales, whilst the latter has a clothing of hairs and piliform scales, and the nervure dividing the discoidal cell bifurcates at its outer extremity, cutting off a portion of the discoidal cell, and forming what Heylaerts calls the "cellula intrusa," a character generally, but not entirely, wanting in the Fumeids. According to Heylaerts the three species that he places in his genus *Bijugis*—*bombycella* (and var. *rotundella*), *proxima*, *pectinella* (and var. *perlucidella*) have hairs and slender scales like the Epichnopterygid species, and also have the "cellula intrusa" as they, whilst the female has articulated antennæ and legs like the Fumeids, and yet "does not leave the case for copulation." We may here note that *Proutia*, too, has the Epichnopterygid "cellula intrusa," and, in this respect, disagrees with the Fumeids. One would like to know the exact species about which Heylaerts makes (p. 47) the statement that "quelques *Psyche* vrais et quelques *Oiketicina* femelles ont des pattes parfaitement articulées aussi," for there is in the British Museum collection a large ? Oiketicid case, from which a female pupa-skin protrudes much as do those of the Micro-Psychids. This case is placed above the name *Amatissa consorta** and is labelled as coming from Sikkim, 1893. Heylaerts further states that "une foule de *Psyche* (vraies) femelles quittent à moitié leur fourreau avant la copulation, et n'y rentrent entièrement qu' immédiatement avant l'acte copulatif, précisément comme dans le genre *Bijugis*." This possibly refers to the movement that certain Psychids make in order to break open the silken tube that closes the free end of the case during the pupal period, and that thus admits the entrance of

* Under this name are (1) three males, apparently belonging to two (? three) distinct species, (2) a large ♀ case from which this ♀ pupa protrudes, and (3) a smaller case which one supposes might belong to the species represented by the smaller male in the series.

the abdomen of the male for the purpose of copulation. Spüler (*Lepidopteren-Fauna Baden*, 2nd ed., p. 30) very properly points out that *Epichnopteryx* is very distinct from *Fumea*, that *pulla*, *sieboldii* and *nudella* (*suriens*) have vermiform females that do not emerge from the larval case, whilst the species remaining under *Fumea* are more nearly related to the Taleporiids. He further notes that the females of *Bijugis* have antennæ and legs somewhat arrested in development, but do not emerge from the case, the females of this genus thus forming a transition between *Fumea* and *Epichnopteryx*. As we have already stated, Chapman considers them to be rather intermediate between the latter and *Luffia*. We may here note that since the most specialised Macro-Psychids are without anterior tibial spurs, those with these structures must also be considered as somewhat transitional.

We suspect that we shall be in agreement with most synonymists in our objection to the term *Canephoridae*, as applied by Herrich-Schäffer, Hofmann, and Heylaerts to the combined Epichnopterygid and Fumeid groups, for Hübner, although including all the Macro-Psychids in his *Canephorae-verae* (*Verz.*, p. 398), restricted the generic title *Canephora* to *graminella* (*unicolor*) (*Tent.*, p. 2), which, therefore, becomes the type of this genus. The *Canephoridae*, we consider, must contain this genus, from which it takes its name, and hence appears to be synonymous with our *Psychidae;* besides, the section that these authors misname was, as we have shown (*ante*, p. 265), treated as a separate division by Hübner (*Verz.*, p. 399) under the name *Epichnopterices*, which would, therefore, stand for this particular group were it, indeed, a natural one, but we have already shown that the true Epichnopterygids are not really very closely allied to the Fumeids, and hence the Epichnopterygids must be considered as being more or less restricted to the genera *Bijugis*, *Psychidea*, and *Epichnopteryx*, of which *bombycella*, *sapho*, and *nudella* are respectively well-known typical species.

Speyer gives (*Stett. Ent. Zeit.*, 1865, p. 250) some general views on the classification of the *Psychidae*. After stating that the insects included in Herrich-Schäffer's genus *Psyche* (*Sys. Bearb.*, ii., p. 21) could not be retained in one genus, he named the group corresponding with Herrich-Schäffer's div. v., *Oreopsyche*, which he says has "the wings entirely devoid of scales, only clothed with fine appressed hairs, the membrane either clear as glass (*muscella*, *angustella*, &c.) or more or less of a dark smoky-grey colour varying to black (*plumistrella*, &c.). This is then subdivided on less important characters, into three sections, including: (1) *albida*, (2) *tabanella*, *angustella* (*atra*), *muscella*, *plumifera*, *mediterranea*, *hirsutella*, W.V., (3) *plumistrella*, *tenella*. He restricts the name *Oreopsyche* more particularly to the second section. Standfuss has shown (*Beobach. Schles. Art. des Genus Psyche*, pp. 16-17) that intermediate conditions of hairs and scales occur in certain of the Psychids, whilst Heylaerts states that the species in *Oreopsyche*, Speyer, have scales as well as hairs, *e.g.*, *O. tenella*, *O. plumifera*, &c. Standfuss describes the hairs and scales found in the Psychids as:

HAIRS.—Cylindrical, not (or only slightly) transparent, gradually decrease from base to apex and end in a fine point, without the striæ exhibited by ordinary lepidopterous scales.

HAIR-SCALES.—Flattened, transparent, increasing gradually in width from base to centre and then decrease to apex that ends in a point, have striæ similar to those of ordinary lepidopterous scales.

Scales.—Flattened, sometimes quite transparent, similar to the preceding except that the apex is cut off and blunt, these lead by gradual transitions to scales that are almost as broad as long, and represent the commonest form of lepidopterous scales.

Canephora unicolor is said by Standfuss to be fully scaled, *Pachythelia villosella* and *Acanthopsyche opacella* scaled in part, *Sterrhopterix hirsutella*, *S. standfussi*, *Megalophanes stetinensis*, *M. viadrina* and *Stenophanes graslinella* to have only hairs or hair-scales. These groupings based on the scale-structure agree in the main with Standfuss' divisions—*Pupicolae* and *Pupifugae*. These latter were based on the habit of the female, and are defined as follows:

(1) The females never leave the larval case = *Pupicolae*.
(2) The females have the power of leaving the larval case = *Pupifugae*.

The *Pupicolae* are all placed by Standfuss in the genus *Empedopsyche*. The *Pupifugae* are subdivided into (1) *Oreopsyche* (agreeing with *Oreopsyche*, Speyer), and (2) *Psyche* (including the modern genera *Canephora*, *Pachythelia*, *Acanthopsyche*, &c.). He notes that the females of the first of these subdivisions are more modified* (or, as he says, have a lower organisation) than those of the second, those of the first group having the eyes extremely rudimentary and the sharply bent head very small, whilst those of the second group have the eyes and legs less rudimentary (in *C. unicolor* and *P. villosella* an articulation can sometimes be distinctly recognised).

Wallengren divides the Scandinavian species into four groups, two of which are based on the scale structure and two on neuration, suggesting that the first two groupings are possibly of tribal or subfamily value, the latter simply generic. These are:

(1) *Lepidopsyche:* Alæ squamis tectæ—*unicolor*.
(2) *Psyche:* Alæ diaphanæ, pilosulæ—*viciella*, *stetinensis*, *graslinella*, *villosella*, *opacella*.
(3) *Trichopsyche:* Costa subcostalis tota libera, nec cum costa mediana per costam transversam connexa—*fusca*.
(4) *Carchesiopsyche:* Costa snbcostalis alarum posticarum omnino nulla—*plumifera*, *muscella*, *angustella*, *plumistrella*, *hirsutella*, W.-V.

We may here note the bearing of the peculiar mode of copulation in the higher Psychids on a structural peculiarity of the male moths, *viz.*, the loss of spurs on the posterior tibiæ. These spurs are exceedingly well-developed in the Luffiid, Fumeid, and Micro-Psychid divisions of the superfamily, as, also, in the Epichnopterygids, and are present in part in some Macro-Psychids (Oiketicids and Acanthopsychids). It would appear that in the Empedopsychids and Oreopsychids not only are these spurs absent, but also those of the anterior tibiæ (retained by most other Psychids), and it is supposed that their loss has resulted from the resistance they might offer to their insertion in the ♀ puparium with the abdomen, when pairing is taking place. The Acanthopsychid males have only the end pair of the spurs of the posterior tibiæ, and these extremely short, but the male Epichnopterygids, although the ♀ s remain within the puparium, have the two pairs well-developed.

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* This really is the result arrived at on other grounds—scaling, tibial spurs, &c.—the Oreopsychids and Empedopsychids being more modified than the Psychids (as here used by Standfuss). Like Hofmann, Standfuss considers that these very modified females have a "lower" organisation than have those of the Fumeids, &c., with well-developed legs, antennæ, &c.

We have already referred (*ante*, p. 108) to the observations of Standfuss on the pupation of *Stenophanes graslinella*, and the double moult undergone by it previous to its taking on the pupal form. Standfuss notes a case, spun-up for pupation, and obtained on April 12th, that contained a larva with the head towards the spun-up end of the case; on April 21st a larval skin was seen hanging from the free end of the case, the larva had reversed its position and now had its head towards the free end. On May 6th the case contained a still soft pupa, which on June 7th produced a crippled male. He notes that the male larvæ of *viadrina*, *stetinensis*, *hirsutella*, and *standfussi*, also remain for some time after the case is spun-up with the head towards this end, that they moult in this position, then turn round, remain quiescent for some time, and then moult again and become pupæ. The females of the same species, he asserts, turn round as soon as the case is spun-down for pupation, and change to pupæ by a single moult. The larvæ of both sexes of *unicolor*, *villosella*, and *opacella*, act as do the female larvæ of the preceding. Of this Heylaerts writes: "J'ai trouvé la même chose non seulement pour les espéces dont les fourreaux mâles ont un tuyau de soie trés long, mais aussi pour plusieurs autres. J'ai fait des recherches multiples sur *P. graslinella*, *P. villosella*, *P. hirsutella*, and *P. ecksteini*. J'ai trouvé des chenilles, quittant leur avant-dernière peau dans la position précitée, qui m'ont donné le papillon plus tard. Le doute n'est donc plus permis. Seulement, la femelle aussi change de peau avant de se retourner."

The digest that we have already given of the more important work that has been published on the Palæarctic Macro-Psychids leaves some points on which our own conclusions may be stated briefly. The males of the lower Macro-Psychids are better scaled, and the presence of hair-scales may be looked upon as a specialised character. The suppression of the posterior tibial spurs is also a sign of specialisation, and has undoubtedly been brought-about side by side with the modification of the female, and has been due to the necessities involved in copulation with females that do not leave the puparium for this purpose, and Chapman is inclined to consider that the structure of the tibial spurs forms the best basis for the classification of the Macro-Psychids, if male imaginal characters are at all sufficient for the purpose. The anterior tibial spines or spurs in particular have not been valued by systematists as they deserve; they have, indeed, found them rather troublesome on occasion as not confirming neurational and other characters, but there can be no doubt that they are as valuable for classification (as far as they go) and as good (or bad) for that purpose as any other character. They necessarily conform to ordinary evolutional rules, so that species, having any special form of these spurs are *prima facie* related, and if any species has lost them, it cannot be on the ancestral line of one that still possesses them. They possess the apparent peculiarity of being lost *per saltum* in many instances. This is a peculiarity that is common to all articulate forms and organs. Tarsal joints, antennal joints, joints of other articulate organs, even actual segments, present many instances of being lost apparently *per saltum* (discontinuously). An antennal joint may be regained, not probably actually, but apparently, by the formation of new joints, always possible so long as any joints are left. The anterior tibial spur, however, has only one joint, and, once gone, cannot be reproduced, unless, perchance, within a very limited period by atavism. The Solenobiids and Taleporiids have short anterior tibial spurs, as also have the Luffiids. On the other hand most of the Fumeids have long ones, as also have the Oiketicids and Acanthopsychids, whilst *Proutia* (*betulina*) is in an intermediate position, having anterior tibial spurs of about $\frac{3}{4}$ the length of the tibia, and, so far as the material at hand goes, this appears to be almost the only genus of the Psychids in this position. The Epichnopterygids (?including *Bijugis*), however, have short anterior tibial spurs, which clearly show that these forms are derived in common with *Proutia* and *Fumea* from Luffiid forms but not through these (or similar genera) as intermediate forms. *Fumea* (*casta*, &c.), with its long anterior tibial spurs is, as far as this character goes, on the direct line to the higher Macro-Psychids, and we have the *Psycheoidinae* (*Diabasis*) as intermediates, in so far as the first step in the loss of the posterior tibial spurs is concerned. In the higher Macro-Psychids the posterior spurs are evanescent or lost; the anterior spurs are also often lost, but when they are preserved they are long, showing the derivation from a form of which *Fumea* with the transitional *Proutia* is the lowest preserved.

When we examine the antennæ, we find they divide the Macro-Psychids into two groups, just as is determined by the tibial spurs, and the division is precisely the same in both cases*. In *Luffia*, the pectinations of the antennæ are devoid of scaling, and the long sense-hairs occur more or less all round them, the scaling being confined to the dorsal aspects of the bodies of the antennal joints. Precisely the same structure occurs in *Proutia*, *Bijugis*, and *Epichnopteryx*. In *Fumea* the scaling runs right down the dorsal aspect of the pectinations to their tips, and this structure obtains throughout the (Oiketicids and) Psychids, except that certain Acanthopsychids appear to have lost the scaling on the pectinations; the smoothness of the dorsal aspects of the pectinations makes this tolerably certain. If the want of scales was due to their being rubbed off or lost, their points of attachment would be very evident, and if scales had never been there the surface would present some sense-hairs, which it certainly does not. Of those examined, *Canephora unicolor* preserves a few scales on the antennal pectinations, the other Acanthopsychids seem to have lost them. The following tabulation is an attempt to summarise the chief imaginal characters of the two groups, *viz.*—(1) The Macro-Psychids derived from a Luffiid base. (2) The Macro-Psychids derived from a Fumeid base:

A. Primary Macro-Psychid (still with some Micro characters, as those of ♂ pupa and possession of secondary cell in apex of discoidal cell); short anterior tibial spurs ($\frac{1}{2}$); four posterior tibial spurs; antennæ with unscaled pectinations: ♀ araneiform .. .. *Luffiidae.*

I. Anterior tibial spurs short ($\frac{1}{2}$); antennal pectinations unscaled, posterior tibiæ with 4 spurs—

1. Semi-araneiform ♀ .. .. *Bijugis.*

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* Chapman, to whom we are indebted for the facts in this part of our work, says that he "was very pleased that the antennal structure and anterior tibial spurs gave exactly the same indications," although he adds that he "was unprepared for their absolutely separating the Fumeids and Epichnopterygids, and throwing the former over to the higher Psychid branch." He concludes that "when two such apparently unconnected characters agree so closely, it is impossible to avoid giving great weight to their indications."

2. Vermiform ♀
   a. Anterior tibial spurs preserved .. .. *Psychidea**.
   b. Anterior tibial spurs lost .. .. *Epichnopteryx*.

B. Transition form, anterior tibial spurs $\frac{3}{4}$; 4 posterior tibial spurs; antennal pectinations unscaled .. .. *Proutiinae*.

II. Anterior tibial spurs long ($\frac{1}{1}$); antennal pectinations scaled—
   1. Araneiform ♀. ♂ 4 posterior tibial spurs .. *Fumea*.
   2. ? ♀. ♂ 2 posterior tibial spurs, ? anterior tibial spurs .. .. *Psycheoididae*.
   3. Vermiform ♀. ♂ posterior spurs evanescent † or lost.
      a. Long-winged .. .. *Oiketicidae*.
      b. Square-winged .. .. *Psychidae*.

It is interesting to note that section I refused to lose the posterior spurs and so is a restricted group, whilst II, by losing them, became a dominant and extensive group. Further one may note that the more primary forms, *Luffiidae*, *Proutiinae* (and *Oiketicidae ?*) are long-winged. Section I is round-winged and section II (apart from the *Oiketicidae*) square-winged. Granted that the Oiketicids had a Fumeid origin (not necessarily from *Fumea*), there can be no question that these are more generalised than the Psychids (excluding those derived more directly from the Luffiids), the male characters of the anterior tibial spurs, the presence of well-developed scales, as well as the neuration, confirm this view. So little is known of the structural characters of this large exotic group that it may contain within itself a long range of more generalised and specialised forms. Of the true Psychids, those included in the *Acanthopsyche* of Heylaerts (*Psyche* of Standfuss) appear from the scale-structure, tibial spurs, &c., to be the most generalised, *e.g.*, *Canephora unicolor*, *Pachythelia villosella*, *Acanthopsyche opacella*. Of the remainder, one section has the remarkable character of moulting twice in assuming the pupal state; this would be sufficient to define it, being a most unusual and peculiar habit, but it may also be separated by its neuration as well as by being what Standfuss defines as *Pupicolae*, the remainder (with the Acanthopsychids) forming his *Pupifugae*. We may accept these names of Standfuss and divide the Psychids proper thus:

A. Preserve the anterior tibial spurs .. .. .. ACANTHOPSYCHINAE.

B. Lose the anterior tibial spurs—
   1. With two moults to pupal stage; imagines with somewhat generalised neuration .. .. } EMPEDOPSYCHINAE (PUPICOLAE).
      a. Slenderly built species .. .. .. *Sterrhopterix*.
      b. Robustly built species .. .. .. *Stenophanes*.
   2. With one moult to pupal stage; imagines with somewhat specialised neuration .. .. } OREOPSYCHINAE (PUPIFUGAE).
      a. Slenderly built species .. .. .. *Scioptera*.
      b. Robustly built species .. .. .. { *Oreopsyche*, *Hyalina*.

There is a relation between the length of the antennæ and the

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* *Psychidea*, Rbr. = *Epichnopteryx* (Group *b*), Heyl., *Ann. Soc. Ent. Belg.*, xxv., p. 72, defined as follows: "Les tibias antérieurs avec une épine tibiale ne dépassant pas la moitié de la longueur du tibia antérieur—*sapho*, *nocturnella*, *nudella*, *vestalis*, *staudingeri*, *millierei*, *flavescens*." Rambur gives *nudella* (*pectinella* in error) as the type of the genus, and one may note the genus as having: Antennal pectinations with hairs on the upper surface (no scales); the anterior tibial spine short $\frac{1}{3}$ or $\frac{1}{4}$, arising at middle of tibia.

† The Psychid posterior spurs are noted as "evanescent or lost" so as to cover cases where traces of them may be detected.

robustness of the species, but it is questionable whether the divisions so defined have any real natural value, although they are obviously very convenient. Viewed from the neuration standpoint only, the *Pupicolae* are the most generalised of the higher *Psychidae* (excluding Oiketicids, &c.); the Acanthopsychid neuration is also somewhat generalised, less so, however, than that of the *Pupicolae*, but the Acanthopsychids still possess the anterior tibial spurs (an ancestral character probably derived with the Oiketicids from a Fumeid base). In both characters the *Pupifugae* are more specialised, having a very modified form of neuration and having also lost the anterior tibial spurs. Our own impression, therefore, based on such characters as we have discussed, is to separate the *Oiketicidae* from the *Psychidae*, and to subdivide the latter into the three* subfamilies :

(1) Acanthopsychinae (*Pachythelia*, *Canephora*, *Acanthopsyche*, &c.).
(2) Empedopsychinae (or Psychinae) (*Sterrhopterix*, *Stenophanes*, &c.).
(3) Oreopsychinae (*Oreopsyche*, *Hyalina*, *Scioptera*, &c.).

The higher Psychids present much variety in nervure 1 of the fore-wings, which develops sundry new branches, clearly an effort to strengthen the inner margin of the wing against any violence to which it may be subjected against the margin of the ♀ case in pairing, and is, therefore, adaptive to this purpose, just as is the loss of the posterior tibial spurs. It reaches its highest point of elaboration in the Oiketicids, where, also, it is usual for the hindwing to be diminished in size, as being in the way under the same circumstances. The long forewing of the Oiketicids is probably an adaptation to this modification of the lower one, at least as much as an inheritance from such forms as *Luffia*, *Proutia* and *Dissoctena*.

We have already dealt with the main characters presented by the Macro-Psychids in our general remarks on the superfamily. The eggs are so delicate and usually so massed together that the slightest touch ruptures them, and they are laid in the empty pupa-case, the skin of which is so delicate that if it be removed from the puparium when full of eggs one might almost suspect one had the slightly dried body of the female. The larvæ are remarkable for their strong true legs, their short prolegs and the peculiar migration of the posterior tubercles (ii) towards, or the anterior (i) from, the medio-dorsal line. The male pupæ are characterised by the peculiar intersegmental hooks (or spines), and the ventro-anal hooks that homologise with the anal larval prolegs, whilst the female pupa exhibits, in the mouth-parts and appendages, strong indications of the great modifications that have taken place in the female imago, in which the whole animal is essentially specialised to become a mere egg-producing mass, all structures not directly connected with reproduction being reduced to the most rudimentary condition. The larval case serves as a puparium, and the female of the Macro-Psychids (excluding the Proutiids and Fumeids) never leaves it until egg-laying is finished, and then only to die. The male pupa, on the contrary, protrudes the greater part of its body in the manner common to the male (and female) Micro-Psychids before

* We have not considered the *Apteroninae* and *Animulinae*, the first of which would also probably fall into this group. The second is more doubtful. Chapman notes *Animula ephemeraeformis* as being an Oiketicid, but Kirby places this species in the genus *Thyridopteryx*, and restricts *Animula* to *hübneri*, Westd., *nigrescens*, Dbldy., *herrichii*, Westd., *dichroa*, H.-Sch., and the allied species.

the emergence of the imago, and, when the latter has escaped, leaves the pupa-skin projecting from the free end of the case.

Standfuss has repeatedly noticed that if, in confinement, the end of a larval case be spun-up by its fellow captives, the larva very soon turns itself round in the case and re-opens the case with its jaws; also, that if larvæ be removed from their cases they soon regain an entrance, turning themselves round after crawling in head first. He also notes that of the eight Silesian species, only two (*S. hirsutella* and *A. opacella*) complete their metamorphoses in one year, the others require two, passing some 22 months of this time in the larval state, a fact the more remarkable because the larvæ are practically polyphagous. Very few species live on trees, the larvæ of most being confined to low plants, and they appear to prefer uncultivated ground, and more especially localities protected from cold winds and yet exposed to the full blaze of the midday sun. Most of the Fumeids, however, appear only to take one year, and probably also the Epichnopterygids, both of which Standfuss excludes from his consideration of the Macro-Psychids. He further notes that "the female larvæ, which, until the time they are full-fed, live in similar situations with those of the males, separate from the latter and pupate on tree-trunks from 2ft.-5ft. from the ground (*unicolor*, *villosella*, *opacella*, *standfussi*), or on the ends of twigs of bushes and trees (*hirsutella*, *graslinella*), on tall herbaceous plants (*stetinensis*, *viadrina*), occupying a position where they may be readily discovered. On the other hand the male larvæ generally spin up low down on stems (*stetinensis*, *viadrina*, *standfussi*, *graslini*), on fallen leaves and twigs (*villosella*, *stetinensis*), on exposed roots (*opacella*), at the foot of tree-trunks (*unicolor*, *villosella*, *opacella*, *stetinensis*), but always so as to be exposed to the sunshine during the day. The male larvæ of *C. unicolor* often spin higher up, and it is the general rule for those of *S. hirsutella* to do so."

The rapidity with which the wings of the male expand after emergence is very remarkable. Standfuss notes the expansion as occupying only from 50-55 seconds in *hirsutella*, *stetinensis*, and *unicolor*, and allows another three minutes for the wings to be folded back roofwise ready for use, although flight rarely takes place under from 10-20 minutes.

Family: FUMEIDAE.

We have placed in the family *Fumeidae* two subfamilies *Proutiinae* and *Fumeinae*, but are by no means satisfied that these are so closely related to each other as placing them thus implies. The species in these two subfamilies, together with *Bacotia sepium*, have hitherto been included in one genus.

The differences that distinguish the male imagines of the Proutiids from the Fumeids are in precisely the same characters that most clearly differentiate the Epichnopterygids from the higher Psychids. These are more particularly: (1) The presence of the "cellula intrusa" formed by the bifurcation of the median nervure within the discoidal cell.* (2) The absence of scales on the antennal pectinations. (3) The shorter anterior tibial spurs. These characters link the Proutiids with the Epichnopterygids, and one might assume from this that the Proutiids

* We learn from Chapman that this character does not distinguish the *Proutiinae* from the *Fumeinae*, since *Bruandia* (*reticulatella*) has this cell whilst *Fumea* (*casta*) is without it.

were a branch from the stem that connects the Luffiids and Epichnopterygids (for the short anterior tibial spurs suggest strongly that the Epichnopterygids are directly derived from the Luffiid stem), but it is just in this character that *Proutia* fails, for its anterior tibial spurs are intermediate in their development between the short-spurred Luffiids and the longer-spurred Fumeids, and one is forced to the conclusion that it must have branched almost directly from the same point as that at which the Epichnopterygids left the Fumeids, specialising its neuration in the direction of the former and its anterior tibial spurs in the direction of the latter. It seems, however, extremely unlikely that we are here precisely at the dividing of the ways, and much more likely that the division took place still further back. This view is to some extent confirmed when we find *Luffia* on the Epichnopterygid side still with "Micro" characters, and *Dissoctena* on the Fumeid (or Psychid) side, still clearly a Taleporiid in many of its characters; nor must it be overlooked that at least one Fumeid genus, *Bruandia*, comprises species with short anterior tibial spurs.

It is, of course, quite conceivable that this bifurcation in similar organisms, under similar changes of environment, took place over and over again, and that the differences between *Proutia* and *Fumea* are simply one instance of such an evolutionary movement unconnected with any other. It is difficult, however, on this hypothesis, even in view of the few transitional forms that we so far have explored, to conceive this to be possible, without postulating that, on occasion, species of the one branch gave rise to some of those on the other, a much more unpromising view of the matter for acceptance. We are still in doubt whether it would not have been wiser to have accepted the Epichnopterygids as the terminal of the Luffiid stem, with *Proutia* and *Fumea* representing two equally independent branches of the same stem, the Proutiids low down and more generalised, the Fumeids higher and more specialised, and leading more directly to the higher Psychids (as represented by *Acanthopsyche*, *Oreopsyche*, &c.).

The Proutiids, in the structure and covering of their cases, have a position somewhat intermediate between the Luffiids and the Fumeids. The males of all this family appear to fly by day, but the female crawls from her case and sits on the outside, her ovipositor, however, within the case, until fertilisation, after which she lays her eggs within the empty pupal skin, which is left within the puparium. We may see here a very definite step towards the specialisation that has taken place in the female of the higher Psychids. The Taleporiid ♀ sits not only quite outside her case, but it is not till after fertilisation that she searches for the opening of her case for oviposition. The Fumeid ♀ makes sure of having this opening when wanted by keeping her ovipositor within the mouth of the pupal case, raising it only for the few moments required for fertilisation. Failure so to raise it is clearly a first step to the ♀ remaining entirely within the case. The habits of the Fumeid female, therefore, whilst linking it with the Taleporiids, at the same time show a distinct progression towards those of the higher Psychids whose females remain within the puparium. The male pupa is, of course, partly protruded before the emergence of the imago, but the female pupa remains in the case and the eggs are laid in the empty pupa-skin. The male pupa, which has not the dorso-anal spikes (characteristic of the Taleporiids), is provided with the two ventro-anal hooks (modifications of the anal prolegs of the larva ?) that characterise the Macro-Psychids. The Fumeids therefore combine, to some extent, the characters of the Micro- and Macro-Psychids, but in a rather different manner from the Luffiids which have Taleporiid pupæ. The larval characters, too, are largely Macro-Psychid, the dorsal tubercle ii being nearer the median line than i, otherwise the general structure is that common to almost all the Psychid families. The larvæ differ from those of the Luffiids (*L. lapidella*) in their coloration, in walking when out of their cases as ordinary larvæ or nearly so, and especially in having two transverse (subsegmental) ridges across the dorsa of the abdominal segments, of which the anterior is the sharper, the posterior the more rounded, still more in having the trapezoidal tubercles reversed only to the extent that that word implies (˙ . . ˙), and not so that they are, as in *Luffia*, nearly in a straight line (· . . ·). In all, the 3rd thoracic plate is well-developed laterally, and is not distinctly divided into two parts at its anterior border. In these respects the Fumeids and Proutiids agree, whilst that of *Luffia* belongs to a different section of the Psychids (Chapman). The eggs are not quite so delicate as in the higher Psychids and Luffiids. It is essentially in the habit of the female that the Fumeids differ from the Epichnopterygids with which they have been erroneously associated (even being placed in the same genus) by some of our best lepidopterists, and it is just this habit, coupled with a rather more definite specialisation of the pupal and larval characters, that leaves us in no manner of doubt that the Epichnopterygids form a Macro-Psychid family. Still, there are marked structural differences in all the stages between the Fumeids and Epichnopterygids, the latter agreeing more particularly with the *Proutiinae* than with the *Fumeinae*, in neuration, antennal structure, and the structure of the anterior tibial spurs. We may here note that in the Fumeid female the corneous plates of the abdomen are one dorsal and one ventral, whilst those of the Luffiid female are divided in the middle line forming two dorsal and two ventral.

Subfam.: PROUTIINAE.

Tribe: PROUTIIDI.

We have already discussed the want of homogeneity between the *Proutiinae* and the *Fumeinae*, the two subfamilies which we have placed in the *Fumeidae*. The superficial similarity of the male imagines and their almost uniform brown coloration have led not only to their being placed in the same genus, but even to their confusion as species. The male Proutiids have more pointed forewings, the antennæ have scaleless pectinations, and the nervure that passes through the discoidal cell bifurcates to form the "cellula intrusa" before leaving the cell. The anterior tibial spurs are variable (from one-half to three-fourths the length of the tibia), and suggest a distinct Luffiid connection, and an intermediate position between the Luffiids and Fumeids. The cases are covered with small pieces of dead leaves, bark, and sometimes lichen, and are, therefore, much nearer, in this respect, to those of the Micro-Psychids than are the Fumeids. The general structure of the larva, pupa, and the female, as well as the habits of the latter, appear to be almost identical in the *Proutiinae* and the *Fumeinae*, but in *Proutia* the larval head (and thoracic plates ?) are black as in the

Luffiids and Micro-Psychids, whilst in *Fumea* these structures are marked with whiter lines, as in so many of the higher Psychids.

Genus: Proutia, Tutt.

Synonymy.—Genus: *Proutia*, Tutt, "Ent. Rec.," xi., pp. 211, 238 (1899); Chapman, "Proc. Ent. Soc. London," 1899, p. xxiv (Dec. 1899). *Psyche*, Zell., "Isis," 1839, p. 283; Spey., "Isis," 1846, p. 34; Brd., "Mém. Soc. Doubs," ii., livr. 1-2, p. 65 (1845); "Mon. Psych.," p. 100 (1853); Tompkins, "Zool.," 1859, p. 6464; Mitfd., "Zool.," 1861, p. 7452; "Ent. Mo. Mag.," vi., p. 94 (1869); p. 186 (1870). *Talaeporia*, Hdrch., "Lep. Eur. Cat.," ed. 3, p. 78 (1851); Koch, "Schm. S.-W. Deutsch.," p. 372 (1856). *Fumea*, Speyer, "Geog. Verb. Schmett.," i., pp. 311, 460 (1858); ii., p. 280 (1862); "Verh. N. H. Ver. Preuss. Rhein.," xxiv., p. 183 (1867); Hein., "Schmett. Deutsch.," i., p. 187 (1859); Wilde, "Zeits. Nat. Halle," xvi., p. 306 (1860); "Pflanz. Raup. Deutsch.," ii., p. 73 (1861); Staud. and Wocke, "Cat.," 2nd ed., p. 65 (1871); Wocke, "Zeit. Ent. Bresl.," ii., p. 26 (1872); Glitz, "J.-B. Nat. Ges. Han.," xxiv., p. 36 (1874); Mill., "Cat. Lép. Alp.-Mar.," pt. 3, p. 105 (1875); Foucart, "Mém. Soc. Agric. Nord," (2), xii., p. 520 (1875); Sint., "Arch. Nat. Liv.," (2), vii., p. 335 (1876); Rehb., "Abh. Nat. Ver. Brem.," vi., p. 468 (1879); Frey, "Lep. der Schweiz," p. 92 (1880); Peyer., "Cat. Lép. Als.," ed. 2, p. 59 (1880); Heyl., "Ann. Soc. Ent. Belg.," xxv., p. 73 (1881); Röss., "J.-B. Nass. Ver. Nat.," xxxiii.-iv., p. 227 (1881); Snell., "De Vlinders," p. 443 (1882); Jourd., "Mém. Soc. Aube," xlvii., p. 46 (1883); Schmid, "C.-B. Nat. Ver. Regensb.," xxxix., p. 85 (sep., p. 37) (1885); Jordan, "Schmett. N.-W. Deutsch.," p. 94 (1886); Calberla, "Iris," i., p. 154 (1887); Rühl, "Soc. Ent.," iii., p. 11 (1888); v., p. 154 (1891); Teich, "Arb. Nat. Ver. Riga," N. F. vi., p. 20 (1889); Zimm., "Verh. Nat. Ver. Hamb.," vii., p. 20 (1891); Stein., "Iris," v., p. 413 (1892); Paux, "Rev. Biol. Nord," v., p. 322 (1893); Hed., "Ent. Medd.," iv., p. 262 (1894); Barr., "Ent. Mo. Mag.," xxx., p. 267 (1894); [*nec.* xxxi., p. 275 (1894)]; "Brit. Lep.," ii., p. 361 (1895); Car., "Iris," viii., p. 88 (1895); Meyr., "Handbook," p. 774 (1895); Schütze, "Iris," ix., p. 335 (1896); Lutz., "K. B. Ver. Riga," xxxix., no. 52 (1896); Horm., "Ver. z.-b. Ges. Wien," xlvii., p. 323 (1897); Reutti, "Lep. Bad.," 2nd ed., p. 306 (1898); Tutt, "Ent. Record," xi., p. 211 (1899). *Epichnopteryx*, H. Sch., "Sys., Bearb.," v., p. 62 (1853); "Neu. Schmett.," p. 8 (1856); Hofm., "Berl. Ent. Zeits.," iv., p. 31 (1860); Staud. and Wocke, "Cat.," 1st ed., p. 29 (1861); Nolck., "Lep. Fn. Estl.," p. 121 (1867); Knaggs, "Ent. Ann.," 1870, p. 136 (1869).

This genus was first separated from *Fumea* in the *Entom. Record*, vol. xi., p. 211, where it is noted as follows:

> *Proutia*, the larvæ of which cover their cases with pieces of leaf and bark placed irregularly, and represented in Britain by *betulina* and *salicolella*.

We would here cite *betulina* as the type of the genus, the chief characters of which may be summarised as follows:

Ovum.—Oval in outline (length : breadth : : 5 : 3); surface smooth; colour pale yellow.

Case.—Straight, carried horizontally, fixed vertically for pupation; silken tube covered with small scraps of vegetable *débris* (rarely grass), not regularly arranged as in *Fumea*.

Larva.—Slender (compared with *Fumea*); head black, retractile; pro- and mesothoracic dorsal plates, lateral mesothoracic plates, small metathoracic dorsal and lateral plates, all with pale longitudinal markings (except dorsal line) ill-developed; tubercle i anterior to but outside ii, latter with the shorter hair; the corneous plates of dorsal tubercles distinct, forming summit of lateral ridge; iii with porrected seta; anal segment with dark cornęous plate; 3rd pair of true legs less strong (than in *Fumea*); prolegs short with the oval of crochets broken on inner margin.

Pupa.—♂. (Compared with *Fumea*) darker and of more robust appearance; labrum as long as broad, lower margin in line with that of cheek; maxillæ pointed; mandibles well marked; spiracles more projecting but surrounding vallum less pronounced, ventro-anal hooks more terminal and wider apart, darker and slightly longer; labial palpi narrower basally; wing apex to near end of 3rd tarsi (one width of tarsi). ♀. Labium very short, mandibles large; second hair of labrum rather dwindled; cheeks, labium and maxillæ rounded; maxillæ not marked off from labium, which has a pale (transparent) spot in centre (? point of attachment to imago).

Imago.—♂. Wings almost unicolorous, well scaled, oval in outline; antennæ 21 (*betulina*) to 26 (*eppingella*) joints, last joint simple, pectinations long, faintly clubbed, unscaled; anterior tibial spurs from one-fourth from base of tibia to end of tibia. ♀. Antennæ 15 joints (*betulina*); 4 joints to tarsi (mark of anchylosis of 4-5); surface of skin with a few hairs only; white transparent marks (? tubercle i) on certain plates of the abdominal segments. Carries pupal head-parts on emergence (? always).

Neuration.—♂. *Anterior wings:* 7 to apex; subcostal accessory cell wanting; median present and bifurcating in discoidal cell to form a median accessory cell (the "cellula intrusa"). *Posterior wings:* Median between 5 and 6.

This genus is possibly, in spite of the position we have given it, more closely allied to the Epichnopterygids than to the Fumeids, but the case covered with pieces of bark, leaf, and lichen, the black head and thoracic plates of the larva, are sufficient to distinguish it, and whilst the antennæ separate this genus somewhat widely from *Fumea*, the early stages and the females separate it widely from the Epichnopterygids. The male imago is distinctly Fumeid in general appearance and coloration, but has less square forewings, and this superficial resemblance has, perhaps, misled all previous authorities and tempted them to place *P. betulina* and *B. sepium* in the genus *Fumea*. Speyer, in 1846, observed that the pupa of *P. betulina* was to be distinguished from that of *B. sepium* by the two rather widely separated ventro-anal hooks. The pupal headparts are carried on the head of the ♀ imago on emergence and in this *Proutia* also agrees with the Epichnopterygids (as represented by *Epichnopteryx pulla*).

We are quite ignorant as to the number of species there may be in *Proutia*. Two are found in most of the lists, *viz.*, (1) *betulina*, Zell. (=*anicanella*, Brd.), (2) *salicolella*, Brd. These three names apparently represent the only European species that have yet been described and which appear to work out as follows: (1) *Betulina*, Zell. [which also equals *betulina*, Speyer (*teste* the small number of antennal joints, *ante*, p. 258)]. (2) *Anicanella*, Brd. (which Bruand himself refers to *betulina*, Speyer). (3) *Salicolella*, Brd. It is quite evident that Bruand's *salicolella* is almost entirely referable to *Bacotia sepium*, but the male and first part of the description of the larval case evidently refer to *P. betulina*. Did Bruand then have two species of *Proutia*, or did his *salicolella* (so far as it was a *Proutia*) = his *anicanella*; and further, was he right in referring Speyer's *betulina*, to his *anicanella*? Considering that he appears to have mixed up a *Proutia* (*betulina*) and *Fumea* (*casta*) to make up his *roboricolella*, and referred the larva, case, &c., of *B. sepium* to *P. salicolella*, when he had described and figured the former species nine years previously in the *Ann. Soc. Ent. France*, 1844, pp. 195-197, as *clathrella*, we have little hesitation in assuming that his *anicanella* may have been *betulina*, as he himself said, and slightly smaller specimens than those he described as *salicolella*. If, indeed, he had two Proutiid species, there is no proof that they were the same as the two now known in Britain, but if they were it follows that the larger species *betulina* would probably be represented by his *salicolella*, and the smaller by his *anicanella*. Chapman has assumed the latter to be so, but we cannot very well accept this view and have named our smaller British species *eppingella*. The facts relating to Bruand's species (*Mon. des Psychides*, pp. 98-101), appear to be as follows:

(1) *Psyche roboricolella.**—Of this no doubt his male, case, and possibly larva are, as far as the descriptions are concerned, *F. casta* (*nitidella*), but the female appears certainly to be that of *P. betulina*, whilst his figures of the neuration of the species (pl. iii., figs. 72 and ? 72) are just as certainly *P. betulina*, showing a large cellula intrusa, a character apparently wanting in *Fumea* (*in sensu strictiore*). It was a species that he evidently did not know well in nature, for he notes that it is the most common species of the genus around Paris, but quite otherwise around Besançon, where one found it much less frequently than *F. crassiorella* and *F. intermediella*. It appears certain that Bruand had no very clear idea of the limits of *betulina*, some dark examples of which, one suspects, he placed with the Parisian examples of *F. casta* to form his *roboricolella*.

(2) *Psyche salicolella.*—The male of Bruand's *salicolella* is almost certainly *betulina*, so also is the case according to the Latin diagnosis—"Involucrum, ut apud *anicanellam*, quisquilius lignosis vel corticeis indutum"—but when he described this more fully in French, he evidently mixed up therewith cases of *B. sepium*, for he notes it as "un peu resserré à l'ouverture, s'élargit légèrement au milieu et se termine en pointe obtuse." The larva described is almost certainly that of *B. sepium*, and the ♀, which agrees with no known species in having "une seule petite tache noirâtrè à la partie ventrale, endessous du quatrième anneau," appears otherwise to be that of *F. casta* (*nitidella*). His figures are undoubtedly those of *P. betulina* throughout, the male, case, and larva (pl. ii., figs. 74 *a-d*) showing the real Proutiid characters, whilst the neuration (pl. iii., fig. 74) is also distinctly Proutiid, and possibly that of *betulina*.

(3) *Psyche anicanella.*—There is no doubt from the description of the case that this is a Proutiid, one suspects it to refer to *P. betulina*, and the female, both by description and figure (pl. ii., fig. 73) almost certainly belongs to this species. Bruand himself inclined to consider it a variety of *roboricolella*, which, as shown above, was certainly in part *P. betulina*, and one suspects that he had the same species (in part at least) in the examples he was comparing. Bruand also notes

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* We at first suspected that Speyer's criticism (*Stett. Ent. Zeit.*, xlix., pp. 203-4) was based on a book knowledge only of *roboricolella* and a real knowledge of *betulina*, but his detailed description of the antennæ, &c., of the former made this doubtful, and further reference showed that Bohatsch sent him a pair of insects and the case (the ♀ labelled "Douai, R. 31. V. old wood-lichens"), which, after comparison with the description of *roboricolella* in Bruand's *Monograph*, he determined to be the latter species, although he states that the ♀ is not larger than those of *intermediella* and *anicanella*, and that Bruand's pl. ii., fig. 72A does not show the shape of wing accurately, and the hindwing is made much too bright. He then states that "*roboricolella* is somewhat smaller than *nitidella* (*intermediella*, Brd.), but of the same colour, a little shorter in the forewings, which are rather more rounded at the apex; the shape of the wing differs greatly from that of *betulina* (=*anicanella*, Brd.); the antennæ are 16-jointed, finer than those of *nitidella* and *betulina*, their pectinations filiform, distinctly thickened at the tip, in the middle of the shaft somewhat more than double as long as the joints on which they are seated, otherwise all else is as in *nitidella*. The ♀ differs distinctly from the otherwise similar ♀ of *nitidella* in having a white anal tuft. The case also is similar to that of *nitidella*, covered lengthwise with narrow dry grass stems or twigs, quite unlike that of *betulina*." Speyer then notes that Bruand doubts whether his *anicanella* (*betulina*, Zell.) may not be a mere variety of *roboricolella*, but the former asserts that he has in different years bred nearly 200 *betulina*, and convinced himself as to "its distinctness from its nearest relatives. Besides the entire difference of the larval cases, and the difference in form of the forewings of the male, the antennæ present considerable differences. The anal tuft of the ♀ *roboricolella* is, indeed, white, but not snow-white as is that of *betulina*; *roboricolella* is much nearer to *nitidella* than to *betulina*," and Speyer adds that he has caught and bred *nitidella* so commonly (and once reared a whole brood from eggs), and yet has never once had a ♀ *nitidella* with a really white anal tuft, though some have been whitish-yellow, and hence lighter than usual, that this distinction, coupled with the difference in the shape of the wing, which appears to be constant, compels him to look upon *roboricolella* as distinct. On the other hand he considers *nitidella* to agree well with *intermediella*. Which *Fumea* is it that Speyer is here referring to *roboricolella*? Is there, indeed, a *Fumea* with a ♀ with "entirely *white*" anal tuft as Bruand describes? Has the male such neuration that it comprises a "cellula intrusa" as Bruand figures?

that a pair of his species had recently been sent him by Speyer as *betulina*, all of which goes to support the view that *anicanella* was really *betulina*, as all our leading lepidopterists have for many years supposed.

If the above facts and conclusions be correct, we have *P. betulina* extending at least in part over Bruand's *roboricolella* and *salicolella*, and absorbing his *anicanella*, as certainly *B. sepium* absorbs his *tabulella* and extends partly over his *salicolella*. It may be added as a curious incident that though Bruand correctly figures the male, female, and case of *B. sepium* (pl. ii, figs. 75 *a-b*), yet his neuration of this species (pl. iii., fig. 75) is entirely incorrect, and evidently belongs to a *Proutia* (or less likely to one of the Fumeids of the *reticulatella* group), the accessory apical discoidal cellule present in *B. sepium* being absent in this figure, whilst a large "cellula intrusa," unknown in *B. sepium*, is figured; yet there can be no doubt that Bruand knew the life-history of this species well (see, *Bull. Soc. Ent. France*, 1844, pp. 195-197, and figs. E *a-e*), but, when he described it as *clathrella*, he evidently could not separate the imagines from those of the allied species.

We have in Britain two Proutias, and Bruand described two Proutias —*anicanella* and *salicolella*, the latter of which, in part, *i.e.*, so far as it is a *Proutia*, equals *betulina*, and Bruand says that his *anicanella* is also Speyer's *betulina*, and notes it as being smaller, 11mm.-12mm., than *salicolella* 12mm.-13mm. This difference is, perhaps, trifling, and both sets of measurements are probably included within the limits of *betulina*, which extends sometimes to almost 14mm., but it is noteworthy that our two British Proutias—*betulina*, and that which we have hitherto called *salicolella* (but which is certainly not *salicolella*, Brd.)—differ similarly in size, the latter being the smaller (and on the whole less dark). On this account Chapman inclines to sink *salicolella*, Brd., as *betulina*, and to retain *anicanella*, Brd., as our *salicolella* (both species by the bye appear to have ♀s with white anal tuft), but the evidence for this appears quite insufficient, and there seems to be no positive basis for doing so. It is rather remarkable though that a poor example which Chapman received from Staudinger as *salicolella* (from France) appears to be the smaller species we have hitherto called *salicolella*, but which certainly is not *salicolella*, Brd. This insect never seems to have been, hitherto, adequately described, and on account of this, and of the unsatisfactory nature of the evidence relating to *anicanella*, Brd., we are inclined to name the species and so get rid of the inextricable confusion that has grown up from the use of Bruand's name. We cannot do better, perhaps, than call it *eppingella*, from Epping Forest, whence Prout's examples (♂ and ♀), the only authenticated British specimens, have come. Mason has another ♂ but he knows nothing of its history, and we have seen (as noted above) one other ♂ example from Staudinger's collection. Our suggestion that this species was probably more generally distributed than *P. betulina* (*Ent. Rec.*, xi., p. 238) is, therefore, quite erroneous.

There is one other described species that appears to be a *Proutia*. This is Heylaerts' Asiatic species *rouasti*. A description of the species will be found in our account of *P. betulina*.

The ♂s of the British species can be distinguished by the following characters:

(1) *P. betulina*.—Antennæ 21-jointed; wings with hind margin more oblique and apex more pointed, making wing look longer and more Luffiid in shape.

(2) *P. eppingella*.—Antennæ 26-jointed; wings shorter, apex more rounded, hind margin less oblique, except for trace of darker markings along nervures; wings almost indistinguishable in form and colouring from *F. casta* (*nitidella*).

It must be admitted that, unless specimens are in fine condition and similarly set, it is difficult to be quite sure of distinguishing any of these Proutias, Fumeas, and Bacotias, from each other by wing characters, especially when we remember the great variation in size and colour of *F. casta* (*nitidella*). Such definite structural characters as those of the antennæ are alone to be trusted. The larval case, however, forms a really good point of distinction, although that of *Proutia* resembles that of *Fumea* in being straight, and horizontal (not vertical), *i.e.*, applied to the surface on which the larva walks, and not at right angles to it. Both *Proutia* and *Fumea*, however, often raise their cases considerably in walking, and it is perhaps the rule, rather than otherwise, for the case to be raised when affixed for pupation. In these respects, therefore, *Proutia* is not so removed from *Luffia* as the higher Psychids. Like *Fumea* the case has a short mouth tube of collapsible silk, covered with small scraps of tolerably uniform size, but not put on with such nice regularity as in *Fumea*. These scraps appear, in both cases, to be mouthfuls of stuff, *i.e.*, such an amount of material as the larva would remove at one bite. The rest of the case is of soft silk also, and is not collapsible owing to the covering material. *Bacotia* covers its case with lichens, *Fumea* with bits of grass stems, *Epichnopteryx* (*pulla*, etc.) with grass blades. *Proutia* rarely if ever uses any of these materials, lichens, perhaps, most frequently. It uses almost anything else in the way of dead vegetable matter, scraps of rotten wood, of bark, of dead leaves; perhaps if we got the living case at the right moment we should find bits of fresh leaves, bits of leaf thorns, bits of dead plant stems (not grass), and so on.

Neither of our British species appears in the perfect state until summer is well advanced. They are probably not so rare as one might suppose and are possibly much overlooked, and we have but little doubt that other undescribed species have still to be discovered in this genus. Bruand states that late frosts affect the larvae of this genus most injuriously. He notes that in the two or three years preceding the publication of his *Mon. des Psychides* (1853), both *P. anicanella* and *P. salicolella* had become much rarer than hitherto, apparently from this cause.

Proutia betulina, Zeller.

Synonymy.—Species: *Betulina*, Zell., "Isis," 1839, p. 283; Speyer, "Isis," 1846, p. 35; "Geog. Verb. Schmett.," i., p. 312 (1858); ii., p. 280 (1862); "Verh. Nat. H. Ver. Pr. Rhein.," xxiv., p. 183 (1867); Reutti, "Lep. Bad.," 1st ed., p. 174 (1853); 2nd ed., p. 306 (1898); H.-Sch., "Sys. Bearb.," v., p. 62 (1853); "Neu. Schmett.," p. 8, figs. 11-12 (1856); Koch, "Schm. S.-W. Deutsch.," p. 372 (1856); Hein., "Schmett. Deutsch.," i., p. 187 (1859); Hofm., "Berl. Ent. Zeits.," iv., p. 33 (1860); Wilde, "Zeits. Nat. Halle," xvi., p. 306 (1860); "Pflanz. und Raup. Deutsch.," ii., p. 73, pl. iii., fig. 22 (pupa) (1861); Staud. and Wocke, "Cat.," 1st ed., p. 29 (1861); 2nd ed., p. 65 (1871); Nolck., "Lep. Faun. Est.," p. 121 (1867); Knaggs, "Ent. Ann.," 1870, p. 136 (1869); Gärt., "Verh. Nat. Ver. Brünn," viii., p. 84 (1870); Glitz, "J.-B. Nat. Ges. Han.," xxiv., p. 36 (1874); Mill., "Cat. Lép. Alp.-Mar.," pt. 3, p. 105 (1875); Sint., "Arch. Nat. Liv.," (2), vii., p. 335 (1876); Rehberg, "Abh. Nat. Ver. Brem.," vi., p. 468 (1879); Frey, "Lep. der Schweiz," p. 92 (1880); Peyer., "Cat. Lép. Als.," 2nd ed., p. 59 (1880); Röss., "J.-B. Nass. Ver. Nat.," xxxiii-iv., p. 227 (1881); Heyl., "Ann. Soc. Ent. Belg.," xxv., p. 73 (1881); Snell., "De Vlinders," p. 443 (1882); Jourd., "Mém. Soc. Aube," xlvii., p. 46

(1883); Schmid, "C. B. Nat. Ver. Regensb.," xxxix., p. 85 (1885); Jordan, "Schmett. N.-W. Deutsch.," p. 94 (1886); Calb., "Iris," i., p. 154 (1887); Rühl, "Soc. Ent.," iii., p. 11 (1888); v., p. 154 (1891); Teich, "Arb. Nat. Ver. Riga.," N. F. vi., p. 20 (1889); Zimm., "Verh. Nat. Ver. Hamb.," vii., p. 20 (1891); Steinert, "Iris," v., p. 413 (1892); Hed., "Ent. Medd.," iv., p. 262 (1894); Barr., "Ent. Mo. Mag.," xxx., p. 267 *in part* (1894); [*nec* xxxi., p. 275 (1895)]; "Brit. Lep.," ii., p. 361, *in part* (1895); Carad., "Iris," viii., p. 88 (1895); Meyr., "Handbook," &c., p. 774 (1895); Schütze, "Iris," ix., p. 335 (1896); Lutz., "K. B. Ver. Riga," xxxix., no. 52 (1896); Horm., "Verh. z.-b. Ges. Wien," xlvii., p. 323 (1897); Tutt, "Ent. Rec.," xi., pp. 211, 238 (1899); Chapman, "Proc. Ent. Soc. London," 1899, p. xxiv (Dec., 1899). *Anicanella*, [? Brd., "Mém. Soc. Doubs," iii., livr. 5-6, p. 30 (1850); "Mon. des Psych.," p. 100 (1853); Speyer, "Geog. Verb. Schmett.," i., p. 459 (1858)]; Mitford, "Ent. Mo.-Mag.," vi., p. 94 (1869); p. 186 (1870). [? *Roboricolella*, Brd., "Mon. des Psych.," p. 98, *in part*, ♀ and Pl. iii., fig. 72 (1853); ? Tompk., "Zool.," 1859, p. 6464.] *Salicolella*, Brd., "Mém. Soc. Doubs.," livr. 1-2, pp. 65-66 (1845); "Mon. des Psych.," p. 100, *in part*, figs. 74 *a-c* (1853); ? Speyer, "Geog. Verb. Schmett.," i., p. 460 (1858); Tompk., "Zool.," p. 6464 (1859); Mitf., "Zool.," 1861, p. 7452. [? *Nana*, Hein., "Schmett. Deutsch.," i., p. 188 (1859).] *Salicicolella*, Staud. and Wocke, "Cat.," 1st ed., p. 29 (1861); 2nd ed., p. 65 (1871); ? Mitfd., "Ent. Mo. Mag.," vi., p. 94 (1869); p. 186 (1870); ? Fouc., "Mém. Soc. Agric. Nord," (2), xii., p, 520 (1875); ? Heyl., "Ann. Soc. Ent. Belg.," 1881, p. 73; ? Paux, "Rév. Biol. Nord," v., p. 322 (1893); Barr., "Ent. Mo. Mag.," xxx., p. 268 (1894); "Brit. Lep.," ii., p. 363 (1895).

Original description.—*Psyche betulina.* Es gibt hier bei Glogau in einen Birkenwalde eine Art, die im männlichen Geschlechte der *Nitidella* so ähnlich ist, dass ich beide bis jetzt nicht habe unterscheiden können, im weiblichen Geschlechte aber sich durch die fast schneeweisse Behaarung des Afters, wo *Nitidella* eine graue hat, auszeichnet. Wesentlicher aber als hiedurch unterscheidet sich meine *Psyche betulina* durch dem Raupensack, der nach hinten kegelförmig zuläuft und, statt mit Grashalmen, mit zugerundeten Stückchen weisser Birkenrinde und andern blattähnlichen Substanzen bedeckt ist. Man könnte vermuthen, die Raupe nehme diese Bedeckung, weil sie keine Grashälmchen habe. Allein von mehr als 300 Raupen, die ich nährte und neben Birkenrinde mit Gras versah, hat auch nicht eine das letzere zur Bekleidung des Sackes genommen, sondern sie haben sich, wenn ihnen Birkenrinde fehlte, einander Stücke von der Säcken geraubt, um sie ihrer eignen Wohnung anzuheften. Am liebsten fressen sie frische Birkenkätzchen, später Weidenkätzchen, zuletzt mussten sie sich mit Wollweiden-, Weissdorn- und Birkenblättern begnügen. Die Schmetterlinge erschienen erst gegen die Mitte des Juli. Ausführlichere Nachrichten werde ich über diese Art, von deren Raupe ich schon die nöthigen Abbildungen und Beschreibungen verfertigt habe, dann geben, wenn ich die *nitidella* nach allen ihren Stadien verglichen haben werde (Zeller, *Isis*, 1839, p. 283).

Imago.—Anterior wings 12mm.-13mm. somewhat elongated, the costa well arched, apex slightly rounded, of an uniform glossy brown colour, nervures darker, the fringes similarly coloured, but still more glossy. Posterior wings almost of the same tint as the forewings, but less glossy, the fringes glossy, like those of the forewings. Head, thorax and abdomen unicolorous dark brown. [The tibia and tarsi of 3rd pair of legs very pale, on their inner aspect almost white.]

Sexual dimorphism.—♂. To the general description just given we may add that the nervures are often darker than the ground colour; the eyes large and black; the tarsi with light rings at each joint; the antennæ brown, pectinated, with 21 joints, the first two and the last joints without pectinations, the 3rd joint very short and with very short pectinations, those on the 4th longer, on the 5th-12th about equal, but on the 8th, perhaps, the longest ($=2\frac{1}{2}\times$ length of antennal joint), both branches spring from base of joint; joints scaled dorsally in two rows (basal and middle) but not very regularly; ventral aspect of joints with hairs and pectinations (without scales) covered with sparse sense-hairs, dorsally as well as ventrally, length of hairs about one-third of antennal joint. ♀. The head black, small, partly retractile within the fleshy hood of prothorax and placed ventrally; very large compound eyes, each occupying greater part of cheek; antennæ almost colourless, transparent, 14 joints (but with a tendency to fusion that leaves a doubt whether there are 13, 14 or 15 joints); prothorax, mesothorax, and metathorax well-developed, shiny and entirely corneous dorsally; the abdominal segments very wide (front to back); the legs dark, tarsi paler (almost colourless and transparent), 4-jointed, each with two pale terminal claws. The ground colour of the body yellowish-brown tinged with vinous (becoming entirely vinous when dead); each of the segments appears to be divided into two subsegments (really the segment and intersegmental membrane); on the anterior part of the segment is a large, dull, brownish-black, rough, corneous, quadrangular dorsal plate, ventrally a smaller nerve patch may be observed; the intersegmental membrane of the ground colour; there are no scales as in *Luffia* and *Bacotia*, and although there are scattered hairs the general surface is practically naked. On the underside of the 7th abdominal is a thick protruding tuft of pure snowy-white silky hairs, beyond which is the exceedingly long (when protruded) ovipositor, the joints of which are about equal to the length of the body when both are fully stretched; the front edge of each of the abdominal segments has a raised brownish rim, the dark quadrangular plate occupies about four-fifths of the dorsum of each segment; the tubercles i and ii appear to be represented by conspicuous, brownish, circular areas. The venter of the thoracic segments is also black, shiny, and corneous the front edge of the dorsum of these segments being noticeably rough and darker, and suggesting an analogy with the dorsal quadrangular abdominal areas. [Described from ♀s sent by Whittle July 10th, 1899.] Speyer describes the female as dirty yellow tinged with red, and with glossy snow-white anal tuft. Bacot notes that the female has small, shiny, semitransparent sacs on the meso- and metathoracic segments which represent the wings. These Chapman says are small triangular pale lappets (not narrow ribbons as in *Luffia*). Bacot also notices the scattered whitish hairs or hair-like scales on the lateral area, and says that the anal tuft is of a glistening snow-white colour. It may be here noted that the female carries the pupal head-piece on the imaginal head as in *Epichnopteryx pulla*.

Comparison of Proutia betulina and Bacotia sepium.—The males of *B. sepium* and *P. betulina* show much superficial resemblance. There is, in both, a dark shade at the end of the discoidal cell, and the nervures beyond the cell are somewhat darker. Newly-emerged specimens of *B. sepium* have some slight suggestions of the reticulations common in the Taleporiids, but these never seem to occur in *P. betulina*. The best distinction between the two insects is in the neuration *B. sepium* having an accessory cell in the apex of the discoidal cell, whilst *P. betulina* is without it, but the latter possesses the "cellula intrusa," which is not represented in *B. sepium*. The accessory cell of *B. sepium* marks its connection with the Micro-Psychids, all of which possess this structure, whilst the Macro-Psychids never have it. (This cell is sometimes absent in *B. sepium*, the variation being, no doubt, related to the transitional position of the species.) In the antennæ *B. sepium* has 26 joints, *P. betulina* 21 joints, whilst the anterior tibial spur of *B. sepium* is half the length of the tibia, and in *P. betulina* it is three-fourths its length, the latter marking a transitional stage between the short-spurred Micro- and the long-spurred Macro-Psychids. The antennal pectinations in *B. sepium* are short, square-set, and rigidly maintain their positions in the dried specimens, whilst those of *P. betulina* are long and flowing, and twist considerably in drying.

Structural difference in females of Bacotia (sepium) and Proutia (betulina).—Some confusion appears to have occurred between *Bacotia* and *Proutia*. Chapman notes, in comparing *Bacotia sepium* ♀ with that of *Proutia betulina* ♀ —

♀ *B. sepium* has the four joints of the tarsi of the following relative lengths: 1st leg—4, 1, 1, 2. 3rd leg—3, 1, 1, 2.

♀ *P. betulina* has the four tarsal joints of all the legs of the same relative length—2, 1, 1, 2.

The female of *P. betulina* has a pure snow-white anal tuft, and except for a few similar scattered hairs on the surface of the body, is otherwise naked. *B. sepium* is somewhat thickly clothed with ordinary scales and the anal tuft is pale brownish.

Comparison of Proutia betulina, P. salicolella and Fumea casta (nitidella).—Zeller, in describing *P. betulina*, noted that the male was so like *F. nitidella* that he had not been able to distinguish them, but that the female was distinguished by the almost snow-white anal tuft, which was grey in *F. nitidella*. Bruand, who is supposed by almost all our leading lepidopterists to have renamed the insect *anicanella*, on the strength of this character, notes that the male is darker than that of *F. roboricolella* (which is described as "nigro-brunneus"), and the wings a little more elongated, and insisted on the character presented by the snowy-white anal tuft of the female. We have already noted (*ante*, pp. 281-2) that Bruand's *salicolella* is probably this species (so far as it is a *Proutia* at all, and excluding such parts of his description as obviously refer to *B. sepium*), also that the ♀ of Bruand's *roboricolella* (*Mon. des Psych.*, p. 99) and the male neuration (Ibid., pl. iii., figs. 72 and ? 72) apparently belong to this species. Chapman suggests that Bruand's *anicanella* is possibly the smaller *Proutia*, the *salicolella* of various authors, and the description suggesting both smaller and more rounded wings than *salicolella*, Brd., leaves one with the impression that this may just possibly, indeed, be so. Mitford, who clearly writes as if he knew both *P. betulina* and *P. salicolella*, stated (*Ent. Mo. Mag.*, vi., pp. 94, 186) that Bruand's name of *anicanella* was very suitable for this species (*betulina*), as the ♀ has the anal tuft of a snowy whiteness, whilst in the ♀ of *P. salicolella* this part is not so white, particularly beneath, but it has a white bloom on the sides. He also differentiates the males, stating that the forewings of *salicolella* are more elongated, whilst those of *betulina* (*anicanella*), on the contrary, rather resemble specimens of *F. intermediella* and *F. roboricolella*." This differentiation of the males suggests that his *salicolella* might be, after all, *B. sepium*, for, in stating that the wings of *salicolella* are "more elongated than those of *betulina*," he is in error, since the specimens we have examined show *salicolella* (*i.e.*, *eppingella*) to have shorter and rounder wings than *betulina*.* Our criticism (*Ent. Record*, xi., p. 211), therefore, wants modifying in this particular. We suspect that Barrett's ♀ *F. betulina* (*Ent. Mo. Mag.*, xxxi., p. 275) "thinly covered with dark grey scales," is, after all, also *B. sepium*, as the ♀s of the Proutias are particularly naked, and carry only a few whitish hairs.†

Comparison of P. betulina and P. rouasti.—*Fumea rouasti*, m. ♂. Antennis composito-pinnatis, fuliginosis; alis griseis densis squammatis, oblongis; ciliis albidis subnitidis. Alæ anteriores costis xi, cellula media cellula intrusa; alæ posteriores costis vii. Thorace abdomineque nigris griseo-villosis. Pedibus canis; tibiis posterioribus latis, compressis. Expansio alarum 12-14mm. Habitat: Ala Tau (Turkestania Rossica) (Heylaerts, *Ann. Soc. Ent. Belg.*, xxii., p. cxl (1879)]. A further description of this species (with figures) is given by Heylaerts (*Rom. Mémoires*, ii., p. 190), based on three specimens taken June 5th, 1877, by Haberhauer. In it he states that *F. rouasti* has the same shaped wings as *sepium*, but is very different from it in neuration, which resembles that of *betulina*. The head is black, covered with grey-brown scales, very short, the pseudopalpes having a similar colour. The antennæ, half the costal length, have the shaft grey, the pectinations darker and shorter than those of *betulina*. The black thorax and abdomen are covered with grey scales . . . . . The anterior tibiæ have a very long spine; the posterior are very long, wide, compressed and whitish, and have two pairs of strong spurs. The anterior wings are elongated and narrow, the apex a little more rounded than that of *sepium* . . . . . The scales are narrow and shorter than those of its congeners; the colour very clear fuliginous-grey. The neuration is like that of *betulina*, but the discoidal cellule differs in shape, being narrower and more elongated, and the cellula intrusa is very long. The fringe is shiny, yellowish-white, longer than those of the known species.

Ovum.—About ·75mm. in length, ·45mm. in width, oval in outline (a longer oval than that presented by the egg of *L. lapidella*), almost circular in cross section, pale yellow in colour, the surface smooth and shiny, no structure apparent. (Bacot. Described July 9th, 1899, from unfertilised eggs laid by ♀ bred from Chingford larva.)

Case.—The case is about 8mm. in length, and 3mm. wide, roughly and bluntly conical (diminishing slightly behind, so that the posterior end appears somewhat thinner), the larval head being protruded from the wider end. The case is composed of silk, covered with lichen, chips

* With regard to the doubt that we here throw on Mitford's *salicolella*, it must be confessed that there is little direct evidence. Chapman notes a case in the Stephensian collection labelled *salicolella* (from Mitford), and probably correct. There can be no question that the *anicanella* in the same collection ♂, ♀, and cases are really *P. betulina*. It is difficult to understand the statement of Mitford (*Zool.*, p. 7453) that "the females of *salicolella* remain within the larval case." Chapman notes among certain Proutias (*betulina*) from Dr. Mason (all labelled Mitford), a male with *sepium*-shaped wings, white hind tibiæ, &c., together with a ♀ *betulina*, and large ♂ and ♀ cases of *betulina*. A second Mitfordian ♀ is referable to *casta* (*nitidella*).

† Since this has been in type Chapman has examined the New Forest examples and refers them to *B. sepium*.

of bark and minute pieces of vegetable *débris* (apparently rarely grass) placed irregularly, the particles really small (but large compared with those used by the larva of *Luffia lapidella*) and there is silk spun over the outside. The case has a particularly blackish appearance (Described May 27th, 1899, from cases found on tree-trunks by Whittle, at Eastwood). Chapman describes a case as 9·4mm. in extreme length, covered with black dead vegetable matter—dried scraps of bark, oak-leaves, &c.—with some loose spinning outside it, and some coloration due to green lichen. Another has pieces of dried grass, scraps of oak-bracts, &c. (Described June 18th, 1899, from cases taken by Prout at Chingford). Zeller notices the case as tapering conically behind, and, instead of being covered with grass stems (as that of *F. nitidella*), it is covered with rounded particles of white birch-bark, and other leaf-like substances. He adds that "one might suspect that the larvæ used these materials because grass-stems were not available," but that "when provided with grass they did not use it, and when there was insufficient birch-bark they stole the material from other cases." [Bruand says that the case resembles that of *P. salicolella*, *i.e.*, it is covered with particles of wood and little pieces of bark."] Herrich-Schäffer's figures (*Neue Schmett.*, figs. 11-12) of this case show it as larger, more slender, and with more material fastened outside than that of *B. sepium*. The male pupa-case is figured as having emerged to about the 6th abdominal segment. Mitford describes the cases as having "the materials placed crosswise, and with no lengthy pieces of grass or straw used in their formation." Two of Mitford's cases (in Dr. Mason's collection) are large, with materials standing well off the case. The male case is 6·25mm. long, very dark, and among other things has a very definite piece of brown leaf fastened to it, also at the attached end the exuviated larval skin, but this apparently results from tearing the case in removing it from its attachments. The female case is 10mm. long, brown, with scraps of dead leaf, and wide from the projection of many of the scraps. Chapman states that a *male* case from Eastwood has the larval skin wedged tightly into the spinning that has resulted from the removal of the case from its attachment. He also notes that the cases in Constant's collection appear to have a few bits of grass on them. The smallest of several cases, obtained November 1899, measured 2mm. in length, and was covered with very minute fragments; one, about 4mm. long, has two relatively large flat pieces of bark laid flatly against it on one side, and a large piece (3mm. long) on the other, with smaller portions; a larger case (5mm. long) has various pieces of dark brownish bark, and one piece looks like the pale brown scale of a leafbud. The larvæ in these cases do not carry themselves at all erect, except at times when gravity assists, usually dragging the cases along fairly flatly.

Comparison of cases of Proutia betulina, Luffia lapidella, and Bacotia sepium.—Small cases of *P. betulina*, 2mm. long (obtained at Eastwood, in November, 1899), show definite Luffiid affinities. These are carried in a very upright manner, not so absolutely so, as *B. sepium* larva carries its case, but very nearly as much so as *Luffia lapidella*. It further resembles the case of *L. lapidella* in having a very slight but recognisable curvature, one side being straight (the lower one as the case is carried), the other, or forward one, being curved. The materials with which it is clothed are also very fine, there being only one tiny scrap of coarser material. These Luffiid characters are also more or less noticeable in the higher Macro-Psychids, the young larvæ of which carry their cases perpendicularly to the surface on which they travel. The young case of *P. betulina* differs from that of *L. lapidella*, of similar size, in being very slender and very slightly (if at all) wider at one end than the other (Chapman). Compared with the cases of *P. betulina*, those of *B. sepium* are short, wide, slightly protuberant beyond the middle, ending in a blunt rounded apex, they are carried vertically and are fixed so for pupation ; the cases of *P. betulina* taper definitely towards the apex, are more slender and spindle-shaped, carried at an angle to the surface, not vertically, unless its weight allows it to hang vertically downwards. The case of *B. sepium* is covered with pieces of lichen, whilst that of *P. betulina* is clothed with bits of bark, rotten wood, brown dead leaves, and looks very black and dirty owing to the material used.

Larva.—The head black, with one pale line on each side of centre, outside the clypeus ; the 1st joint of the labrum and the bases of antennæ pale ; the prothorax dark (nearly black), with central and two lateral (or subdorsal) pale bands, the dorsal wider behind, very narrow in front, the lateral irregular and interrupted in the middle by a dot ; these pale and dark bands run down the meso- and metathorax on the intervals as well as on the plates ; on these is a third pale band at margin of plates, above lateral plate ; the second dark band forms a large, square, blackish patch on the plates at their lower portion, omitting (in full darkness) the anterior margins of plate ; the markings are paler on the meso- than on the prothorax, and on the meta- than mesothorax. The abdominal segments are dark reddish, or reddish-chocolate, very decidedly bisegmented, having pale (not punctated) spots in row in division between subsegments and in groove above flange ; there is a very conspicuous dot where these two grooves meet. They occur also along the anterior margin of segment, and in the grooves of flange and beneath (apparently the same pattern as in larva of *F. casta*). The general aspect of the true legs very dark, but the joints paler brownish. The longitudinal flange is made up of three elements, the central one being straight, narrow and high, the others squarer and flatter. The anterior trapezoidal tubercles (i) outside the posterior (ii), and with shorter hairs ; iii on upper ridge of flange carries a strong hair (Chapman. June 12th, 1899, from larva taken by Prout at Chingford). A description of a second *adult larva* reads as follows : Almost fullfed, 6mm. long. Head absolutely black (with a very narrow pale line each side of clypeus) except that the antennal bases and the base of labrum is pale or white. The prothoracic plate also is black, with a pale dorsal line, very slender at anterior margin, so as to be indistinct, and no subdorsal line (except a faint suggestion at the posterior margin). The prothoracic plate is brown rather than black, with very slender dorsal line, the subdorsal line also faint, curved, and very narrow ; the second plate below this, black, and the divisional membrane round this plate pale, the dorsal and subdorsal lines strong on the membrane between the pro- and mesothorax. The metathorax not so dark, but the pale lines still very narrow and weak ; the subdorsal somewhat diagonal ; a delicate plate in prespiracular region as on mesothorax. The membrane around prothoracic shield, in front and laterally, is conspicuously pale. The hairs on the head and front of the pro- and mesothorax, long and porrected as in the larvæ of the Fumeas. The general colour of the abdomen is dark-red or chocolate, the coloration fainter in the grooves of the lateral flanges, &c., but practically there are no pale markings. The anal plate is dark brownish. The corneous plate of the trapezoidal tubercles and the plate internal to i form, very sharply, the ridges noted as characteristic of the Fumeid larvæ. The plumpness of individual larvæ may have much effect on the prominence of these, but the larva is not so plump as those of the Fumeas, and, for this reason, the pale dots are at first invisible, but are detected easily enough when looked for. The plates for tubercles i and ii are very distinct, forming summit ridges to their respective subsegments; tubercle i is placed well in front of, but also well outside, ii; the hair on iii is porrected; the prolegs have the usual Psychid pear-shaped margin of hooks, open at the inner end (Chapman. June 12th, 1899, from larva taken by Whittle at Eastwood). The *young larva* (occupying a case 2mm. long, November, 1899) has the head quite black, the labrum, jaws, and other mouth-parts brown. The first thoracic plate is large, black, without line or division; the mesothoracic plate is about half the width of the prothoracic, brownish in colour, and with a central pale line or division, and a marginal plate below; the metathoracic plate does not appear to be continuous across the dorsum, and the darker (brownish) portion of it is quite a small patch and away from the middle line. (These characters show a definite approach to *Luffia*.) The remainder of the dorsum is pinkish-brown, with apparently the same arrangement of tubercles and light spots as in the fullgrown larva. The legs are large and strong, pale brown, much darker along the outer border. The prolegs are marked by about 16 corneous points or hooks. The nervous cord is very conspicuous ventrally, the double brownish-yellow ganglia being very large. The *halfgrown larva* (from a case 5mm. long) has a black head, the prothoracic plate black, with a very narrow white median line, not reaching the anterior border. The legs and mouth-parts are very dark but not quite black; the mesothoracic plate, paler than the prothoracic, is relatively rather wider than in the small larva, has a central pale line and a pale longitudinal shade half-way between this and its lateral border, the lower plate dark; the metathoracic plate is very pale, but appears continuous across the dorsum. The hairs on the head and thorax of all these larvæ are very long, more than half the larval diameter (Chapman. November 20th, 1899).

Comparison of larvæ of Proutia betulina and Bacotia sepium.—The larva of *B. sepium* has a black head and thoracic plates, relieved on the thorax by only a median whitish line; that of *P. betulina* has brownish subdorsal markings (approaching those of *F. casta* larva). In *B. sepium* the metathoracic plate is represented by only a small scrap on either side, in *P. betulina* it is complete across the dorsum, as in *F. casta*. The colour of the abdominal segments in *B. sepium* is sepia, in *P. betulina* it is a ruddy- or pinkish-brown. Their structure is very different; the abdominal segments in *P. betulina* are divided dorsally into two distinct ridges, carrying respectively the anterior and posterior trapezoidal (i and ii) tubercles. In *B. sepium* there is no such definite division, and the tubercles are in transverse alignment (approximately) with the anterior tubercle (i) external (Chapman).

Pupa.—*Male:* The pupa has the general Macro-Psychid characters, in that the segmental incision between abdominal segments 2-3 is movable dorsally, segments 3-7 are free, a single row of hooks to anterior margin of abdominal segments 3-8, intersegmental hooks on segments 4-7, and two ventro-anal hooks. Length about 5·5mm., width about 1·5mm.; tapers gradually from about 4th or 5th abdominal, the width of the 10th abdominal segment being about ·3mm.; the pupa is fairly straight, the only curvature being in the last three segments, which throws forward the ventro-anal hooks. The colour is yellow-brown on the thorax, but approaching fuscous on the abdominal segments, the whole pupa looking darker, heavier, and stronger than those of *Fumea crassiorella* or *F. casta* (*nitidella*). The anterior dorsal hooks are on a transverse ridge, and are not in very accurate alignment, but are still distinctly one row, except, perhaps, on the 7th segment, where two rows may be distinguished; there are about 28-30 hooks on the 5th abdominal segment; the hooks get fewer and more confined to the middle line further back, whilst the ridge on which they are situated gets higher, so that on the 7th and 8th they are about six or seven in number, but large and bold, and on a ridge that reminds one of the ventral flange of the 7th abdominal segment of *Hepialus*. The posterior (intersegmental) row of hooks is about 22 in number where best developed (on 4 and 5), and evanescent laterally; they form very definite sharp spines medially. The prolegs are very well marked, consisting of a depressed oval line with a central elevation. The spiracles are at the summit of dark brown cones, which are surrounded by a circular line, which is, however, hardly elevated. The position of the obsolete 8th abdominal spiracle is occupied by a conical projection, directed somewhat backwards, that is much larger than the other spiracles, and is no doubt an accessory anal armature. Some little way above the marks of the prolegs are similar oval depressions, smaller, and with their long axes longitudinal, and again above these is a depressed line; these no doubt represent the elements of the lateral flange. Some of the ordinary tubercles bear very distinct brown bristles, others are difficult to detect, owing to being broken off or to the particular incidence of light—probably all are present; iv and v are below the spiracle, of which the anterior is shorter and the posterior longer, vi is not clearly detected, but vii and viii are very evident; dorsally ii is distinct, but i and iii are less clearly determinable, but i is seen on the anterior segments, and iii is well marked on 6 and 7. The anal hooks are dark and terminate in a sharp point, between them is the longitudinal anal line; before this, and between and in front of the hooks, are two definite rough points; on the 8th abdominal is the genital longitudinal line, with a rounded eminence on either side; it also possesses two dorsal hairs on either side; the 9th abdominal appears to possess three tubercles on either side, but the 10th is without any. The surface dorsally is marked behind the spines by transverse ridges that might be taken for subsegments, six or seven in number, but that they are not continuous, anastomose in some cases, and narrow to points and disappear in others; the surface, examined more minutely, is seen to be dotted with fine points; the intersegmental membrane is finely marked into hexagons with the centres thickened (and raised ?). The thoracic portion is dorsally about 1.8mm. in length, smooth, finely marked by transverse rows of points; on the mesothorax are two bristles on each side, one near the middle line centrally the other forward and outside this; the metathorax has two similar pairs of bristles; those on the prothorax, if present, are not detected. The wings are attached to the 1st and 2nd abdominal segments, but beyond this apparently free, the hind margin of hindwing is visible to posterior border of abdominal segment 2. The wings extend to hind margin of 4, and further if the segments are contracted. They have a very sharp apex, between which the ends of the third pair of legs appear, and extend beyond them for a length barely exceeding their own breadth. The second pair of legs falls short of the wing apices, and the antennæ are somewhat shorter still, and the first pair of legs less extended than these, the difference in length between these successive points being about the same, the first legs extending for about two-thirds of the wing-length, whilst between them are the anterior femora; the vertex carries two short (antenna-basal) hairs, and a pair at base of labrum. The labrum is dark, square, rather narrower transversely than longitudinally, and carries the usual two pairs of hairs; the mandibles are well marked; the lower border of cheeks, mandibles, and labrum, form a fairly transverse line; the maxillæ are triangular, the apical as well as the two basal angles being sharp; the labium, separated from maxillæ for its whole length, is very narrow basally, widens greatly to end of maxilla and then terminates in a rounded end; the central incision is short, and the two sides closely opposed, so as to allow the end, as above stated, to be in one curved sweep. The dorsal head-piece is a very small strip, barely chitinised, only along the posterior edge. *Female* (described from a dehisced specimen): Of the Macro-Psychid type, with the dorsal hooks (anterior) of the 4th, 5th, 6th and 7th abdominals developed. Free segments 3-7, incision between 2-3 dorsally only; colour rather dark brown, especially dorsally; small in thoracic region. (The pupa wants the head-parts which are attached to the imago.) Length 5mm. The 4th and 5th abdominal segments are very similar to one another, they have about 30 spines or hooks towards the anterior margin of the segments; the outer ones are small and evanescent, and are not in very strict alignment; medially they are raised in a slight degree above the general surface, on a ridge, and have fine bracket-like ridges proceeding forwards from each hook, giving a longitudinally striated surface, with numerous fine points between the striæ; outwardly the striæ fail, and only the fine points occur all round the anterior margin of the segment; behind the hooks are transverse ridges (or furrows) about 22 in number, which fail laterally, the venter being quite smooth (apart from markings yet to be noted), the intersegmental membrane succeeds this and consists of a hexagonal pavement, with a denser point in the centre of each lateral plate. The spiracles are slightly dorsal of an exact lateral line, on small conical eminences; ventrally are the circles representing the prolegs. Dividing the space between the spiracle and proleg into three equal spaces are two hollows, not altogether unlike the prolegs in appearance, the more dorsal being at the posterior margin of the segment, the other situated medially. The hairs are as in larva—i towards middle of segment, ii at posterior border of segment half-way between i and dorsal line, iii some little way exactly above spiracle, iv and v close together, at same horizon, the posterior with stronger hairs, vi immediately above lower lateral hollow; three hairs in an oblique row above prolegs and one below prolegs. The 7th abdominal segment has i-vi and ventral pair of hairs the same as on the 4th and 5th segments; the 8th has four or five hairs on either side, the 9th has four on either side, and the 10th has one dorsal hair on either side; the 8th and 10th have very definite longitudinal ventral depressions. The wings and third legs extend to the posterior margin of the 2nd abdominal. The anterior wings are flaps, longer than the mesothoracic dorsum (actually 1·0mm. long), the posterior wings show a narrow strip behind them not quite half as long, the leg cases, as well as first femora cases, are all well seen, rather short and broad. The dorsal head-piece is very small. The head-piece (removed from imago) is very decidedly smaller than that of *F. casta* (*nitidella*), widest across the mouth region (instead of narrowing as in *F. casta*). It compares with *Fumea* just contrariwise to the ♂, the labrum is, if anything, broader, rather than narrower, than in the ♀ *Fumea;* the maxillæ are rounded, and not marked off completely from labium, and form with it a wide 4-lobed structure, with a transparent thinned point centrally (attachment to imago?); the aspect of this conjoined labium and maxillæ is very distinctive from *Fumea*. In dehiscence the legs, &c., are rather disarranged, but still adhere to the pupa, the first pair with its femora forms one piece, and the second and third two other portions; the 1st and 2nd thoracic segments split dorsally, and open widely from each other, and from the 3rd thoracic (Chapman).

Comparison of pupæ of Proutia betulina and Bacotia sepium.—The male pupa of *B. sepium* has dorso-anal spikes as in the Micro-Psychids, whilst that of *P. betulina* has ventro-anal spikes as in the Macro-Psychids. The female pupæ of both species, however, have no anal spikes, and hence agree with the Macro-Psychids, thus again showing *B. sepium* to be an intermediate form.

Food-plants.—Fresh birch-catkins preferred, later ate sallow-catkins, and leaves of sallow, whitethorn and birch (Zeller), would not eat lichen but ate the bodies of dried butterflies, &c. (Speyer), lichens on moss-grown tree-trunks and walls (Rössler), *Parmelia pulverulenta* growing on a nut-tree (Gärtner), lichens on buckthorn (Mitford), hawthorn leaves (Prout), sloe leaves (Chapman).

Time of appearance.—Larvæ at Chingford on June 5th and 14th, 1899, the latter not full-fed till July 4th and 10th, the former emerged July 1st, the latter produced ichneumons (Prout); larvæ found at Eastwood, May 27th-July 2nd, 1899, males emerged July 9th, 18th, 20th (2), females on July 6th and 9th (Whittle). Larvæ in May in Nassau, imagines in June (Rössler), imagines first appear about the middle of July (Zeller), larvæ at Wildungen all pupated by beginning of June, imagines were bred from June 20th to the middle of July (Speyer), the larvæ in May in Baden, imagines in June and July (Reutti). Whittle obtained small, half-grown, and apparently full-fed larvæ all together in mid-November of 1899, so that it is quite possible that some individuals spend two years in the larval stage. [Under the name of *salicolella*, Bruand states that the larvæ are fullfed in the Doubs dept. from about May 15th-25th, the imagines emerging about the middle of June, from the 10th-26th.] Tompkins notes it under the same name as being bred (♂) on June 23rd, 1859, from Hampstead Heath cases.

HABITS AND HABITAT.—In confinement the males soon injure themselves, yet Mitford states that they "are of a much more sluggish disposition than those of *F. intermediella* and *F. roboricolella*, and appear to be more nearly allied, as the case proclaims, to *Psyche fusca* which flies most at dusk." We beg to question the latter part of this statement, for there is no doubt that *P. betulina* is distinctly a Fumeid in its early stages. Mitford further notes that males of this species would not pair with females of *F. intermediella* or *F. roboricolella*, but paired readily with those of their own species, but only towards the evening. Bacot notes that the female emerges during the day and then rests with her body curved almost into a ring with that part of her abdomen beyond the 6th segment, inserted into the case and possibly not withdrawn therefrom. The insect frequents old bushes and trees with lichen-covered branches. Mitford bred about a dozen male and female examples from larvæ discovered feeding on the green lichens on buckthorn stems at Hampstead, in 1869; Prout found larvæ when beating hawthorn at Chingford, and Whittle on old tree-trunks at Eastwood. Zeller found the original specimens on the trunks of birch-trees at Glogau. Speyer found larvæ on posts in thick hedges and also on trunks of hornbeam, whitethorn, &c., at Wildungen, whilst Rössler discovered cases on moss-grown tree-trunks and walls in Nassau. Caradja observes that the larvæ of this species (as also those of *B. sepium* and *F. nitidella*) are often found in numbers in Roumania on sugared patches on tree-trunks, the cases especially abundant on old lichen-covered poplar trunks. [Bruand notes of his *salicolella*, which we refer to this species, that it is very uncertain in its appearance. In 1842 (an exceptional year) he collected a score of cases, whilst only four or five were found during the three following years, and from these until 1853 none were seen. He suggests that the late frosts of 1846 appeared to have exterminated the species in the localities known to him. Paux notices cases of *salicolella*—which we also suspect may be *P. betulina*—as somewhat common locally in the woods of Phalempin, Carven and Verlinghem, on trunks of alder, poplar, oak, birch and beech, in April, becoming fullfed from May 15th-25th, the imagines appearing in the middle of June.]

LOCALITIES.—ESSEX: Epping Forest, Chingford (Prout), Eastwood (Whittle). MIDDLESEX: Bishops Wood, Hampstead (Mitford). NORFOLK: ? Ranworth, Horning (Barrett). SURREY: Box Hill (Machin *teste* Barrett), West Wickham (Tompkins), Mickleham (Mitford).

DISTRIBUTION.—AMURLAND (Heylaerts). AUSTRIA: Bucovina, Czernowitz (Hormuzaki), Salzburg (Speyer), Brünn (Gärtner). DENMARK: Ringedal (Hedemann). FRANCE: Aube (Jourdheuille), ? Douai (Foucart), Besançon (Bruand), Cannes and Riviera coast (Millière), ? Nord dept. (Paux). GERMANY: central and southern Germany, Brunswick (Heinemann), Lower Elbe dist. (Zimmermann), Silesia—Frankfort-on-Oder (Assmann), Waldeck, Rhoden, Arolsen, Wildungen, Bamberg, Coburg (Speyer), Glogau (Zeller), Nassau (Rössler), Zeitz-on-the-Elster (Wilde), Bremen, Schönebeck Wood (Rehberg), Saxon Lusatia, Klix (Schütze), Dresden (Steinert), Silesia (Wocke), Ratisbon (Schmid), ? Alsace (Peyerimhoff), Krefeld, Cassel, Lüneburg (Jordan), Hanover (Glitz), Ueberlingen, Freiburg, Lahr, Karlsruhe, Rhine Palatinate, (Reutti), Burgundy, Würtemberg, Stuttgard (Constant coll.), Munich (Hartmann). ITALY: Campagna, Boscolungo (Calberla). NETHERLANDS: common, only in the drier parts (Snellen). POLAND (Kamieniecki *teste* Caradja) ROUMANIA: Grumazesti (Caradja). RUSSIA: Wolmar (Lutzau), Schlock, Dorpat (Teich), Neu-Kasseritz (Sintenis), Livonia (Lienig *teste* Zeller). SWITZERLAND: Zürich (Huguenin).

Proutia eppingella*, n. sp.

Synonymy.—Species: *Eppingella*, n. sp. *Salicolella* ? Tompk., "Zool.," 1859, p. 6464; ? Mitfd., "Zool.," 1861, p. 7452; Tutt, "Ent. Record," xi., pp. 211, 238, *in part* (1899); Chapman, "Proc. Ent. Soc. London," 1899, p. xxiv (Dec. 1899). *Salicicolella*, ? Mitfd., "Ent. Mo. Mag.," vi., p. 94 (1869); p. 186 (1870). *Anicanella*, Chapman, "Ent. Mo. Mag.," xxxvi. (Feb. 1900).

Imago.—Anterior wings 11mm.-12mm., in expanse, rather elongated, somewhat oval in outline, the middle of the costa rather straight, the apex rounded; shiny brown in colour, nervures darker, ending in black dots on outer margin; large black scales scattered over wing; cilia brown, bases darker, very shiny. The posterior wings rather duller brown, the nervures darker; cilia somewhat paler, very shiny. [Described from specimen bred by Mr. Prout from larvæ taken at Theydon Bois.]

Sexual dimorphism.—*Male:* Expanse 11mm. The forewings are a little shorter and a little more rounded towards the apex than those of *P. betulina*, approaching more the form of *F. casta;* the costa is more rounded, the straight central portion being less clearly marked; the scaling is a little less dense than in either *F. casta* or *P. betulina* and not quite so shiny as in the former. In the fresher specimen the colouring is dark, but not quite so dark as in *casta* or *betulina* when fresh, and the older specimen is rather paler than equally old specimens of these species. The nervures are hardly marked at all and there is no definite reticulation. The hind legs and especially the inner aspects of the tibiæ are pale as in *P. betulina*. The hindwings are slightly paler than the forewings, and compare with those of *P. betulina* merely as looking less dense. The male has the antennæ 26- (25- or 27-) jointed (the antennæ not mounted, and counting, therefore, not quite certain), shorter than those of *P. betulina*, pectinations very close together, *i.e.*, antennal joint comparatively (with *P. betulina*) short,

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* Chapman considers that this species may possibly be the *anicanella* of Bruand, basing his opinion largely on the probability of Bruand having two species of *Proutia*, which agrees with the number of European species now known. Bruand, however, makes much of the dark colour of his *anicanella*, whilst other points relating thereto have been already discussed (*ante*, pp. 281-283). Bruand's description of *anicanella* reads as follows: *Psyche anicanella*, "Cat. du Doubs," no. 1180; *roboricolellae* var. ?. *Fumea betulina*, Zell., Speyer, *in litt.* Envergure du mâle 11-12mm. Mas: *Roboricolellae* affinis, sed obscurior. (*P. roboricolella* is described as "nigro-brunneus,") Femina: *Roboricolellae* similis, pilis analibus niveis. Involucrum: Quisquilius fragmentisque lignosis indutum. Eruca: A *roboricolellâ* non differt. J'ai rencontré assez fréquemment sur les vieilles barrières en chêne et contre des troncs de peupliers un fourreau semblable à celui de *salicolella*, c'est-à-dire recouvert de débris ligneux et de petites parcelles d'écorce. Les chenilles contenues dans ces fourreaux ressemblent à celles de *roboricolella*. Le mâle (insecte parfait) est plus foncé que chez cette dernière espèce; puis les ailes paraissent un peu plus allongées. La femelle est aussi très-voisine de celle de *roboricolella*; seulement chez elle la touffe anale est d'un blanc de neige. Est-ce encore là une espèce distincte, ou bien n'est-ce qu'une variété de *roboricolella*? Il faudrait en voir un grand nombre, étudier les nervures, peut-être l'anatomie de chaque individu. Malheuresement, pendant ces trois dernières années, des gelées tardives ont fait disparaître presque toutes les chenilles de *Psychides*, et plusieurs espèces sont devenues trés-rares, du moins dans le Doubs, entre autres celle-ci, *salicolella*, &c. Jusqu'à ce que l'individualité de l'espèce soit bien prouvée, je la considère comme une variété de *roboricolella;* je l'ai designée sous le nom de *anicanella*, qui indique le caractère le plus remarquable chez la femelle. M. Speyer, de Rhoden (Prusse) m'a communiqué tout recemment une paire de l'espèce dont il est ici question, sous le nom de *betulina*, qu'il attribue à M. Zeller. J'ai figuré sous le no. 73, *P. anicanella*, femelle (*Mon. des Psychides*, p. 100).

pectinations rather longer than two antennal joints in both, sensory hairs on all aspects, but no scales; the third joint without pectinations. Length of spurs (or spines) of first tibiæ ·68-·70 (almost the same as *betulina* which = ·70, this figure being really the percentage of tibia beyond the origin of spine, the actual length of tibia is ·021in. as against .029in. in *P. betulina.* In *B. sepium* this is ·49 and in *L. lapidella* ·46). *Female:* Antennæ with thirteen joints (? as in *P. betulina*), the tarsi with four joints, the anchylosis of four and five leaving a mark extending more than halfway across tarsus; in other respects it resembles ♀ *P. betulina.* The two specimens of these species mounted for comparison differ in this respect—that the pale spots on the dorsal abdominal plates are in *P. eppingella* on segments 3, 4, 5, 6, but in *P. betulina* are on 2, 3, 4, 5. There are some rather long loose hair-scales about the prothorax and mesothorax dorsally, and the points that stud all the plates are clearly minute spines on the thorax. The wings are minute, colourless, triangular lappets; the anal tuft white, almost exactly as in *P. betulina* (described from ♀ bred by Mr. Prout from larvæ taken an Theydon Bois).

Note on P. eppingella.—This certainly appears not to be the *salicolella* of Bruand, although it very probably is the *salicolella* of those authors (and collectors) who have obtained a second smaller *Proutia* that they have considered should be distinguished from *P. betulina.* The latter, however, seems to have been so imperfectly known by authors that it must often have been noted as *salicolella* if one may judge from the records. We have only been able to examine three ♂ specimens of *P. eppingella*, one bred by Mr. Prout, one example (locality unknown) from Dr. Mason's collection, and a third from France from Dr. Staudinger. The only ♀ of which we know is one bred also by Prout; this has a white anal tuft, almost like that of *P. betulina.*

Case.—The case is very characteristic, reminding one much of something intermediate between a case of *P. betulina* and *Fumea casta.* Like the former it is covered with bits of bark, wood, and leaves, some of which are, however, placed more or less longitudinally, odd pieces also frequently standing out at a considerable angle from the base (of a spun-up case) where such longitudinal pieces are usually attached. This makes the base of the case appear much more bulky and the presence of three or four pieces of longish material sticking out at a sharp angle from the base gives the case a peculiar appearance. The silken tube itself appears to be rather slender, tolerably uniform in width, but appearing somewhat larger at its attached end. The material with which it is covered appears to be anything but pieces of grass culms, and one ♀ case has three fine thistle prickles standing out beyond the head of the case for 4mm., in the most characteristic Fumeid manner. The cases are almost black in tint, that of the ♀ about 10mm. in length, that of the male about 7mm., and with rather more free silk at the emergence end than is usual in the cases of the Fumeas. The case is used as a puparium, the female pupa-skin being left within it, the male pupa-skin protruding from the 5th abdominal segment (Described from cases collected by Prout at Theydon Bois). [We suspect that Tompkins' case of *salicolella*, which was covered with pieces of bark, very similar to that of *P. fusca* (*hirsutella*), but only one third of its size, was that of *P. betulina.*]

Comparison of cases of Proutia betulina and P. eppingella.—The material for differentiating the cases of *P. betulina* and *P. eppingella* is scanty. Both appear to vary much both in the materials and in the closeness or looseness with which they are applied. *P. betulina* appears to clothe its case with material that is more flatly applied to the case. A case (without imago, but with ♂ pupa-case protruding) from Mr. Mitford, placed in the Stephensian collection at the British Museum as *P. salicolella*, has the materials very openly arranged, so that the case looks exceedingly like that of a miniature *C. unicolor* when that species uses bilberry leaves loosely applied. The materials appear to be bits of dead leaves, and make the case nearly as broad as long (Chapman).

PUPA.—*Male* (description made from one specimen): Smaller than *P. betulina*, shows the (generic?) character of *Proutia* (as compared with *Fumea*) of the cheeks descending only to the level of the end of labrum, maxillary apex sharp rather than rounded. It projects from case to 5th abdominal segment, which is partially exposed. Length 4·5mm.-5mm.; two basi-antennal hairs, a face hair above labrum and two, as usual, on either side of labrum; antennæ and second legs to four-fifths wing, 1st legs to three-fifths, 1st femur to one-fourth; labrum twice length of maxillæ, widening and dividing into two lobes at end; bristles i, ii, iii, iv, v, vi, vii, all distinct on abdominal segments, where their positions are exposed; second abdominal spiracles nearly, if not quite, covered by hindwing; this segment broadens anteriorly markedly; 4-8 carry anterior dorsal spines, weaker in front, but also wider (*i.e.*, more numerous), stronger, and on a higher base backwards, so that the ridge they stand on is more important than the spines themselves; the points of the posterior (intersegmental) hooks are very distinct on 4, 5, 6, 7; a subspiracular depression at anterior margin of segment and a pit lower, towards posterior part of segment, indicate the flange on 4, 5, 6, 7; proleg marks strong; anal hook well developed, the actual points being directed ventrally and even somewhat forwards. *Female* (dehisced): 4·8mm. in length, is without the head-cover (which is attached to imago). What remains is very similar to *Fumea* in the opened anterior portion; the wings adhere to their position, but the mesothorax (½) is separated from metathorax and from its fellow of the opposite side, and is curled inwards a little and sets forward at the middle line (posteriorly) from the metathorax; the prothoracic piece adheres to this posteriorly (in middle line) but is set forward anteriorly, the pro- and mesothoracic pieces thus making a zigzag forwards; the dorsal head-piece is a very minute scrap set well forwards in front of a well-developed intersegmental piece; the leg-pieces are set forward in front, their anterior border forming a nearly complete ring at front of the pupa-case; the rest of the case is cylindrical and hardly begins to taper on 7th abdominal segment, but does so rapidly on 8, 9, 10; anterior dorsal hooks on 4, 5, 6, 7; posterior on 3, 4, 5, 6, they point well forwards (when segments are stretched), and are very fine and sharp; no anal hooks; the usual hairs are present as in ♂; there are four depressions below spiracle, one at anterior and one at posterior border of segment, a third directly below spiracle, and a smaller one between all these; the first two and spiracle form nearly an equilateral triangle, the first three a similar triangle inverted; proleg scars marked; hindwing does not quite cover 1st abdominal spiracle. The curious arrangement, by which in Psychids the incision between abdominal segments 2-3 is free dorsally, and fixed ventrally, is well shown in this specimen. What looks like the posterior border of the 2nd, runs laterally into the middle of 3rd. A second glance suggests an exaggerated form of the anterior widening of 2, which obtains in ♂. This is not so, as the true line of division is in direct line below (but fixed). The actual fact is that the intersegmental membrane, 2-3, which is movable dorsally, divides here, and sends a branch into middle of 3 below spiracle, *i.e.*, a portion, ordinarily of stiff chitin on flank of segment, is here on 3 limp and of the usual intersegmental structure. The wings are attached to end of 1st abdominal, the 3rd tarsi beyond them reach posterior margin of 2. Passing forward, in middle line, we meet, at fairly equal distances, and on a level with wing-tips, the 3rd femora, 2nd legs, 1st legs, 1st femora, then would come the labial palpi which are missing (attached to imago). Longitudinal impressed lines on venter of 8 and of 10 very strong; obsolete spiracles of 8 very prominent; hairs dorsally on 8 and 9, two on either side, none on 10. The face-piece is very like that of *P. betulina* ♀, with a wide labium, the conjoint 4-lobed maxillæ and labium (with the pale central spot), two labral and one supra-labral bristles on either side; jaws pronounced (Chapman).

Dehiscence.—The pupal dehiscence is as in *P. betulina;* the head and leg-parts separate in one piece, but remain nearly in place by inner coverings of 3rd legs, which retain their tarsal ends *in situ* between wing tips; splits down back to not quite posterior margin of mesothorax; dorsal head-piece a very definite little scrap; the prothorax extended tandem on either side in front of mesothorax.

Foodplant.—? Lichens growing on sallow and willow trunks.

Time of appearance.—Larvæ (fullfed) June 9th, 1891, in Epping Forest, near Theydon Bois, imagines bred June 28th-29th (Prout). [The male *salicolella* bred June 23rd, 1859, from Hampstead Heath cases, by Tompkins, was possibly *P. betulina.*]

Habits and Habitat.—Practically unknown. Prout found the three cases, from which the ♂ and ♀ that we have described were bred, on an old lichen-covered willow-trunk in Epping Forest near Theydon Bois. We doubt very much whether the bark-covered cases found on buckthorn on Hampstead Heath by Tompkins, and afterwards by Mitford on birch, can be referred to this species, but rather suspect they belonged to *P. betulina*.

Localities.—Essex: Epping Forest near Theydon Bois (Prout). [Possibly the following belong to *P. betulina*—Middlesex: Bishop's Wood (Baldwin *teste* Barrett), Hampstead Heath (Tompkins). Surrey: West Wickham (Tompkins), Mickleham (Mitford)].

Distribution.—Unknown. Staudinger sent Chapman a Continental example from France but without further data or more definite locality.

Subfam.: Fumeinae.

Tribe: Fumeidi.

The Fumeas proper consist only of the few species whose males have scaled pectinations to the antennæ, whose females emerge from the puparium, whilst the pupal skin is retained within it, the female laying her eggs in the latter; the male pupa partially emerging from the case and being provided with two ventro-anal spikes; the larva forming a case composed of silk with a few small pieces of grass-culms placed parallel to each other, and in the direction of the long axis of the case. Although much has been written of these insects little is known about them, and no author of repute, except Bruand, has attempted to work out the life-histories of the closely allied species, and some of his descriptions are far from satisfactory. It would appear that the known species really to be included in the subfamily are as follows: *Reticulatella*, *raiblensis*, *comitella*, *norvegica*, *saxicolella*, *subflavella*, *edwardsella*, *crassiorella*, *affinis*, *mitfordella*, *hibernicella*, *casta*, *scotica*, *germanica*, and a number of *casta*-like forms that may or may not be entitled to specific rank.

Of these there appear to be two groups separable on account of their neuration, one group following the Epichnopterygids and having a distinct "cellula intrusa," whilst the other has the median nervure running through the discoidal cell without bifurcation. These are:

(1) *Reticulatella*, *? raiblensis*, *comitella*, *norvegica* (*teste* Heylaerts).
(2) *? Saxicolella*, *subflavella*, *edwardsella*, *crassiorella*, *affinis*, *mitfordella*, *hibernicella*, *casta*, *scotica*, *germanica*.

The true Fumeids differ from their near allies, the Proutiids, by having long spurs on the anterior tibiæ, and, in this respect, agree with the higher Macro-Psychids, excluding the Epichnopterygids which have short (or no) anterior tibial spurs and also scaleless pectinations to the antennæ, the Proutiids agreeing with the Epichnopterygids in the latter character. The distinction in the antennæ is probably much older than that of the tibial spurs, since no transitional stages of the former are known, whilst, as regards the spurs, we have, on the Epichnopterygid side, the genera *Bijugis* and *Psychidea*, which are transitional, leading from the Micro-Psychids to *Epichnopteryx* (without spurs), the tendency to long spurs, however, failing on this side and not going beyond the transitional forms. On the Fumeid side leading to the Macro-Psychids, the Fumeas present transitional forms, some species with fairly short and others with long spurs. Those with short spurs are *reticulatella* and *comitella*, and it is interesting to note that both these species retain the tessellated wing-marking so common in the Micro-Psychids. The spur, broadly speaking, reaches to the end of the tibia in all cases, occasionally it distinctly projects beyond it. But we may assume that the end of the tibia is its limit, without serious error, and may express the length of the spur by the distance of its point of origin from the end of the tibia by a decimal. The range of variation in the length of the spur in the tribe, is from ·56 in *B. reticulatella* to ·88 in *F. germanica*. This affords a specific character of some value. Based on the length of their anterior tibial spurs, the Fumeids work out as follows:

(1) Short spurs (under ·64 of tibia)—*reticulatella*, *comitella*, *norvegica*.
(2) Intermediate spurs (from ·65-·71 of tibia)—*subflavella*, *edwardsella*, *crassiorella*, *affinis*, *mitfordella*, *hibernicella*.
(3) Long spurs (from ·77-·81)—*scotica*, *casta* with vars. *minor*, *intermediella*, *bowerella*; (spur ·88) *germanica*.

Another character (probably never more than specific) is afforded by the number of antennal joints. In this character, Chapman says, there appears to be some amount of variation in each species, and although one might properly separate the *crassiorella* with 21 and 24 joints respectively, as distinct species, yet one hesitates to do so when one finds examples with 22 and 23 joints, amongst specimens that it is impossible to doubt are all the same species, and the same considerations apply strongly to the forms of *casta*. The origin of this variation has been traced by Chapman, who shows that there is, in all Fumeids, a large basal joint, then a largish globular joint, before we come to the flagellar joints carrying the pectinations; occasionally (and this seems to be an individual and not a specific character) there intervenes between the 2nd joint and the normal 1st joint of the clavola (or flagellum) a very short joint without pectinations. In one instance, joints 3 and 4 (*i.e.*, joints 1 and 2 of clavola) are fused together, making a long joint with four pectinations. The last flagellar joint also is usually a simple one without pectinations, but occasionally this is very small, and at times wanting, and then the last joint is one with two short pectinations. Based on the number of antennal joints we get the following division:

(1) 20 joints or more: *Reticulatella* (22), *comitella* (20), *norvegica* (22), *crassiorella* [24 (one race), 22 (second race)], *affinis* (24), *subflavella* (24), *edwardsella* (20).
(2) Fewer than 20 joints: *Mitfordella* (17-18), *hibernicella* (19), *casta* ab. *minor* (18), *casta* (type) (18), *casta* var. *intermediella* (19-20), *bowerella* (16-17), *scotica* (19-20), *germanica* (19-20).

Chapman observes that the length of the antennal joints are fairly, and the length of the pectinations very, uniform. The great mass of specimens have pectinations between ·49mm. and ·51mm., whilst the length of the antennal joints is less uniform—four *crassiorella* vary from ·164mm.-·195mm.; *affinis*, *subflavella* and *casta* from ·200-·203 (except one of the latter ·210); *intermediella* runs from ·216-·227, *bowerella* ·240, *germanica* ·182-·194. There is too little material perhaps for generalisation, but the character may be of specific value in *bowerella*, and as a general rule it may be stated that pectinations are of uniform length throughout the genus, but that the length of antennal joints varies directly with the size of the insect and inversely as the number of joints.

The character on which most reliance has hitherto been placed in distinguishing species has been the form and size of their wings and even their colour. As we have already noticed, *reticulatella* and *comitella* are distinguishable by possessing definite wing markings, but the remaining species possess no reliable characters in this direction. Colour is certainly of no real value, all the species go brownish with age and many are of varying colour when fresh. The form of wing is certainly variable within the limits of one species, but is not so easy to define as constant between different species. In the British forms that have been divided into various species the apparent form of the wing is possibly much more dominated by various styles of setting than by any inherent character. All the species have a certain amount of natural curvature in the wings and also a certain amount of pleating or folding at nervures, and the extent to which these are straightened out by pressure and flat setting, or exaggerated by drooping, makes an immense difference in the apparent shape of the wings. There appears also to be considerable variation in size within the limits of a species. Some species, however, are distinctly larger than others, the largest being *crassiorella*. The apterous females also present certain characters, but Chapman, to whose work we are again indebted for the material in this part of our book, states that he has so far been able to differentiate only two forms associated with known species, these are—*crassiorella* and our common British *casta*. He separates that of *crassiorella* by its larger size, dark vinous colour, and especially as having the tarsal joints reduced in number to 3, 4, 4, as the typical form, and to 3, 3, 4 and 4, 4, 4 as exceptions. *F. casta* ♀ has always 5, 5, 5 as the tarsal formula, and is of a greyish instead of a vinous tint.

The larval cases are even more difficult to deal with. Chapman notes that "their variations in size depend chiefly on sex, the ♀s always having the larger cases; they depend also on the particular race, but this is not by any means the same as a particular species. They also depend on the material of which the cases are made. These materials are usually stated to be straws of grass, and they often are so, and the size of those available, makes much difference in the appearance of the cases. But the cases are often made of other material than grass, and I think that many of those that are confidently taken offhand to be of grass because of their whitish colour, are more often made of bits of dead culms of other plants. In some instances leaves of fir are used and this by both the smallest black forms and the larger pale ones. Altogether, though the differences in cases are very great, I feel unable to make anything of their characters for specific discriminations." It would certainly appear from Bruand's description of the case of *comitella*, that this species at least (possibly all the species of *Bruandia*) has a case that presents characters somewhat intermediate between those of *Proutia* and *Fumea*. He notes: "Le fourreau (of *comitella*) est composé de petites pailles placées longitudinalement, mais d'une manière moins régulière que chez *crassiorella*, et entremélées de quelques petits débris d'écorce ; il est à peu près une fois plus petit que celui de *crassiorella*."

The *Fumeinae* show distinct intermediate and transitional forms. Thus the males of *reticulatella* and *comitella* not only have short anterior tibial spurs, and wing-speckling of the Taleporiid type, but they also possess a "cellula intrusa," characteristic more particularly of the Proutiids, the Epichnopterygids, and certain other branches of the higher Psychids; *crassiorella* has anterior tibial spurs of length intermediate between those of *reticulatella* and *casta*, but this species is without the cellula intrusa except as a rare aberration (Chapman notes an example with it on one forewing only and Bruand figures one in his neuration of the insect), and has no Taleporiid wing-specklings, so that, although less markedly typical than the long-spurred species of *Fumea*, it is much nearer these than the short-spurred *Bruandia* (the generic name which we would apply to include *reticulatella* and *comitella*). We consider *crassiorella*, on account of the intermediate condition of the anterior tibial spurs and the large number of antennal joints, also worthy of generic rank, and propose for it the name *Masonia* (after Dr. Mason whose generosity in allowing his specimens for study may here be courteously acknowledged). This leaves in *Fumea, in sensu strictiore*, only those species that have long anterior tibial spurs, and it is in this strictly limited sense that we propose to use the name. We thus get in the *Fumeidi* the three genera: (1) *Bruandia*—with *reticulatella* as type. (2) *Masonia*—with *crassiorella* as type. (3) *Fumea*—with *casta* as type.

The scaling of the pectinations of the antennæ is the most important point in the classification of the Fumeids, broken only by *Proutia* at the very bottom of the Macro-Psychids; the character is, however, constant in all the *Psychidae*, and equally absent in *Epichnoptery-*

gidae. The anterior tibial spurs are equally constant in the terminal forms but less settled low down. We first find, therefore, scaled antennal pectinations in the lower Fumeids, then the gradual acquisition of long anterior tibial spurs; a tendency to develop long spurs also occurred in the Bijugids, but did not affect the Epichnopterygids. The long anterior tibial spurs of *Fumea* (as limited above) and the absence of the cellula intrusa suggest distinctly that they are on the direct line of evolution of the true *Psychidae*, the intermediate conditions of the anterior tibial spurs and the presence of the cellula intrusa placing *Masonia* and *Bruandia* nearer the Luffiids and Proutiids, and also nearer the Epichnopterygids. The presence of the pupal ventro-anal spikes show these Fumeids to be distinctly Macro-Psychid whilst the larvæ are very similar to those of *Proutia*. Although the carrying of the pupal head-parts by the female on emergence is rather a character of *Proutia* and *Epichnopteryx*, Chapman observes that he has seen several *Fumea* females with the pupal head-parts attached, so that *Fumea* has clearly not escaped this tendency, still in *Fumea* it is very unusual, and one might say pathological, as it occurs only rarely and in individuals of species that have not the habit normally, and there are usually with the head-parts some other pupal parts not symmetrical on both sides. The apterous female, even when copulation is taking place, keeps the ovipositor partly within the case, the eggs being afterwards laid within the empty pupal skin. The eggs themselves are not so fragile as those of *Luffia* or *Epichnopteryx*, and are mixed with the hairs from the anal tuft. Latitude has a great deal to do with the time of emergence of the imagines, but, in Britain, from the middle of June until the middle of July covers the general period of emergence for the imagines of most of our species.

There is no modern work from which one may obtain a brief knowledge of the Palæarctic species that are not British, and as we are quite ignorant of the number of species inhabiting our islands we propose giving a brief summary thereof. No known species of *Bruandia* occurs in Britain, unless *norvegica* [which Heylaerts states (*in litt.*) most positively has the cellula intrusa] occurs in our more northern latitudes. The following are

The Palæarctic species of the genus Bruandia.

Bruandia reticulatella, Bruand.—Original description. *Psyche reticulatella*, Mann, Mas 13mm. Alæ rotundatæ, nitentes; anticæ pallidè albo-griseæ, fasciis transversis brunneis tesselatæ, posticæ subhyalinæ. Anteriarum costa, omnium margo brunneæ; fimbria albicans, nitensque. Antennæ tenuibus plumulis pectinatæ, brunneo-cinereæ; caput concolor, necnon corpus. Femina larvaque ignotæ (Bruand, *Mon. des Psychides*, p. 88).

Bruand (who describes from one of Mann's Austrian specimens) compares it in shape and form of wings with a small *pulla*; the forewings very pale grey, with transverse brown reticulations which extend from the costa to the inner margin; there are a dozen of these transverse rays and they form a W in the middle of the wing; the costa and the margin preceding the fringe are brown, the fringe itself whitish, silky, and very shiny on all four wings. The hindwings are grey-brown, a little hyaline, almost unicolorous, with the margin preceding the fringe as in the forewings. The body and the antennæ are of a pale grey-brown, the latter ciliated with rather fine pectinations. Chapman notes as follows: "♂, 22 joints to the antennæ, the anterior tibial spur arises at ·56 the length of the tibia from its further extremity giving the length of the spur on the assumption that the extremity of the spur reaches exactly the end of tibia. Anterior wings 13mm., in expanse. The wing-texture and general appearance is much like that of *Bijugis bombycella*, more flimsy and translucent than in the true Fumeas. The costa, too, is more rounded than in the species of *Fumea*, *i.e.*, the central portion, which is usually straighter than the basal or apical portion, or even quite straight, is either very short or partakes of a continuous curve from base to apex. The colour is pale yellowish-brown, with a network of slightly darker brown (doubtless the darker portion is much more nearly black in fresh specimens). The darker markings follow the nervures longitudinally and between the nervures form transverse bands, usually not crossing the nervures, but alternating at the nervures. The paler spots are fairly circular, or, at least, of equal transverse and longitudinal dimensions. The dark marks in the discoidal cell do not cross the median nervure, but alternate at it. From the cell to the fringe are, in each intercellular space, four pale patches, and one may count thirteen dark marks along the costa and ten along the inner margin, the two or three basal ones being, in each case, ill-marked. The hindwing is marked only by slightly darker nervures. Specimens bred from Cannes, however, that agree absolutely with the specimens from which this description was made in the formula of the tibial spur, *viz.*, ·57 and ·56, in the greater transparency of the wings, and in the roundness of the costa and apex, vary in wing expanse from 9mm. to 16mm., are very dark in colour and exhibit reticulation that can only be detected with difficulty." Chapman suspects that this may be the *norvegica* of Heylaerts, if not he proposes for it the name of var. *obscurella* (*in litt.*).

Bruandia raiblensis, Mann.—Original description.—*Fumea raiblensis*, n. sp. ♂. Der *Fumea reticulatella* zunächst, aber ¼ grösser (wie eine kleine *bombycella*), etwas gestreckter und dünner beschuppt, heller grau, Vorderflügel mit rindenartigen Querriefen, diese aber feiner, weniger scharf als bei *reticulatella* und etwas dunkler aschgrau als der Flügelgrund, nicht bräunlich, Spitze vorgezogen, Hinterflügel und Unterseite einfärbig hellgrau. Die Wimpern an den Kammzähnen der Fühler scheinen mir etwas kürzer und feiner als bei *reticulatella*. Zunge, Beine wie gewöhnlich. Am 28 Juni fing ich am frühen Morgen zwei Männchen auf der Gravenlahn, im Krummholz, wo sie langsam flogen [Mann, *Verh. zool.-bot. Ges. Wien*, xx., p. 40 (1870)].

Mann's remark that it is nearest to *F. reticulatella*, but one-fourth larger, leads us to place the species here, and his note that it "is somewhat more elongated and thinner scaled, paler grey, the transverse reticulations considerably smaller than in *reticulatella*, and always of a darker ash-grey than the ground colour, not brownish," suggests that it may have been a somewhat larger form than usual of the latter species. Chapman notes that his Riviera specimens of *reticulatella* show that the species varies much in size and tint.

Bruandia comitella, Bruand.—Original description.—*Psyche comitella*. Mas: *Crassiorellâ* minor: alæ paululò minus elongatæ; colore similes, sed strigis parte extremâ tesselatæ. Femina: *Crassiorellâ* affinis, at dilucidior; pili autem lanuginosi partis analis obscuriores. Involucrum: *Crassiorellae* similis, sed paleis gracilioribus neenon rarioribus. Eruca: *Crassiorella* pallidior, lineis autem nigris; capitis praesertim lineamentis differt. Envergure du mâle 15mm. The *male* is blackish-grey, a little less dark than *M. crassiorella*, the ground colour of the wings reticulated as in *T. tubulosa* (but less distinctly). This reticulation of the upper wings makes it impossible to confound *comitella* with its allies. The wings a little less rounded and proportionately more elongated than *crassiorella*, the antennæ feebly pectinated as in *salicolella*, &c. The *female* is very similar to that of *crassiorella*, but it is a little smaller, a little less hairy and of a less vinous tint (some examples of *comitella*, however, also have this tint, but it is then uniform, whilst in *crassiorella* it exists more particularly on the sides and in the incisions). The legs of *crassiorella* are blacker than those of *comitella*, the dorsal shields are also darker in the former than the latter; lastly the silky anal tuft is paler in *crassiorella* (Bruand, *Mon. des Psychides*, p. 96).

This species much resembles *B. reticulatella*. It has a more solid aspect than that species, the reticulations are more confined to the apical portion of the wings, the costa is rather straighter, and the usual tint is much darker. It is generally possible to distinguish several rows of pale spots parallel with the hind margin and a darker shade occupying the distal margin of the cell. The most certain characters by which to recognise it are the tibial spur length of ·61-·62, and the 20-jointed antennæ (Chapman). *Food-plant:* Bruand says that the larvæ live on the lichens of old dwarf sallows, that they are to be found at the same time as *P. salicolella*, sometimes even on the same tree. *Case:* The case is composed of short straws, placed longitudinally, but less regularly than in *crassiorella* and mixed with small pieces of bark. *Larva:* The larva is dirty-yellow, or pale brown, not vinous, with three lateral streaks, very marked on the anterior segments, and almost obliterated on the 4th (1st abdominal). These streaks are black on the 1st segment, blackish-brown on the 2nd, and quite feeble on the 3rd. For the rest, even on the 1st segment the two upper streaks alone are well marked, the lower is much less intense and sometimes broken on the 1st segment. Between the first and second streaks, is a little round point, black on the two anterior segments, less marked on those following. The head corneous, shining, of the same colour as the body, with three longitudinal lines on each cheek; the upper of these lines is very slender and descends almost to the mandibles, the two lower are shorter, more pointed at the extremity, and thicker at the base (against the edge of the first segment). Between the two cheeks two other rather finer lines run from the summit of the head (where they unite into a rather sharp point) down to the mandibles, thus forming an elongated triangle. *Comparison with larva of M. crassiorella:* This larva differs from that of *crassiorella* in its ground colour and streaks being less vinous, by the absence of one of the intermediate points, by a greater development of the longitudinal streaks, and by the markings on the head. *Pupa:* Yellow-brown with a blunt anal end. *Time of appearance:* The eggs hatch in June, the larvæ hybernate small, in the deep crannies and among the moss on the willow stems. They are full-grown from May 15th-20th, pupate at end of month, the imago emerging from June 10th to 20th. *France:* Besançon (Bruand).

Bruandia norvegica, Schöyen.—Synonymy. *Norvegica*, Schöyen, "Nyt Mag. f. Naturv.," 1880, p. 303; Heyl., "Ann. Soc. Ent. Belg." xxv., p. 73 (1881); "C.-R. Soc. Ent. Belg.," xxvi., p. cxl (1882); "Rom. Mém.," ii., p. 7 (1885); Lampa, "Ent. Tids.," 1885, p. 39. *Nitidella*, Schneid., "Enum. Ins. Norv.," iii., p. 36 (1876). Original description. *Fumea norvegica.* Mas: *F. crassiorellae*, Brd., similis; non brunneo- sed griseo-fuscus, fere murinus; alis anterioribus elongatis, angulo externo rotundato, posterioribus latioribus, rotundatis, squamulis teneribus griseis obtectis. Capite parvo, omnino dense laete griseo-hirto; pseudopalpis brevibus griseis; antennis griseis ad apicem bipectinatis, 20-articulatis, ciliis longioribus; thorace abdomineque dense griseo-hirto; abdominis ultimo segmento pilis longissimis obtecto. Pedibus flavo-griseis, tibiis anterioribus spina magna adhærente. Alarum fimbriis flavo-albidis, nitidis, ad basin obscurioribus. Alis anterioribus costis 11, cellulæ discoidalis cellula magna intrusa*. Exp. al. 16mm.-20mm. Femina.—Etiam *F. crassiorellae*, Brd., ♀ similis, omnino tamen flavo-grisea; capite parvo, brunneo-griseo nitido; oculis magnis compositis; antennis flavo-albidis, fere hyalinis. Segmentis 3 primis supra flavo-brunneis nitidis; segmentis abdominalibus supra macula quadrangulari brunnea, nec nigra; ultimo segmento pilis longissimis, albidis nitidisque obtecto; oviducto articulato. Pedibus flavis fere hyalinis. Larva.—*F. crassiorellae*, Brd., larvæ similis; capite tamen nigro strigis luridis; thoracis segmentis strigis latioribus nigris; abdominis segmentis magis ferrugineis. Involucrum.—Breve, cylindricum, paleis longitrorsum obtectum. Habitat.—Norvegia (et ? Suecia) montana; Gallia meridionalis (Alpes-Maritimes) (Heylaerts, "*Comptes Rend. Soc. Ent. Belg.*," xxvi., p. cxl).

Although *B. norvegica* was first made known (by publication) by Schöyen, he evidently used a name that had been previously given (in MS.) by Heylaerts. Schöyen notes (*Nyt. Mag. Nat.*, 1880, p. 303) that "both the examples referred to by Schneider in *Enum. Ins. Norv.*, iii., p. 36, under the name of *F. nitidella*, Hb. (*intermediella*, Brd.), and several others from the University collection found at Christiania, by Professor Esmark, have been determined by Dr. Heylaerts as belonging to this species (*crassiorella*) which, as far as is known, has been previously recorded only from southern and central Europe. One of the examples 'cum cellula intrusa' is named var. *norvegica* by Dr. Heylaerts, who considered that it might prove to be a distinct species." Heylaerts himself, although including it in his 1881 list as a distinct species, did not describe the insect till 1882 and then states that he did so from "two examples from a little collection in the Christiania Museum and another from Staudinger, all three having been captured in Norway." He further notes that "in July 1880, some cases, with larvæ, were received from Millière, that had been taken at St. Martin Lantosque; from these, between July 20th and August 10th, a ♂ and ♀ emerged," and Heylaerts expresses his surprise at finding that they "belonged to a species hitherto considered as exclusively Norwegian." He later recorded two typical examples from Ordoubad in Transcaucasia.

Genus: Masonia, Tutt.

Synonymy.—Genus: *Masonia*, Tutt, "Ent. Rec.," xii., p. 20 (1900). *Psyche*, Bruand, "Mém. Soc. Doubs," iii., livr. 5-6, p. 29 (1850); "Mon. des Psych.," p. 92 (1853). *Fumea*, Reutti, "Lep. Bad.," 1st ed., p. 174 (1853); 2nd ed., p. 306 (1898); Speyer, "Geog. Verb. Schmett.," p. 459 (1858); Nick., "Lotos," xi., p. 155 (1861); Wilde, "Pflanz. Raup. Deutsch.," ii., p. 78 (1861); Bond, "Ent. Mo. Mag.," iv., p. 113 (1867); Knaggs, Ibid., p. 133 (1867); "Ent. Ann.," 1868, p. 105 (1867); Mitford, "Ent. Mo. Mag.," vi., p. 94 (1869); Sta., "Ent. Ann.," 1871, p. 108 (1870); Staud. and Wocke, "Cat.," 2nd ed., p. 65 (1871); Cuní y Mart., "Lep. Barc.," p. 63 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 105 (1875); "Ann. Soc. Ent. Belg.," xx., p. 63 (1877); Tur., "Bull. Soc. Ent. It.," xi., p. 171 (1879); Mart. y Peña, "Cat. Ins.

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* As there was some doubt whether our *scotica* might possibly be the same as Heylaerts' *norvegica*, although it has no cellula intrusa, Dr. Chapman wrote to him, and Heylaerts in reply said: "*Norvegica* is a distinct species, and it has always, in France and Norway, the cellula intrusa. . . . the latter is by no means characteristic of the *crassiorella* group, for the last named species does not possess it nor do *intermediella* and *nitidella*" (*in litt.*, Dec. 18th, 1899). Schöyen notes the example in the Christiania Museum that Dr. Heylaerts examined as "an old one captured June 24th, 1879, possessing the cellula intrusa, and apparently with 20 joints to antennæ (but the number is doubtful); the tibial spine difficult to measure but looks to be about one-half the length of the tibia" (*in litt.*, January 12th, 1900). Heylaerts further notes that *norvegica* "is a very rare species with rather elongated forewings. The original description was made from Norwegian and French examples together, but both are identical" (*in litt.*, January 16th, 1900).

Catal.," p. 115 (1879); Peyer., "Cat. Lép. Als.," ed. 2, p. 59 (1880); Heyl., "Ann. Soc. Ent. Belg.," xxv., pp. 72-3 (1881); Rössl., "J.-B. Ver. Nat. Nass.," xxxiii-xxxiv., p. 227 (1881); Frey, "Mitt. Sch. Ent. Ges.," vii., p. 18 (1884); Schmid, "C.-B. Nat. Ver. Regens.," xxxix., p. 85 (Sep. p. 36)(1885); ? Lampa, "Ent Tids.," 1885, p. 39; Teich, "Arb. Nat. Ver. Riga," N.F. vi., p. 20 (1889); Kirby, "Cat. Lep. Het.," p. 523 (1892); Zap. and Korb, "Ann. Soc. Esp.," xxi., p. 113 (1892); Paux, "Rev. Biol. Nord," v., p. 322 (1893); Carad., "Iris," vi., p. 201 (1893); viii., p. 88 (1895); Barr., "Ent. Mo. Mag.," xxx., p. 265 (1894); "Lep. Brit.," ii., p. 354 (1895); Meyr., "Handbook, &c.," p. 773 (1895); Lutz., "K.-B. Riga," xxxix., no. 50-51 (1896); Tutt, "Ent. Rec.," xi., p. 237 (1899); Chapman, "Proc. Ent. Soc. Lond.," 1899, p. xxv (1900).

The genus *Masonia* is first noticed *Ent. Record*, xii., p. 20, where one reads as follows:

Genus: *Masonia*, n. gen., with type *crassiorella*. The anterior wings without reticulations, the median nervure not forming a cellula intrusa; the anterior tibial spine intermediate, ·66-·72 the length of the tibia; the antennal joints usually 20 or more.

The genus *Masonia* may be diagnosed as follows:

Ovum.—Oval (somewhat variable in shape), straw-colour, no surface sculpture, covered outside with woolly fibres.

Case.—As in *Fumea* (but composed of coarser materials).

Larva.—As in *Fumea*.

Pupa.—♂. Of ordinary Fumeid type with ventro-anal spikes. Compared with pupa of *F. casta*, the cheeks project downwards (backwards) and reach (especially laterally) far below labrum; maxillæ proportionally to labium larger and wider. ♀. (Compared with *F. casta*) the cheeks are shorter and more rounded; maxillæ smaller and shorter; labium wider and shorter.

Imago.—♂. Anterior wings ample; antennal joints 20 (*edwardsella*) to 24 (*crassiorella*), pectinations scaled; anterior tibial spur intermediate in length (between *Bruandia* and *Fumea*). ♀. With diminished tarsal joints 3, 4, 4 in the three legs (*crassiorella*).

Neuration.—As in *Fumea**, *i.e.*, without the cellula intrusa (present in *Bruandia*).

Compared with *Fumea* the males of this genus have shorter anterior tibial spurs and have a larger number of antennal joints. The genus

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* Bruand figures (*Mon. des Psych.*, pl. iii., fig. 68) *crassiorella* with a cellula intrusa. Heylaerts and Chapman both consider that Bruand made an error. Possibly he had a dark specimen of one of the species of *Bruandia* mixed with his series, although Chapman suggests he may have had an aberrant *crassiorella* that possessed it, since he himself had fallen into a similar error with the same species, by the examination of an aberration that had a cellula intrusa well developed in one forewing and absent in the other. At any rate typical *crassiorella* has no cellula intrusa. That Bruand was not very clear about the "*nitidella*" group would appear to be equally certain from Speyer's note (*Stett. Ent. Zeit.*, xlix., p. 204) where the latter observes that when he was writing his *Geog. Verb. Schmetterlinge*, he sent a number of his Psychids to Bruand for comparison with his species, amongst them four specimens (two ♂ and two ♀) of his *nitidella*, numbered 15-18. His answer showed that he was not clear about their determination for he wrote: "Nos. 15 et 18 me paraissent *crassiorella*, 16 et 17 *roboricolella* ou peut-être *intermediella*. Voyez *Monographie*." Speyer says, however, that "none of these examples resemble the size and light coloration of *crassiorella* as Bruand describes and figures it, and as a specimen he sent shows it really to be," and that he "could no more take them for *roboricolella* on the characters quoted above (see *ante*, p. 281, footnote). There is, therefore, only *intermediella* that it could be and with this my *nitidella* agrees well. The somewhat lighter colour of the original of *intermediella* received from Bruand can be accounted for by its age. Staudinger in his *Catalog* (1871) united these and I agree with this opinion. The pectinations of the example from Bruand, do not show, in the outer series, any perceptible apical thickening, but it is possible that, in this particular, individual variations may occur. It would be well if the noteworthy (if not striking) differences, which the male antennæ show in this group, should be tested as to their constancy in a great number of examples for each species, a work which will need that these organs be more perfect than in those specimens I have."

is practically continuous with *Fumea* but exhibits certain characters which show that its species are more or less intermediate between *Bruandia* and the former genus. The species that appear to belong here are—*crassiorella*, *affinis*, *subflavella*, *saxicolella*, *edwardsella*, and *mitfordella*. The males of these species appear not to have yet developed the long anterior tibial spurs of *Fumea*, although they have progressed beyond *Bruandia* in this direction. They have retained the greater number of antennal joints (as in the more generalised *Bruandia* and *Proutia*) but the female (of *crassiorella*) appears in the tarsal structure to be more modified than in *Fumea*. The cases are truly Fumeid, covered with slender straws arranged longitudinally, and do not present the mixed characters mentioned by Bruand as being noticeable in *B. comitella*. Of the species noted, *affinis* appears to be most closely allied to (if not a form of) *crassiorella*, *saxicolella* (noticed by Bruand as a possible var. of *comitella*) does not appear to have been recorded since Bruand's time, *subflavella*, described by Millière, might very well be synonymous with *saxicolella*, *edwardsella* is a species closely resembling *subflavella* but with fewer antennal joints (also from south-eastern France), and *mitfordella* and *hibernicella*, which are separated by Chapman, have, hitherto, been placed in British collections with *F. casta*.

Masonia crassiorella, Bruand.

Synonymy.—Species: *Crassiorella*, Brd., "Mém. Soc. Doubs," iii., livr. 5-6, p. 29 (with reference to Reaum., *Mém.*, iii., p. 149, pl. xi., fig. 8) (1850); "Mon. des Psych.," p. 92, pl. ii., figs. 68 *a-d*, *nec* pl. iii., fig. 68 (1853); Speyer, "Geog. Verb. Schmett.," i., p. 459 (1858); Staud. and Wocke, "Cat.," 1st ed., p. 28 (1861); 2nd ed., p. 65 (1871); Const., "Cat. Lép. Saone," p. 91 (1866); Bond, "Ent. Mo. Mag.," iv., p. 113 (1867); Knaggs, "Ent. Mo. Mag.," iv., p. 133 (1867); "Ent. Ann.," 1868, p. 105 (1867); Mitford, "Ent. Mo. Mag.," vi., p. 94 (1869); Cuní y Martorell, "Lep. Barc.," p. 63 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 105 (1875); Turati, "Bull. Soc. Ent. It.," xi., p. 171 (1879); Mart. y Peña, "Cat. Ins. Catal.," p. 115 (1879); Peyer., "Cat. Lép. Als.," ed. 2, p. 59 (1880); Rössl., "J.-B. Ver. Nat. Nass.," xxxiii-xxxiv., p. 227 (1881); Lampa, "Ent. Tids.," 1885, p. 39; Teich, "Arb. Nat. Ver. Riga," N.F. vi., p. 20 (1889); Zap. and Korb, "An. Soc. Esp.," xxi., p. 110 (1892); Kirby, "Cat. Lep. Het.," p. 523 (1892); Paux, "Rev. Biol. Nord," v., p. 322 (1893); Barr., "Ent. Mo. Mag.," xxx., p. 265 (1894); "Lep. Brit.," ii., p. 354 (1895); Carad., "Iris," vi., p. 201 (1893); viii., p. 88 (1895); Meyr., "Handbook," p. 773 (1895); Lutz., "K.-B. Riga," xxxix., no. 51 (1896); Tutt, "Ent. Record," xi., p. 237 (1899); Chapmn., "Proc. Ent. Soc. Lond.," 1899, p. xxv (1900).

Original description.—*Psyche crassiorella*, Bruand (*Fumea crassiorella*, Gn. ? *Nitidella*, Hübn. Réaumur, tom. iii., *Mém.* v., pl. xi., fig. 8). Envergure du mâle 16mm.-17mm. Mas: alæ oblongæ, flavo-brunneæ, nitentes; fimbria concolor, margine obscuriori. Femina: araneiformis, omnibus sequentibus major. Involucrum: paleis longitrorsùm positis indutum, magnum. Eruca: pallidè livida, strigis punctisque brunneis anticorum segmentorum parte superiori gaudens. Caput nitens, colore corneo, lineis necnon punctis brunneis (Bruand, *Essai Mon. sur la Tribu des Psychides*, p. 92).

Imago*.—Anterior wings 13mm.-17mm. in expanse; apex rounded; distinctly oblong; brown; shiny; a concolorous transverse fimbria (seen only in certain lights); the outer margin rather darker; wings

* *Crassiorella* may be defined as 13mm.-17mm. in wing expanse, with 21-24 antennal joints, anterior tibial spur ·66-·70 (of length of tibia). This range does not occur everywhere, some races being of 15mm.-16mm., with 24 antennal joints invariably, other races (*e.g.*, the English) having from 21-23 joints (Chapman).

concolorous; posterior wings and fringes of the same tint as the anterior wings.

Sexual dimorphism.—*Male:* Ample winged, and the largest of the Fumeids occurring in Britain. Its colour varies from deep brown to fuscous (and more rarely to grey-fuscous); antennal joints 21-24 (usually 24); tibial spur eleven-sixteenths of length of tibia. Bruand describes the male as being of an intense brown and very shining, the antennæ pectinated, the wings oblong in shape, appearing distinctly larger than *B. comitella* which has almost exactly the same measurements but with the wings more elongated and narrow. *Female:* Bruand describes the *female* as araneiform, entirely apterous, short, bent in a semicircle; the anterior portion slender, the head very small, corneous and shining; the body (which appears slightly silky) is of a vinous tint, with six blackish-brown rectangular chevrons occupying the dorsal area, commencing on the 1st abdominal segment; a blackish corneous shield is present on the dorsum of the three thoracic segments which are very contracted; the legs are long; the anal area is terminated very obtusely by a large tuft of downy hairs (whitish-grey above and brown below), in which the ovipositor is placed. The feet are horn-colour; the antennæ short; short and exceedingly fine silky hairs may be observed all over the body; ventrally there is a blackish spot at each incision. Our own description of a female, bred from a case found at Bournemouth, is as follows: Of a dark flesh colour ("slightly vinous," Bruand), the antennæ black on either side of thorax, the head and legs black-brown and shiny, the latter with pale terminal hooks; the pro- and mesothorax covered with a shiny, black-brown, corneous plate; the head, pro-, meso-, and metathorax smaller than the 1st abdominal which swells suddenly at about its centre, the other abdominal segments being swollen and distended; a large, transverse, corneous, dark brown shield covers the anterior half of (? the metathorax, and) the first six abdominal segments dorsally, that on the 6th being more solid, not centrally divided; those on the preceding segments divided by a longitudinal medio-dorsal line (? depression); these plates only extend on either side to the subdorsal area although the subsegments on which the plates are placed (and of which they are the dorsal parts), are sharply cut off laterally and ventrally from the subsegment following; the whole of the abdominal segments behind the 6th are much modified, a ring of dirty whitish or yellowish silky hairs surrounding the posterior edge of the 7th abdominal, the 8th-10th being modified into the ovipositor; hairs are distinctly visible on the sides of the abdominal segments (Described June 7th, 1899, from moth reared from larva sent by Mrs. Cowl). Chapman notes the ♀ as having diminished tarsal joints, usually 3, 4, 4, for the three legs, but occasionally with 3, 3, 4 and 4, 4, 4, so that there is obviously considerable variation in this direction.

M. crassiorella as a British species.—This species was first introduced as British by Bond in 1867, and confirmed by Knaggs in 1867, and Mitford in 1869. In introducing (*Ent. Mo. Mag.*, iv., p. 113) it as British, Bond writes: "The males are larger than either *F. nitidella* or *F. roboricolella*, to which group they belong. The ♀ is larger and more obese. I have had males in my cabinet for some time, but it was only by breeding the female this year that I was enabled to make out the species. There are good figures in Bruand's *Monograph*, pl. ii., fig. 68, *a* ♂, *b* ♀." In recent years it has been taken by Digby (probably in Dorsetshire), and, in May, 1899, Mrs. Cowl sent larvæ from Bournemouth, which produced females, one of which paired with a male (from a Locarno case) bred by Chapman. The latter observer notes that the Bournemouth ♀s presented the special characters of *M. crassiorella*, and that the Locarno ♂ that paired with the Bournemouth ♀ refused to look at a ♀ *F. casta*. At the time, Chapman says, he did not observe that this ♀ was *M. crassiorella*, but later examination showed it to agree with Locarno ♀s and to differ absolutely from *F. casta*. Among Mason's material (mixed with *F. intermediella*) a ♀ *M. crassiorella* was found whose tarsal formula is 3, 3, $3\frac{1}{2}$, the $\frac{1}{2}$ representing an incomplete anchylosis.

NOTE ON M. CRASSIORELLA FROM VARIOUS LOCALITIES. —*M. crassiorella* is large, certainly always larger than the average of other British forms (or species), although some large northern forms of *F. scotica* are larger than some *M. crassiorella*. Comparing *M. crassiorella* reared from Cannes and Locarno, males sent from Staudinger, and another continental source, five others (British) from Dr. Mason's collection, and a Dorsetshire example from Mr. Digby, one observes that these specimens differ in tone, the bred ones being much darker than the others (whether really or from freshness one is unable to say); there is some little difference in wing form, some appearing narrower than others, probably more due to differences of setting, damage to fringes, &c., than to actual fact. The Cannes and Locarno specimens and that from Staudinger differ most, perhaps, in superficial aspect (chiefly colour and setting) but agree absolutely in having 24 joints to the antennæ and similar tibial spurs; the other continental specimens have 22-23 joints, whilst the only two of Dr. Mason's whose antennæ are sufficiently perfect to count, have respectively 22 and 21 joints, that from Digby has also 22 joints. A male *M. affinis* from Staudinger has 24 antennal joints, a tibial spur of ·70 of length of tibia, is a little smaller than *M. crassiorella* and appears to be more densely scaled; this appears to be a local form of *M. crassiorella*, although without further material the opinion is perhaps of little value. [Other continental specimens sent as *M. affinis* have 19 joints to antennæ, anterior tibial spurs $\frac{4}{16}$ in length and belong clearly to the *casta* group]. I am not sure that I have not now two species confounded under this name. The type should be a large species, at least 16mm. in expanse, and those specimens that I regard as absolutely agreeing with this supposed type have 24 joints to the antennæ and a tibial spur formula of ·68-·70. This form I have reared from Cannes and received from Staudinger. From another German source, however, I have received specimens with 22 joints to the antennæ, and the British specimens I have seen (Mr. Digby's and those in Dr. Mason's collection) agree in this. I have also specimens bred from Locarno larvæ with only 22 antennal joints, and a wing expanse down to 12mm. All these have fairly uniform tibial spurs, varying, however, from ·64-·68 (for British examples), ·66-·69 (the typical 24-jointed form), and ·69-·72 (the Locarno form). I am unable to bring other characters into line with these variations and the number of antennal joints does not vary in accord with the tibial spur. (It is quite possible that my extreme measurements may be somewhat in error and that ·67-·70 is the correct tibial formula for *crassiorella*) (Chapman).

VARIATION.—This large Fumeid would appear to be somewhat variable, but it is not at all clear that the forms referred hereto really all belong to one species, nor is it at all certain that our British specimens (with 22 antennal joints) are identical with the large typical *M. crassiorella* (with 24 antennal joints) or *affinis* (also with 24 antennal joints). Chapman notes *affinis*, Reutti (received from Staudinger), as being "smaller than *M. crassiorella*, more densely scaled, with a tibial formula of ·70, and, except the denser scaling, unable to find anything to prevent it being considered a var. of *crassiorella*." He further considers that Hofmann's description of *affinis* in the *Berl. Zeitschrift*, 1860, p. 33, is clearly of the form close to *M. crassiorella*, and observes that Hofmann gives *nitidella* 16, and *affinis* 21, antennal joints, clearly meaning 18 and 23 (or 24 more probably) and ignoring the two hidden basal joints close to head. Teich notes that in the Baltic provinces *M. crassiorella* is the darkest *Fumea* known to him, whilst Chapman says that the Dalmatian specimens in Constant's collection under the name of *affinis* are almost black in colour.

a. var. *affinis* (? sp. dist.), Reutti, "Lep. Bad.," 1st ed., p. 174 (1853); 2nd ed., p. 306 (1898); Spey., "Geog. Verb. Schmett.," ii., p. 280 (1862); Hofm., "Berl. Ent. Zeits.," iv., p. 33 (1860); Nick., "Lotos," xi., p. 155 (1861); Wilde, "Pflanz. Raup. Deutsch.," ii., p. 78 (1861); Staud. and Wocke, "Cat.," 1st ed., p. 28 (1861); 2nd ed., p. 65 (1871); ? Tur., "Bull. Soc. Ent. It.," xi., p. 171 (1879); Frey, "Mitt. Schw. Ent. Ges.," vii., p. 18 (1884); Schmid, "C.-B. Nat. Ver. Regensb.," xxxix., p. 85 (Sep. p. 36) (1885); Teich, "Arb. Nat. Ver. Riga," N.F. vi., p. 20 (1889); Lutz., "K.-B. Riga," xxxix., no. 51 (1896).—? ♂ *. Larger, and with more pointed apex to forewings (than *intermediella*), grey in colour, not glossy; fringes shiny, of the colour of the forewings. ♀. $4\frac{3}{4}'''$ long. Head yellow, reddish spotted, hairy; antennæ wholly clear yellow, shorter than preceding (*intermediella*). Dorsal plates yellow, shiny, the first clear, the two others spotted with red, all on both sides above anteriorly with dark reddish bosses. Legs yellow, somewhat hairy. Abdomen dirty yellow, scaled, dorsal spots reddish-brown, often reddish in the incisions; the two penultimate segments strongly covered with grey scales dorsally, therefore dull; the remaining segments somewhat shining; anal tuft yellow, with silky gloss; the ovipositor yellow, shaded with reddish, joints not so distinctly visible as in preceding, the venter also bears very narrow, linear transverse spots. Sometimes the two hindmost dorsal plates are browner, and the other dorsal spots divided longitudinally. The ♀s emerged July 3rd† (Reutti).

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* Reutti himself queries the male as belonging to the ♀ he describes, but in the 2nd ed. of Reutti's *Catalogue* the species is made synonymous with *crassiorella*, Bruand.

† Hofmann gives a much better description. He notes: "The males of *affinis* are larger (6-7 lines in expanse), and the abdomen and wings brighter brown, than in *nitidella*. The forewings are more elongate, the apex more pointed, darker coloured than the hindwings which are greyer, less glossy (but with glossy fringes of the colour of the forewings), the antennæ long, consisting of 21 joints. The ♀ is $4\frac{1}{2}'''$-$4\frac{3}{4}'''$ long (excluding the ovipositor), with brownish-yellow, dark-spotted head, and large black eyes. The antennæ are bright brownish-yellow, shorter and thicker than in *nitidella*, consisting of eleven short joints and ending in a rounded tip; the legs yellowish covered with single hairs; the tarsus 5-jointed (this disagrees with *crassiorella*, J.W.T.). The first thoracic segment has a broad dorsal plate which is yellow and shining, and only on the anterior margin slightly tinged with brownish. The dorsal plates of the two following segments are narrow, marked with reddish-brown; all three being darker brown on the sides. The abdomen is dirty yellow-brown, with seven brown dorsal spots, and the same number of brown transverse stripes (divided medially) on the venter. The ovipositor tinged with brownish-yellow; anal tuft yellowish, with silky gloss. The case is distinguished from that of *F. nitidella* by its size and by being clothed with coarser and more projecting material, giving it a more bristly appearance. *Affinis* is probably widely distributed, but passes unnoticed from being confused with *nitidella*. Full-grown larvæ are to be found at Ratisbon and Erlangen at end of May and in June, on various deciduous trees, and these produce imagines in July" (*Berl. Ent. Zeitschrift*, 1860, p. 33).

Chapman, as we have observed, notes *affinis* received from Staudinger as being possibly referable to *crassiorella*. He further remarks that it "possesses (according to Hofmann) five antennal joints more than *nitidella*, therefore, 23 or 24 joints, so that the specimen from Staudinger is probably the species described by Hofmann. This has an anterior tibial spur of ·70, 24 antennal joints, and precisely the same colouring and wing form as *M. crassiorella*, but is slightly smaller (12mm.-13mm.), and appears to be more densely scaled, the basal half of the cilia of hind margin of forewing looking especially dense. The measured length of the antennal pectinations is greater than that of *M. crassiorella* which may or may not be a good character. One is not prepared to say that this specimen is only a var. of *M. crassiorella* and even less disposed to assert it to be a good species." Reutti's original description of the male as having the apex of the forewings "more pointed and acute" than *intermediella*, suggests doubt as to whether it applies to our largest and broadest-winged *Fumea*, and Hofmann's tarsal formula for the female does not agree with Chapman's for *M. crassiorella*. The distribution of *M. affinis* is probably much confused with that of *M. crassiorella*. It has been recorded from:

Austria: Bohemia (Schneider), Galicia (Klemensiewicz). Germany: Ratisbon, Erlangen (Hofmann), Freiburg, Bruchsal, Alsace (Reutti). Italy: Lombardy—Brianzi (Turati). Russia: Wolmar (Lutzau), Baltic Provinces (Teich). Switzerland: Bergün (Zeller *teste* Heylaerts).

Comparison of M. crassiorella with F. scotica.—Specimens of a *Fumea* from Scotland (received from Fletcher) look practically indistinguishable from *M. crassiorella* until their antennæ and anterior tibial spurs are examined, and they are quite as large as *M. crassiorella*; all these, however, have tibial spurs $\frac{13}{16}$ of tibia in length, and the antennal joints number 18, 19 and 20. The suspicion that these *F. scotica* might be specifically identical with *B. norvegica*, is not allowable since the latter has a large cellula intrusa, which is wanting in the former.

Comparison of M. crassiorella and M. subflavella.—*M. subflavella*, a species described and figured by Millière, is decidedly smaller than *M. crassiorella*, is of a yellowish colour (even in fresh specimens). The anterior tibial spur is a shade larger than that of *M. crassiorella*, and there are 24 joints to the antennæ. Occurring on the same ground as *M. crassiorella*, and vouched for by so close an observer as Millière, who knew *M. crassiorella* well, it seems, on the small material at hand, that it would be unwise to say that it is only a var. of *M. crassiorella* (Chapman). We cannot help expressing our own suspicion that the *saxicolella* of Bruand is (in spite of its 15mm. wing expanse) identical with Millière's species.

Egg-laying.—The eggs are laid in the same manner as those of the other Fumeids. The ♀ sits with her ovipositor extending into the larval case (containing the pupa-skin), and on the approach of a male slightly lifts the abdominal segments, pairing only lasting about five minutes. The eggs are then packed into the empty pupa-case with plenty of wool amongst them, and separate without much difficulty, the whole being covered with wool when the eggs are all laid. The ♀ then drops from the case and perishes (Chapman). Bruand writes that "the ovipositor is about 5mm. in length, composed of three (? 2, *vide*, *ante* p. 218) segments, which fit one within the other. The form of the ovipositor allows the female to deposit her eggs at the bottom of the case (which it leaves on emergence), afterwards covering them with down from the anal extremity."

Ovum.—About ·80mm. in length, and ·37mm. in width; roughly oval, but variable in shape, some being long and cylindrical, others quite ovoid. The egg is of a pale straw-colour, slightly wrinkled from dessication, but with no structural sculpture. Each egg is seen, under a microscope, to be covered as it were with wool, *i.e.*, there is a network of wool fibres over each egg, to about the extent of twenty meshes to the length of the egg, yet there is in reality so little that without a microscope it is invisible (Chapman).

Case.—Cases extend from 9mm.-12mm. in length, cylindrical in shape, surrounded somewhat regularly with straws, which are almost of the same length as the central silken cylinder, four longer straws extend 3mm. beyond the others at the posterior end and give it some appearance of squareness. The case is similar to that of *F. casta*, but larger, and made of coarser materials. The ♀ cases are frequently without the projecting straws (or they project to a less extent) and are usually broader, and hence appear stumpier than the ♂ cases. Bruand notes the case as "composed of pieces of straw or of dried grass culms, placed longitudinally and almost parallel. It is stout compared with its length and more bulky than those of *F. intermediella*, *B. comitella*, and *M. saxicolella*. This fact inclines one to the opinion that this is the species that Réaumur wished to indicate by his fig. 8. The case represented by his fig. 9 (of the same plate) resembles that I have found on rocks (more particularly on the road to Paris, at the Croix d'Arènes, near la Butte), *i.e.*, it is shorter although the straws are equally coarse." The imagines from these cases he found indistinguishable. We suspect that this difference was largely a matter of sex.

Habits of larva.—Some larvæ in our possession hatched July 11th, 1899, and immediately made themselves minute cylindrical cases of the silk in which the eggs had been enveloped, and which they carried about in a vertical position at an amazing pace for such tiny creatures so handicapped. They feed up slowly all the summer and autumn, hybernate during the worst of the winter like their congeners, and are rarely seen again in spring until they are found on the rushes, grass culms, tree-trunks, or rocks, spinning up preparatory for pupation. Bruand says that the hybernated larvæ reappear with the first fine days of spring, and may be met with at the foot of rocks facing east or south and upon old walls covered with grass and bramble. In the Doubs dept. it is generally fullfed in April (at the commencement of the month only in early seasons).

Larva.—The larva is dirty yellow, or very pale brown; approaching slightly to vinous, with two dorsal lines of an intense vinous-brown, between which may be noticed, on each of the first three segments (thoracic), two dark brown dots. Above the stigmata is an elongated spot of the same tint as the dorsal lines. These spots and lines are much more strongly marked on the pro-, than on the meso- and metathorax, whilst on the fourth they are obliterated. Its head is horny and shining, of a pale brown or vinous tint with five lines and two blackish-brown dots on each cheek, also another spot of the same colour above the mandibles; the upper line is bent in an opposite direction to the lower; they both originate against the 1st segment and run so as to unite at their extremity, whilst the second and fourth lines form a sort of cross, of which the points are turned towards the mandibles, and between them the third (central) line, a little paler than the others, is situated; the two dots are placed at the extremity of this third line, one a little above, the other a little below it. One notices the very fine grey rather long hairs on the head and anterior segments, and other much shorter ones on the rest of the body, the latter, however, only visible under a lens (Bruand). Bruand remarks that he has given a full description of the cheeks of the head, because they often offer a better means of distinguishing the species, than is sometimes to be found in the markings of the anterior segments.

Food-plant.—Grasses (Bruand).

Habits and Habitat.—The habits of this species are practically unknown, most of the examples that have fallen into our hands having been sent as cases picked up when already spun down for pupation on rushes, grass or fences. When the female emerges, she sits curled up on the end of the case in a three-quarter circle, the ovipositor thrust into the case, the head curled under ventrally and almost invisible and no amount of ordinary disturbance causes her to change her position. On the approach of a male she raises her abdominal segments slightly, and pairing occurs almost immediately, the wings of the male are dropped down roofwise and practically cover the female; the act of copulation only lasts a few minutes. The species is little known in these islands, yet probably has a very wide distribution, and is possibly common in some localities. Cuní y Martorell says that the males fly from 5.0 a.m.-7.0 a.m. in April and May, at Barcelona, &c., the larva being found abundantly in winter throughout the district, on *Plantago*, whilst in March the spun-up cases are to be seen on walls, fences, &c. Millière says that in South France it has similar habits to those of *F. intermediella* both in the larval and imaginal states. Rössler says that in the Rheinthal there occurs on rocks and walls an insect that is larger than *F. nitidella*, which emerges in June and entirely agrees with *crassiorella*, Bruand. Paux notes it as rare in Emmerin Wood, where cases can be obtained in April and May.

Time of appearance.—The imago appears in Britain throughout June and July, and cases brought from Locarno in April, 1899, disclosed their imagines in June (Chapman), Knaggs bred examples from cases found in abuudance in Hornsey Wood, in July 1867. June 7th, 1899, ♀ from case from Bournemouth. July 5th, 1899, ♀ bred from case from Deal (Bacot). Reutti notes it as occurring from May to July in Baden, Turati as appearing in May in Lombardy, and Heylaerts notes breeding a male and female on July 20th and August 10th, 1890, from cases found at S. Martin Lantosque. Two ♀ s emerged July 11th, 1899, from cases sent a few days previously by Dr. Chapman from Fusio. Caradja observes that at Slanic some cases were found empty at the beginning of July, but emergences from others continued until July 17th.

Localities.—Dorset: Purbeck (Digby), Bournemouth (Cowl). Kent: Deal (Dadd). Middlesex: Hornsey Wood (Knaggs), Bishop's Wood, Highgate (Mitford). ? York: Askham (Corbett *teste* Tutt).

Distribution.—Austria: Dalmatia (Constant), Galicia (Klemensiewicz). France: Saone-et-Loire (Constant), Haute-Garonne, Vallée du Lys (Caradja), Doubs (Bruand), Alpes-Maritimes (Millière), mts. around Cannes (Constant), Dept. Nord (Paux), Germany: Nassau, Rheinthal (Rössler), Ratisbon (Schmid), Alsace, Vosges, Niederwald (Peyerimhoff), Burgundy (Constant coll.), Munich (Hartmann). Italy: Lombardy—Brianza (Turati). Roumania: Slanic (Caradja). Russia: Wolmar (Lutzau), Baltic Provinces, Schlock, Dubbeln (Teich). Scandinavia: Norway, Christiania (Esmark), Aker, Asker (Sparre-Schneider). Spain: Teruel (Zapater and Korb), Bogatell, Saragossa, Barcelona, San Gervasio, Sarriá, San Genis, Coll (Cuní y Martorell). Switzerland: Locarno, Fusio (Chapman), Bergün (Zell. coll.).

Masonia mitfordella,* Chapman.

Original description.—These look very like ordinary *nitidella*, but have 19 joints to the antennæ, usually only present in larger forms, and, what is more distinctive and important, the length of the tibial spur approaches that of *crassiorella*, *viz.*, ·70. The female (in Clark's collection) with these specimens, is of the *casta* not the *crassiorella* type. This form may be provisionally called var. *mitfordella* [Chapman, *Proc. Ent. Soc. London*, 1899, p. xxvi (1900)].

Note on M. mitfordella.—The specimens on which this species is founded are in the collections of Mr. Clark (2) and Dr. Mason (3). All these were collected by Mr. R. Mitford, those in Mr. Clark's collection having been labelled by Mitford, "n. sp.," but without indication of where he obtained the specimens or on what ground he considered them to be new and distinct. The specimens are faded and not in the finest condition. In general aspect they are very like the small (*nitidella*) form of *F. casta* with an expanse of about 11mm. The form of the wing seems to differ a little from typical *F. casta*, the base of the inner margin being much less produced in a rounded curve, the base of the wing being consequently narrow and the costa and inner margin are less nearly parallel, but diverge at a wider angle. The antennæ are 19- or 18-jointed (specimens not mounted) and the length of the tibial spur is ·70-·71 (the lowest figure yet met with in *casta* is ·77). The wing form is so dependent on accidental circumstances of setting that it is difficult to place much reliance on it. These examples might be regarded as very small *M. crassiorella* if one could assume a range of variation in the latter species so great as to allow a race of 11mm. and at the same time allow the antennal joints to diminish to 19 or 18 (Chapman, *in litt.*, December 15th, 1899).

Masonia hibernicella†, Chapman.

Original description.—*M. hibernicella*, in coll. Fletcher, expanse 14mm., 19 antennal joints, spur length ·67, with very much the aspect of a large *F. casta*, tips more rounded than in *F. scotica*, which it otherwise a good deal resembles; the colour is a brownish mouse colour, with the nervures that reach the margin very distinctly darker lined. This is a feature observed in many *F. casta*, and seems to be due to a certain amount of depression at the nervures, resulting from folding in drying making the scales there thicker (Chapman, *in litt.*, January 21st, 1900).

Palæarctic species of Masonia not yet recognised as British.

Masonia saxicolella, Bruand.—Original description. *Psyche saxicolella*, Bruand, "Cat. du Doubs," no. 1178. ? *Comitellae* var. Envergure du mâle,

* We suspect this is the species which Mitford exhibited at the meeting of the Ent. Soc. of London, March 4th, 1861, and noted as: "*Psyche*, sp.? Apparently a very distinct species allied to *P. roboricolella*, but the wings more rounded as in *P. radiella*" (*Zoologist*, 1861, p. 7453).

† The specimens of this species are united with those of *F. scotica* in the *Proc. Ent. Soc. London*, 1899, p. xxvi.

15mm. Mas: *Comitellae* habitus necnon magnitudo. Sed color albo-cinereus, strigis nullis, margine costæque summo nigro-griseis: nervis ad extremitatem obscurioribus. Femina larvaque ignotæ (*Mon. des Psychides*, p. 98).

To this Bruand adds that, in 1848, he took, on the rocks of the citadel of Besançon, by the side of the Port-au-Bois (nord), a Psychid which on emergence gave a male that appeared to be a variety of *B. comitella*. It had the same shape but was entirely of a very pale grey, almost white, unicolorous, and very shiny, with the fringe, and particularly the top of the costa, blackish-grey. It is not reticulated, but the nervures are a little darker exteriorly. He suggests that if it represent a variety of *B. comitella*, it must be a very rare one, and that out of 50 examples he had bred of the latter species (between 1841 and 1846) all had been reticulated, nor was there one with the ground colour approaching it in pallor. The figure of Bruand (fig. 71) is, as usual with the members of this group, a very bad one.

Masonia subflavella, Millière.—Description*. *Fumea subflavella.* Les ailes de *subflavella* sont médiocrement allongées: 12mm., arrondies au bord externe, d'un fuligineux clair, et souvent roussâtre, couleur non dué à la vétusté de l'insecte puisqu'il la possède dès le jour de son éclosion. La tête est fort petite; cependant les antennes me semblent plus développées que chez les autres *Fumea*, ses voisines. Ces antennes, la tête et le corps ont la couleur blonde les quatre ailes. La ♀ ne paraît se distinguer en rien des *roboricolella* et *comitella*. Pourtant si la chenille et le ♂ de *subflavella* différent des espèces congénères précitées, il est a supposer que la ♀ s'en éloigne par certains caractères réels, mais difficiles à saisir (Millière, *Ann. Ent. Soc. Belg.*, xx., p. 63, pl. i., figs. 5-7).

Millière notes the larva as related to *roboricolella*, Brd., and *comitella*, Brd., being separated from the former by the pale yellow colour and by the black bands of the first three segments. It is distinguished from the latter by the vinous colour of segments 4-12, and by the absence of the black dots on the anterior segments. The larvæ of *subflavella* is therefore bright yellow anteriorly (thoracic segments), of a distinct vinous posteriorly (abdominal segments). The first three segments are corneous, shiny, and marked with a triple black band which is only interrupted at the incision; the anal segment also carries a very small corneous plate. The larva hybernates, fixed to a wall or tree-trunk, commences to feed again in March, and by the end of April has spun up for pupation. The case is covered with short irregular straws (figure shows it as a Fumeid case with straws somewhat expanding at end from which imago emerges). The imagines appear at the commencement of June and continue to do so for fifteen or twenty days. The ♀ comes out of its case, when copulation takes place, after which the insect lays its eggs in the case, and then falls down and dies at once. The ♂ approaches *roboricolella*, Brd., for shape, and *comitella* for colour, but it is paler "et tire sur le blond." It flies in the neighbourhood of Cannes; the cases also abundant at San-Remo; also observed at Bordighera, Menton and Monaco. Chapman says: "This species is very close to *crassiorella;* occurring, however, as it does in the same regions with the latter, its definite difference in coloration and its recognition by Millière (who must have been familiar with both forms) as a distinct species, are strong points in favour of its being really distinct. In addition to this it has a

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* Millière gives an earlier but less satisfactory description in the *Cat. Lép. des Alpes-Maritimes*, p. 305 (p. 105 in *Ann. de la Soc. Sci. Nat. Arts et Belles-lettres de Cannes*, 1875).

slightly different form of wing, being proportionally broader basally. The Riviera examples have a wing expanse of 12mm.-13mm., 24 joints to the antennæ, and the length of the tibial spur is ·70." [We strongly suspect this species, in spite of its rather smaller size, to be synonymous with Bruand's *saxicolella*.]

Masonia edwardsella, n. sp.—Anterior wings 11mm. in expanse, rather square, somewhat thickly (but loosely) scaled, pale (tending to whitish) in colour; cilia, darker, shiny; posterior wings and cilia concolorous with those of forewings; antennæ with 20 joints, anterior tibial spur ·71 of length of tibia, no cellula intrusa.

The cases from which these males were bred in June, 1898, were collected by Mr. Edwards and Dr. Chapman at Aix-les-Bains the preceding April, when the larvæ were full-fed. The cases are coarser than those of *F. casta* and are surrounded by stouter stalks, three or four of which project (more particularly in those of the males) beyond the end of the case. [A full account of the imago, larva, pupa, &c., may be found in the *Ent. Record*, vol. xii., Feb. no.]. It is just possible that this is a rather small form of *M. subflavella* the ♂ of which, however, has 24 antennal joints and an anterior tibial spur ·70 of the tibia in length. The specimens are referred to as *saxicolella, Ent. Rec.*, xi., p. 238, a species to which *edwardsella* must also be very closely allied. Chapman notes that "the specimens much resemble *subflavella* but are smaller, have only 20 joints to the antennæ, and a tibial spur length of ·71; they resemble *B. reticulatella* in the looseness of their scales, and there may be some grounds for suspecting that they are Bruand's *saxicolella*, which, however, is defined as being 15mm. in expanse, and probably also, as well as *B. reticulatella*, has the cellula intrusa which *edwardsella* is without."

Genus: Fumea, Haworth.

Synonymy.—Genus: *Fumea*, Haw., "Trans. Ent. Soc. Lond.," 1812, p. 340, *in part*; Stphs., "Ill. Brit. Ent.," ii., pp. 81-83, *in part* (1829); Wocke, "Cat. Lep. Siles.," p. 2 (1853); Reutti, "Lep. Bad.," 1st ed., p. 173 (1853); 2nd ed., p. 306 (1898); Mann, "Wien. Ent. Monats.," i., p. 147 (1857); Sta., "Man.," i., p. 167, *in part* (1857); Speyer, "Geog. Verb. Schmett.," i., pp. 311, 458 (1858); "Stett. Ent. Zeit.," xlix., p. 203 (1888); Hein., "Schmett. Deutsch.," i., p. 187 (1859); Kranz, "Schmett, Münch.," p. 35 (1860); Wilde, "Zeits. Nat. Halle," xvi., p. 306 (1860); "Pflanz. u. Raup. Deutsch.," ii., p. 77 (1861); Nick., "Lotos," xi., p. 156 (1861); Schmidt, "Schr. Ges. Königs.," iii., p. 73 (1862); Bond, "Ent. Mo. Mag.," iv., p. 113 (1867); Knaggs, "Ent. Ann.," 1868, p. 105 (1867); Staud. and Wocke, "Cat.," ed. 2, p. 65 (1871); Wocke, "Zeit. Ent. Bresl.," iii., p. 26 (1872); Meurer, "Schmett. Rudolstadt," p. 31 (1874); Cuní y Martorell, "Cat. Lép. Barc.," p. 63 (1874); Bang-Haas, "Nat. Tids.," (3), ix., p. 408 (1874); Glitz, "Jahresb. Nat. Ges. Han.," xxiv., p. 36 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 64 (1875); Fouc., "Mém. Soc. Agric. Nord," (2), xii., p. 520 (1875); Curò, "Bull. Soc. Ent. It.," viii., p. 145 (1876); Schneid., "Siebke Enum. Ins.," iii., p. 36 (1876); Sint., "Arch. Nat. Liv.," (2), vii., p. 335 (1876); Tur., "Bull. Soc. Ent. It.," xi., p. 171 (1879); Staud., "Hor. Soc. Ent. Ross.," xiv., p. 350 (1879); Sand, "Cat. Lép. Auv.," p. 32 (1879); Pfütz., "Deutsch. Ent. Zeit.," xxiii., p. 37 (1879); Rhbg., "Abh. Nat. Ver. Brem.," vi., p. 467 (1879); Peyer., "Cat. Lép. Als.," ed. 2, p. 59 (1880); Schm., "Arch. Meckl.," xxxiii., p. 64 (1880); Frey, "Lep. der Schweiz," p. 92 (1880); Heyl., "Ann. Soc. Ent. Belg.," 1881, p. 22; Röss., "J.-B. Nass. Ver. Nat.," xxxiii-iv., p. 227 (1881); Ersch. and Feild, "Trudy Ross.," xii., p. 204 (1881); Alb., "Bull. Mosc.," lvi., pt. 4, p. 381 (1881); Husz, "Magy. Karp. Evkön.," viii., pp. 251, 283 (1881); Snell., "De Vlind.," p. 443 (1882); Donck., "Ann. Soc. Ent. Belg.," xxvi., p. 27 (1882); Jourdh., "Mém. Soc. Aube," xlvii., p. 46 (1883); Schmid, "C.-B. Nat. Ver. Regens.," xxxix., p. 84 (1885); Krieghoff, "Mitt. Geog. Ges. Thür.," iii., p. 121 (1885); Lampa, "Ent. Tids.," p. 39 (1885); Váng., "Rovar. Lapok.," iii., p. 143 (1886); Jord., "Schmett. N.-W. Deutsch.," p. 94 (1886); Calb., "Iris," i., p. 154 (1887); Rühl, "Soc. Ent.," i., p. 171 (1887); v., p.

154 (1891); Zimm., "Verh. Ver. Nat. Hamb.," vi., p. 21 (1887); Petersen, "Btr. Kennt. Russ. Reiches," (3), iv., p. 86 (1883); Teich, "Arb. Nat. Ver. Riga," vi., p. 20 (1889); Pabst, "Iris," iii., p. 106 (1890); Stein., "Iris," v., p. 413 (1892); Brown, "Act. Soc. Linn. Bord.," xlv., p. 55 (1892); Kirby, "Cat. Lep. Het.," p. 523 (1892); Paux, "Rev. Biol. Nord," v., p. 322 (1893); Klem., "Ver. z.-b. Ges. Wien," xliv., p. 177 (1894); Barr., "Ent. Mo. Mag.," xxx., p. 265 (1894); "Lep. Brit.," ii., p. 353 (1895); Meyr., "Handb.," p. 773 (1895); Mab., "Bull. Soc. Aude," vi., p. 158 (1895); Carad., "Iris," viii., p. 88 (1895); ix., p. 6 (1896); Chapman, "Ent. Mo. Mag.," xxxii., p. 80 (1896); Schütze, "Iris," ix., p. 335 (1896); Lutz., "K.-B. Ver. Riga," xxxix., no. 49 (1896); Horm., "Verh. z.-b. Ges. Wien," xlvii., p. 323 (1897); Bonj., "Bull. Soc. Ouest Fr.," vii., p. 192 (1897); Tutt, "Ent. Rec.," xi., p. 237 (1899); Chapman, "Proc. Ent. Soc. Lond.," 1899, p. xxv (1900). *Phalaena*, Pall., "Nova Acta Ephem.," iii., p. 435 (1767); Retz., "Gen. et Spec. Ins.," p. 37 (1783). *Tinea*, Geoff., "Fourc. Ent. Paris," ii,, p. 335 (1785); Hb., "Eur. Schmett.," p. 15 (1796). *Bombyx*, Bkh., "Sys. Besch.," iii., p. 283 (1790); Tisch., "Enc. Taschenb.," ed. 2, p. 204 (1825). *Psyche*, Schr., "Fauna Boica," ii., 2, p. 90 (1802); Ochs., "Die Schmett.," iii., p. 169 (1810); Zink., "Germ. Mag. Ent.," i., p. 36 (1813); Zell., "Isis," 1838, p. 716; 1839, p. 283; Bdv., "Gen. Ind. Meth.," p. 79 (1840); Hering, "Stett. Ent. Zeit.," iii., p. 8 (1842); Dup., "Cat. Méth.," p. 65 (1844); Bruand, "Mém. Soc. Doubs," ii., livr. 1-2, p. 65 (1845); "Mon. des Psych.," p. 95 (1853); Speyer, "Isis," 1846, p. 34; Heydrch., "Verz.," ed. 2, p. 6 (1846); Richter, "Stett. Ent. Zeit.," x., p. 85 (1849); Seyffler, "J.-H. Ver. Nat. Württ.," v., p. 97 (1850); D'Ailly, "Tijd. Wis.-en Nat. Wet.," iii., p. 265 (1850); Hein., "Stett. Ent. Zeit.," xii., p. 63 (1851); Ver Huell, "Sepp. Ned. Ins.," vii., p. 183 (circ. 1853); Guille., "Ann. Acad. Sci. Clermont-Ferrand," xxvii., p. 125 (1854); Tomp., "Zool.," 1859, p. 6464; Now., "Enum. Lep. Hal. Or.," p. 31 (1860); Kell. and Hoffmn., "J.-H. Ver. Nat. Württ.," xvii., p. 288 (1861); Wernbg., "Btr.," i., pp. 316, 356, 372, 377; ii., pp. 130, 167 (1864); Mitf., "Ent. Mo. Mag.," vi., p. 94 (1869); p. 186 (1870); Guén., "Lép. Eure-et-Loire," p. 56 (1875); Parfitt, "Trans. Dev. Ass.," x., p. 550 (1878). *Fumaria*, "Haw. Lep. Brit.," iii., p. 373 (rect. 473), *in part* (1811). *Epichnopterix*, Hb., "Verz.," p. 400, no. 3865, *in part* (? 1818). *Canephora*, Hdrch., "Verz.," ed. 3, p. 24 (1851); Koch, "Schmett. S.-W. Deutsch.," p. 71 (1856). *Epichnopteryx*, H.-Sch., "Sys. Bearb.," v., p. 62 (1855); Bert., "Pollichia," 1859, p. 319; Kef. and Wernebg., "J.-B. Ak. Erfurt," i., p. 156 (1860); Hofm., "Berl. Ent. Zeit.," iv., p. 32 (1860); Staud. and Wocke, "Cat.," ed. 1, p. 28 (1861); Const., "Cat. Lép. Saone-et-Loire," p. 91 (1866); Röss., "J.-B. Nass. Ver. Nat.," xix-xx., p. 140 (1866); Nolck., "Lep. Fn. Est.," p. 121 (1867); Maassen, "Stett. Ent. Zeit.," xxix., p. 439 (1868); Stange, "Verz. Halle Schmett.," p. 18 (1869); Tengström, "Not. Sällsk. F. F. Fenn.," p. 330 (1869); Heyl., "Tijd. Ent.," xiii., p. 148 (1870); Knaggs, "Ent. Ann.," 1870, p. 136 (1869); Paul and Plötz, "Mitt. Nat. Ver. Neupomm.," iv., p. 68 (1872); Kretsch., "Mitt. Ver. Frankf.-a.-O.," ii., p. 27 (1884); Carad., "Iris," vi., p. 201 (1893).

The nomenclature of this genus appears exceedingly difficult to unravel. Excluding those authors who dealt with the species now under discussion as *Tinea*, *Bombyx*, or *Psyche*, the commonest species, *casta* (*nitidella*), appears to have been first included in a heterotypical genus by Haworth in 1811,* when he erected the genus *Fumaria* [*Lep. Britannica*, pt. 3, p. 373 (rect. 473)] and included in it, *muscea*, *pectinea*, *plumistrea*, *nitida*, *plumea*, all of which, with the exception of *nitida*, appear to be *pulla* in different stages of fineness or the reverse. On June 2nd, 1812, Haworth read a paper before the Ent. Soc. of London, and in a postscript notes (*Trans. Ent. Soc. London*, 1812, p. 340) that for the genus *Fumaria* in *Lepidoptera*

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* The following entry has been made in the copy of Haworth's *Lepidoptera Britannica* in the Nat. Hist. Museum, South Kensington, concerning the date of publication of this work, together with the statement that the dates were copied from the covers of the original parts: pt. 1, pp. 1-136 (1803); pt. 2, pp. 137-376 (1809); pt. 3, pp. 377-511 (1811); pt. 4, pp. 512-609 (1828). It is of course open to question whether Haworth's alteration of his earlier name should be allowed to stand.

Britannica, p. 473, the readers of that work are requested to read *Fumea*, the former name being occupied by a genus of plants. Stephens, in 1829, adopted the generic name *Fumea*, gave the same five species as Haworth, including a short account of the life-history of only one of them—*nitidella*—which he noted also in his generic diagnosis, and thus evidently restricted *Fumea* to the group of which *nitidella* is the commonest representative. In 1855, Herrich-Schäffer applied to this same group Hübner's name of *Epichnopteryx*, making the *pulla* group his *Fumea*. Speyer, on the other hand, in 1858, restricted the name to the *nitidella* group, remarking (*Geog. Verb.*, i., p. 458) that *Fumea* was "erected in 1813, by Herworth (*sic*) for *nitidella*, &c., and must, therefore, be retained for the genus which contains this species." It is quite evident that Haworth's genus was erected for *nitidella* and *pulla*, the latter under various aliases, and that there was no special restriction of the name by Haworth to the group containing the former species, and that, had it not been for Stephens' restriction in 1829, Herrich-Schäffer's action would have stood. In the first edition of Staudinger and Wocke's *Catalog* (1861) these authors follow Herrich-Schäffer, but in the second edition (1871) they changed the name of the *nitidella* group to *Fumea*, and retained that of *Epichnopteryx* for the *pulla* group. Haworth's diagnosis of *Fumaria* reads as follows:

Fumaria (The chimney-sweeper). Characteres generis: Antennæ breviusculæ, masculinæ validissimæ pectinatæ, radiis lente filiformibus, distantibus, instar costarum Halecis. Corpus breve alaeque omnes rotundatæ fumosæ; hirsutæ, sed alarum pagina saepe denudata: volata diurno, solari, humillimo.

It is quite evident that this contains a combination of characters taken from *nitidella* and *pulla* but as Haworth does not restrict it particularly to either, but on the contrary includes both, and even applies the name of "chimney-sweeper" to every one of the species included in it, we are thrown back on Stephens' action to determine the type. Haworth included in the genus the following species:

(1) *Muscea* (The transparent chimney-sweeper) = *muscella*, Fb., 1 = *bombycella*, Hb., 1, 4? (2) *Pectinea* (The light chimney-sweeper) = *pectinella*, Fb., *Ent. Syst.*, iii., 482, 235? = *pectinella*, Hb., *Tin.*, 1, 5. (3) *Plumistrea* (The chimney-sweeper's boy) = *plumistrella*, Hb., 31, 213. (4) *Nitida* (The shining chimney-sweeper) = *nitidella*, Hb., 1, 6. (5) *Plumea* (The lesser chimney-sweeper) = *plumella*, Hb., 1, 7? = *bombella*, Fb., iii., 482, 234?

Practically the whole of the references to continental species here made by Haworth are incorrect, the species to which his names are referred having long since proved to be species not found in Britain. The only reference which is undoubtedly correct is *nitida*, Haw. = *nitidella*, Hb. As we have before said we suspect all the rest of these names of Haworth to belong to *E. pulla*, but have no very definite proof thereof. They may have included, of course, some of the Fumeas recently differentiated by Chapman, but this, too, is very dubious. Stephens includes the same five species as Haworth in his genus *Fumea*. Most of the male characters are evidently taken from *E. pulla*. He gives, however, a brief life-history of only one of them, *nitidella*, and this he includes in his generic diagnosis, thus restricting the generic name to this group; his reference to the ♀ also must belong to *F. nitidella*. His diagnosis reads as follows:

Fumea, Haw.—Palpi and maxillæ wanting, their place occupied by a tuft of elongate hairs. Antennæ of the male elongate, bipectinated, the pectinations subclavate, ciliated and straight, of the female, very short, simple, the two basal joints largest; head pilose anteriorly; thorax slightly hairy and generally glossy; abdomen of the male pilose with a tuft at the apex, of the female more robust with a woolly mass at the tip; wings incumbent, of the male diaphanous, deeply ciliated, pilose, of the female wanting; legs rather stout, the posterior tibiæ very pilose with elongate spurs at the apex. Larva enclosed in a case in which it changes to pupa.

It would appear from Wood's figures (*Index Entom.*, figs. 81-85) that our suspicion as to all the names mentioned by Haworth and Stephens (except *nitidella*) referring to *pulla* is well founded. He figures these species (possibly from Stephens' specimens) and applies the same names as these authors to what appear to be different forms of *F. pulla*.

The characters of the genus may be summarised as follows:

Ovum.—Irregularly oval in outline, straw-yellow in colour, surface smooth; laid in case but separable without breaking, small quantity of silky hairs scattered among them.

Case.—Longitudinal silken tube with pieces of grass culms* fastened on it longitudinally, rather longer than case, the outer ones nearly free from case except at attached side; round the flexible mouth of case small scraps of grass stem are laid down very regularly both as to size and position, and with their longer axes longitudinally placed they look like a beautiful tessellated pavement.

Larva.—Macro-Psychid in general character, with brown or pinkish-coloured head and thoracic plates, varied with lighter markings, generally as a central and two lateral (one on either side) longitudinal bands with irregular outlines. The posterior trapezoidal tubercle, ii, much nearer middle line and larger than i, but distinctly posterior to it (they are usually on two transverse ridges crossing the dorsum of the segment).

Pupa.—♂. Pale brown, of delicate appearance; labrum, length less than breadth, falls short of lower margin of cheeks; labium wider basally; spiracles projecting, with a short cone surrounded by a high vallum; wing apex pointed, but double the width of tarsus short of end of 3rd tarsi; ventro-anal hooks shorter, paler, more ventral, and closer together than in *Proutia* (but the whole difference slight). ♀. Cheeks extend downwards below labrum, labium of equal breadth, tip little more than notched; maxilla triangular, marked off from labium; two very distinct hairs on each side of labrum.

Imago.—♂. Antennæ with long pectinations, pectinations scaled; anterior tibial spine almost four-fifths the length of tibia; anterior wings square, posterior wings ample. ♀. Almost apterous, almost naked, scales confined very much to lateral region entirely hairlike; anal tuft; tarsi with five joints to each foot.

Neuration.—Anterior wings with median simple (never with cellula intrusa); no supplementary cell at apex of discoidal cell. Posterior wings with median in line with 6.

We have already stated that Staudinger's *Fumea* (*Cat.*, p. 65) is heterogeneric, and it results that those authors who have followed him have failed to correctly separate the species that he placed under this name. He includes in his genus—*Bacotia sepium* (a Luffiid), *Bijugis pectinella* (a Bijugid), *Psychidea nudella* and *P. saphc* (Psychideids), *Proutia betulina* and *P. salicolella* (Proutiids), *Bruandia comitella*, *Masonia crassiorella*, and *M. affinis*, leaving *Fumea intermediella* and *roboricolella* (already shown, *ante*, pp. 281-283, as having no specific standing). It is quite possible, however, that even when cut down to its narrowest limits, *Fumea* contains many more species than those yet appearing in our lists, and there are possibly many undescribed species in our collections at the present time. The name *nitidella* appears to have been used by some authors in a comprehensive manner, and so as to include not only the more closely allied Fumeas but also the Masonias, &c. Owing to this and other causes we have practically no idea of the

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* Though the pieces on Fumeid cases are always called grass and often are, they seem to be very frequently dead flowering stems of other plants.

distribution (or even of the number of species) in Britain or on the continent of Europe.

What number of species have we in *Fumea?* We take it that *roboricolella* (*ante*, pp. 281-283) has no standing as a species whatever, if it has, Bruand's ♀ and figures of neuration show it to be a *Proutia* and the case, therefore, possibly would not belong to the same species. *Affinis*, as sent out by continental authorities, appears to be a combination of forms referable (1) to *crassiorella* and (2) to *germanica*, whilst we consider that *casta*, Pall. = *nitidella*, Auct. = *intermediella*, Brd. *Norvegica*, Heyl., cannot be a *Fumea* because of its cellula intrusa. Chapman notes of these Fumeas that "there is a large group of forms of a size from *M. crassiorella* downwards, that have 19 or 20 joints to the antennæ, rarely only 18, and a tibial spur of length ·77-·80, which passes without very definite demarcation into an abundant series of rather smaller insects of more uniform size, with 18 joints to the antennæ and tibial spurs of about ·77. No difference appears to be able to be detected in the females of these two groups, the tarsal formula being in all 5, 5, 5, and one cannot always be sure to which form any particular specimen belongs. If these represent two species they would probably be *intermediella* and *casta* (*nitidella*); the only reliable characters of difference would be those of size and that the former has 19 or 20 (very rarely 18) antennal joints, whilst the latter has with some constancy only 18 joints. Besides these are some somewhat doubtful examples of which var. *bowerella*, *germanica* (sent as *affinis* from the continent by Voelschow, but evidently a distinct species), and *scotica* (as large as *M. crassiorella*) are the most striking." Chapman inclines to consider the following (with perhaps the exception of *scotica*) as forms of one rather protean species, represented by various local races (which may be accepted as species by those who so incline):

Scotica, ant. tibial spurs ·78, antennæ 19-20 joints, expanse 13mm.-16mm.

Intermediella, ant. tibial spurs ·77-·81, antennæ (18) 19-20 joints, expanse 12mm.-14mm.

Casta (*nitidella*), spurs ·77, antennæ 18 joints, expanse 12mm.-13mm.

Bowerella, spurs ·77, antennæ 16 joints, expanse 11mm.-13mm.

Minor, spurs ·77, antennæ 18 joints, expanse 9mm.-10mm.

Fumea scotica, Chapman.

Original description.—A large form. . . . with a wing-expanse reaching to 15mm., but in which the tibial spur remains of a length equal to ·8 of the tibia and the antennæ have from 18 to 20 joints (Chapman, *Proc. Ent. Soc. London*, 1899, p. xxvi).

Note on F. scotica.—This is a very large form and of very robust appearance, so that it is very difficult to resist the conclusion that it is a distinct species. It agrees with *F. casta* var. *intermediella* in having 19-20 antennal joints and the anterior tibial spur ·78 the length of the tibia, but in size it rivals that of *M. crassiorella* being 13mm.-16mm., and in apparent solidity and robustness it exceeds it. This form comes from Rannoch and Sutherlandshire (Chapman, *in litt.*, December 15th, 1899).

Fumea casta, Pallas.

Synonymy.—Species: *Casta*, Pall., "Nov. Act. Ac. Caes. Nat.," iii., p. 435, pl. vii., figs 1-5 (1767); Wernbg., "Btr.," i., pp. 316, 356, 372, 377; ii., pp. 130, 167 (1864); Kirby, "Cat. Lep.," p. 523 (1892); Tutt, "Ent. Rec.," xi., p. 237 (1899); Chapm., "Ent. Rec.," xi., p. 324 (1899); "Proc. Ent. Soc. Lond.," 1899, p. xxv (1900). *Tubifex*, Retz., "Gen. et Spec. Ins.," p. 37, no. 50 (1783). *Palearis*, Geoff., "Fourc. Ent. Paris," ii., p. 335, no. 50 (with ref. to *Hist. Ins.*, ii., p. 203) (1785). *Nana*, Bork., "Eur. Schmett.," iii., p. 283, case only, ♂ =? *sepium* (1790): Tisch., "Enc. Tasch.," ed. 2, p. 204 (1825). *Nitidella*, Hb., "Samm. Eur. Schmett. Tin.," fig. 6, p. 15 (1796); "Verz.," p. 400 (1818?); Ochs., "Schmett. Eur.," iii., p. 169, *in part* (1810); Zink., "Germ. Mag. Ent.," i., p. 36 (1813); Stphs., "Ill. Brit. Ent.," ii., p. 81 (1829); Zell., "Isis," 1838, p. 716; 1839, p. 283; Bdv., "Gen. Ind. Meth.," p. 79 (1840); Hering, "Stett. Ent. Zeit.," iii., p. 8 (1842); Dup., "Cat. Méth.," p. 65 (1844); Brd., "Mém. Soc. Doubs," ii., livr. 1-2, p. 65 (1845); Speyer, "Isis," 1846, p. 35 (1846); "Geog. Verb. Schmett.," i., pp. 312, 458, 461 (1858); "Verh. Nat. Ver. Preuss. Rhein.," xxiv., p. 182 (1867); Hdrch., "Verz.," ed. 2, p. 6 (1846); ed. 3, p. 24 (1851); Richter, "Stett. Ent. Zeit.," x., p. 85 (1849); Seyff., "J.-H. Ver. Nat. Württ.," v., p. 97 (1850); D'Ailly, "Tijd. Wis. en Nat.," iii., p. 265 (1850); Hein., "Stett. Ent. Zeit.," xii., p. 63 (1851); "Schmett. Deutsch.," i., p. 187 (1859); Ghil., "Elenco," p. 24 (1852); Ver Huell, "Sepp's Ned. Ins.," vii., p. 183, pl. xliv-xlv (*cir.* 1853); Wocke, "Cat. Lep. Siles.," p. 2 (1853); Reutti, "Lep. Bad.," 1st ed., p. 173 (1853); Guill., "Ann. Ac. Sci. Clermont-Ferrand," xxvii., p. 125 (1854); H.-Sch., "Sys. Bearb.," v., p. 62 (1855); Koch, "Schm. S.-W. Deutsch.," p. 71 (1856); Mann, "Wien. Ent. Monats.," i., p. 147 (1857); Sta., "Man.," i., p. 167 (1857); Barr., "Ent. Wk. Int.," iv., pp. 109-110 (1858); Tearle, "Ent. Wk. Int.," vi., p. 132 (1859); Bert., "Pollichia," 1859, p. 319 (1859); Now., "Enum. Lep. Hal. Or.," p. 31 (1860); Kef. and Wernbg., "J.-B. Ak. Erfürt," N. F. i., p. 156 (1860); Hofm., "Berl. Ent. Zeit.," iv., p. 32 (1860); Kranz, "Schmett. Münch.," p. 35 (1860); Wilde, "Zeits. Nat. Halle," xvi., p. 306 (1860); "Pflanz. und Raup. Deutsch.," ii., p. 77, pl. iii., fig. 48 (1861); Nick., "Lotos," xi., p. 156 (1861); Kell. and Hoffm., "J.-H. Ver. Nat. Württ.," xvii., p. 288 (1861); H. R. Schmidt, "Schr. Ges. Königs.," iii., p. 73 (1862); Rössl., "J.-B. Nass. Ver. Nat.," xix-xx., p. 140 (1866); Gärt., "Verh. Nat. Ver. Brünn," iv., p. 165 (1866); Nolck., "Lep. Fn. Est.," i., p. 121 (1867); Tgstrm., "Nat. Sällsk. F. F. Fenn.," p. 300 (sep. p. 10) (1869); Heyl., "Tijd. v. Ent.," xiii., p. 148 (1870); "Ann. Soc. Ent. Belg.," xxv., p. 73 (1881); "Comp. Rend. Soc. Ent. Bel.," p. xciii (1884); Schneid., "Siebke Enum. Ins.," iii., p. 36 (1876); Röss., "J.-B. Nass. Ver. Nat.," xxxiii-xxxiv., p. 227 (1881); Snell., "De Vlinders," p. 443 (1882); Walker, "Proc. Ches. Soc. Nat. Sci.," iii., p. 73 (1884); Schmid, "C.-B. Nat. Ver. Regensb.," xxxix., p. 84 (sep. p. 35) (1885); Stein., "Iris," v., p. 413 (1892); Carad., "Iris," viii., p. 88 (1895); ix., p. 6 (1896). *Carpini*, Schrk., "Fauna Boica," ii., 2, p. 90 (1802). *Nitida*, Haw., "Lep. Brit.," iii., p. 474 (1811). *Intermediella*, Brd., "Mon. des Psych.," p. 95, fig. 69 *a-c* (1853); Speyer, "Geog. Verb. Schmett.," i., p. 459 (1858); Staud. and Wocke, "Cat.," 1st ed., p. 28 (1861); 2nd ed., p. 65 (1871); Mitford, "Zool.," 1861, p. 7453; "Ent. Mo. Mag.," vi., p. 94 (1869); p. 186 (1870); Const., "Cat. Lép. Saone-et-Loire," p. 91 (1866); Maassen, "Stett. Ent. Zeit.," xxix., p. 439 (1868); Stange, "Verz. Halle Schmett.," p. 18 (1869); Paul and Plötz, "Mitt. Nat. Ver. Neupomm.," iv., p. 68 (1872); Wocke, "Zeit. Ent. Bresl.," iii., p. 26 (1872); Meurer, "Schmett. Rudolstadt," p. 31 (1874); Bang-Haas, "Nat. Tids.," (3), ix., p. 408 (1874); Glitz, "J.-B. Nat. Ges. Han.," xxiv., p. 36 (1874); Fouc., "Mém. Soc. Agric. Nord," (2), xii., p. 520 (1875); Mill., "Cat. Lép. Alp.-Mar.," p. 105 (1875); Curò, "Bull Soc. Ent. It.," viii., p. 145 (1876); Sint., "Arch. Nat. Liv.," (2), vii., p. 335 (sep. p. 9) (1876); Tur., "Bull. Soc. Ent. Ital.," xi., p. 171 (1879); Sand, "Cat Lép. Auv.," p. 32 (1879); Staud., "Hor. Soc. Ent. Ross.," xiv., p. 350 (1879); Pfütz., "Deutsch. Ent. Zeit.," xxiii., p. 37 (1879); Rehberg, "Abh. Nat. Ver. Brem.," vi., p. 467 (1879); F. Schmidt, "Arch. Mecklenb.," xxxiii., p. 64 (1880); Ersch. and Feild, "Trudy Ross.," xii., p. 204 (1881); Albrecht, "Bull. Mosc.," lvi., pt. 4, p. 381 (1881); Husz, "Magy. Karp. Evkön.," viii., pp. 251, 283 (1881); Donck., "Ann. Soc. Ent. Belg.," xxvi., p. 27 (1882); Jourdh., "Mém. Soc. Aube," xlvii., p. 46 (1883); Kretsch., "Mitt. Ver. Frank.-a.-O.," ii., p. 27 (1884); Krieghoff, "Mitt. Geog. Ges. Thür.," iii., p. 121 (1885); Lampa, "Ent. Tids," vi., p. 39 (1885); Vángel, "Rovar. Lapok," iii., p. 143 (1886); Jordan, "Schmett. N.-W. Deutsch.," p. 94 (1886); Calb., "Iris," i., p. 154 (1887); Zimm., "Verh. Ver. Nat. Hamb.," vi., p. 21 (1887); Rühl, "Soc. Ent.," i., p. 171 (1887); v., p. 154 (1891); Peters., "Btr. Kennt. Russ. Reiches.," (3), iv., p. 86 (1888); Teich, "Arb. Nat. Ver. Riga," vi., p. 20 (1889); Pabst, "Iris," iii., p. 106 (1890); Brown, "Actes Soc. Linn. Bord.," xlv., p. 55 (1892); Carad., "Iris," vi., p. 201 (1893); Klem., "Verh. z.-b. Ges. Wien," xliv., p. 177 (1894); Barr., "Ent. Mo. Mag.," xxx., p. 266 (1894); "Brit. Lep.," p. 357 (1895); Meyr., "Handbook, &c.," p. 774 (1895); Mab., "Bull. Soc. Aude," vi., p. 158 (1895); Schütze, "Iris," ix., p. 335 (1896);

Lutz., "K.-B. Ver. Riga," xxxix., Bomb. no. 49 (1896); Chapm., "Ent. Mo. Mag.," xxxii., p. 80 (1896); Horm., "Verh. z.-b. Ges. Wien," xlvii., p. 323 (1897); Bonj., "Bull. Soc. Ouest Fr.," vii., p. 192 (1897); Reutti, "Lep. Bad.," 2nd ed., p. 306 (1898). *Roboricolella*, Brd., "Mém. Soc. Doubs," ii., livr. 1-2, p. 65 *in part*, ♂ and case, ♀ = *betulina* (1845); "Mon. des Psych.," pp. 98-99, pl. ii., figs. 72 *a-c*, *nec* pl. iii., fig. 72 (1853); Spey., "Geog. Verb. Schmett.," i., p. 459 (1858); ? "Stett. Ent. Zeit.," xlix., p. 203 (1888); ? Tomp., "Zool.," 1859, p. 6464; ? Sta., "Ent. Ann.," 1860, p. 139 (1859); ? Staud., "Cat.," 1st ed., p. 28 (1861); 2nd ed., p. 65 (1871); ? Mitfd., "Zool.," 1861, p. 7453; ? Const., "Cat. Lép. Saone," p. 91 (1866); Mitfd., "Ent. Mo. Mag.," vi., p. 94 (1869); p. 186 (1870); ? Fouc., "Mém. Soc. Agric. Nord," (2), xii., p. 520 (1875); ? Gn., "Lép. Eure-et-Loir," p. 56 (1875); Parf., "Trans. Devon. Ass.," x., p. 550 (1878); Peyer., "Cat. Lép. Als.," ed. 2, p. 59 (1880); Paux, "Rev. Biol. Nord," v., p. 322 (1893); Barr., "Ent. Mo. Mag.," xxx., p. 266 (1894); "Brit. Lep.," ii., p. 359 (1895); ? Mab., "Bull. Soc. Aude," vi., p 158 (1895).

Original description.—*Larva* (tab. vii., fig. 1) multoties præcedenti specie (*unicolor*) minor, ei tamen subsimilis est, præcipue figura et anterioris corporis fui extremitatis habitu. Reliquo vero corpore non est pallido, sed rubescente, maxime in dorso. Folliculos sibi struit ex tenuium culmorum gramineorum fragmentis inæqualibus, longitudinaliter sericeo cylindro, in quo latet, circumpositis (fig. 4*a*). Tali folliculo per totam vitam, inde ab ovo, tecta incedit. Hunc, ubi metamorphoseos tempus adest, truncis arborum, parietibus hortorum ligneis, culmis, foliisve arborum et herbarum obviis, obliquo situ affigit, plerumque deorsum inclinatum, aliquando tamen et sursum directum, quod in majori specie numquam observatur. Hoc facto intra folliculum vertitur, ut liber Phalænæ, ex postica folliculi apertura, pateat exitus, tumque depositis exuviis sit Nympha, secundum sexum diversissima. *Feminea Nympha* oblongum farciminulum veluti est (fig. 2), loricatum, a præcedentis speciei Pupa (fig. 7) eo tantum diversa, quod larvulæ exiguum quoddam vestigium, tenellorum nempe futuræ Phalænæ pedum congestas delineationes, in antica corporis extremitate, exhibeat. Coloris est in dorso castanei, subtus dilutioris et fere lutescentis. Prodit ex ea Phalæna fœminea, fig. 3, tab. vii., depicta; similis vermiculo pallido, maculis in dorso transversis fuscis loricato, pilisque vix conspicuis asperso, in cujus antica extremitate capitis nigro-ocellati et vix antennulati minimum rudimentum, pedesque tenelli et tenuissimi seni, quorum priores brevissimi sunt, ægre conspiciuntur. Postice vulvam subulatum longe exserit, ad corpus pilis tenellis subciliatam. Ubi e folliculo prodiit, incurvo corpore, ni decidat, posticæ ejusdem extremitati, per reliquam vitam, adhærere pergit; sæpeque vulva et parte corporis adhuc intra folliculum hærente, ut maris commercium recusare videatur, ibidem, depositis prius pro parte ovis, marcescit. E *mascula Nympha*, quæ solitæ figuræ (fig. 4*b*) est, et ubi maturuit, postice e folliculo emergit (fig. cit.), evolat Phalænula pennicornis, tota cinereo-fuscescens, lucida, quam sedentem sive quiescentem, compositis alis, fig. 5, depingi curavi. Ad Bombyces pariter, utut ex larva tineode prognata, pertinet, poteritque vocari—*Phalaena Bombyx*, tota fusca; femina aptera. Triviale autem nomen *Phalaenae castae* meretur. Hæc mascula Phalæna etiam Frischio nota fuit, qui in *Operis de insectis*, vol. vi., tab. vii., larvam, folliculum, et quam ex ea obtinuit Phalænulam, satis bene depinxit et (p. 17) sententiam nostram de Larvæ pabulo confirmat (Pallas, *Nova Acta Ephem.*, iii., pp. 436-437).

Historical Note.—This species was somewhat fully described and named by Pallas in 1767 and the case, etc., recognisably figured, but in

1737 Réaumur had drawn (*Mém.*, iii., pp. 149, 196, pl. xi., fig. 7) attention to the habits of the larva of this (and other Psychid) species, whilst De Geer described it (*Mém.*, i., p. 506, pl. xxix., figs. 19-22), and Retzius, in 1783, gave to De Geer's insect the name of *tubifex*. Later, in 1762, Geoffroy described the insect (*Hist. Ins.*, ii., p. 203) and in 1785, in *Fourcroy's Ent. Paris.*, ii., p. 335, he named it *palearis*. In 1796, Hübner called the insect *nitidella*, a name that has been very generally applied to the Fumeid species, whilst Schrank, in 1802, called it *carpini*. Bruand seems to have renamed the species *intermediella*, and to have included it also in part in his description of *roboricolella*. So much confusion had gathered around the name *nitidella*, which appears to have been in general use for this species until the publication of the second edition of Staudinger and Wocke's *Catalog* in 1871, that these authors dropped the name and used Bruand's *intermediella*, since which time the latter has been commonly used. Werneburg, however, in 1864, called attention to the earlier name given by Pallas, and this was adopted by Kirby in his *Catalogue* in 1892, and there seems to be nothing left but to use this name. Our *casta*, therefore, includes the great mass of specimens found in British collections, and named (apparently with great capriciousness)—*roboricolella*, *nitidella*, *intermediella*, and even *crassiorella* and *crassicolella*.

Imago.—Anterior wings 9mm.-15mm. in expanse, somewhat square in outline: broad basally, inner margin with a deep rounded lappet at base, deep black-brown in colour when fresh (becoming much browner with age), with traces of a glossy transverse shade just beyond the middle of the wing; the cilia glossy; the discoidal cell without a cellula intrusa. Posterior wings and cilia unicolorous with those of forewings but rather less glossy. Anterior tibial spur ·77 to ·81; antennal joints 16-20.

Sexual dimorphism.—♂. The male, which varies considerably in colour, size, and in structural detail, has already been described. ♀ The female has the head ventral, the prothorax frontal and small, the mesothorax large, the metathorax narrow, the black corneous thoracic plates running quite round the venter. There are conspicuous dorsal rectangular marks on abdominal segments 1-7 and a number of pale hairs along the sides of the abdominal segments, and a distinct, subcutaneous flesh-coloured longitudinal band running just below the large shallow basin-like depressions in which the spiracles are placed, the whole length of the abdominal segments. The anal tuft is yellowish-white in colour and projects slightly above as well as below the ovipositor (Described July 13th, 1899, from a ♀ sent by Mr. Whittle and bred from an Eastwood pupa the preceding day). Hofmann notes the female as 3‴-3½‴ long, with dark brown head and black prominent eyes, yellow-brown antennæ which have eleven cylindrical segments and end in a blunt tip. The legs yellow-brown, the tarsus 5-jointed, the three narrow thoracic segments with shining dark-brown corneous dorsal plates, the ground colour of the body dirty reddish-brown, with seven long, dark brown, rectangular spots dorsally, whilst on the lower side of each segment is a small, dark brown, corneous, transverse stripe broken medially; ovipositor brown; anal tuft silver-grey; last segment of abdomen, dark-brown and corneous.

Variation.—We are entirely indebted to Chapman for our knowledge of the *casta* group of insects. As we have already said, *casta* appears to be the oldest name that covers the great mass of the Fumeas in British collections, and often called without much apparent reason, *roboricolella*, *nitidella*, *intermediella* and even *crassiorella* and *crassicolella*. Chapman says that the definite character that unites all these forms is the length of the anterior tibial spur, which measures from ·77 to ·81 the length of the tibia. The antennal joints vary from 16 to 20 and the wing expanse from 9mm. to 15mm. There is considerable variation in wing form, generally there is a good breadth basally, by the inner margin commencing at the base with a deep rounded lappet, and the inner and costal margin making some approach to parallelism, but not a few of those examined show a considerable approach to the form of *M. mitfordella*, and it is very probable that by measuring the spurs of a number of these some would prove to be really that species. The various races of *F. casta* are exceedingly puzzling and it appears probable that each colony of the species is fairly well-defined (probably due more or less to in-breeding), and does not present, except as aberrations, specimens agreeing with the forms from other localities, and it becomes a matter of little moment as to whether one should call the different races species or not. Chapman further notes that the only ground for doubting that they should be all called one species is that there is some basis for believing that the *casta* and *intermediella* forms do occur together in some localities, and yet maintain themselves as separate races, a matter that certainly requires further investigation. The forms and races of this species differ slightly in size, as also in the number of antennal joints. We have assumed the small, most common, and, perhaps, constant race to be *casta*, the larger and more variable one *intermediella*, Bruand. Warren observes that ♀ examples from Wicken Fen appear to have the anal tuft conspicuously paler. The various forms may be diagnosed as follows :

a. Typ. form *casta*, Pall.—Exp. al. 11mm.-12mm. ; antennal joints 18. This is a very definite race, and appears to be the most common and widespread form. I am by no means prepared to assert that this form is not a true species and distinct from the next form, only, if so, I cannot divide them with even approximate confidence (Chapman).

β. var. *intermediella*, Bruand.—Exp. al. 13mm.-14mm. ; antennal joints 18-20. This is rarer than the last form and it is, in places, apparently a distinct race, in others merely an aberration of *casta*. Some of the largest specimens have only 18 antennal joints, and some of the smallest 20, so that I feel unable to divide the forms *casta* and *intermediella* into two distinct species, defined as—*casta* 18 joints, *intermediella* 19-20, though I am prepared to grant that this may be so and that the variations in size are such as to make them overlap in this feature. In *casta* and *intermediella* the antennæ present indications of being in process of altering the number of joints, for at the base there is sometimes a third (1st of clavola) without pectinations, in others the 1st and 2nd of clavola are joined together in one long joint, carrying two pairs of pectinations. At the tip again the typical arrangement is for the last joint to be simple and the preceding one to carry two pectinations of nearly its own length, but the last (unpectinated) joint may be very small and in some examples is quite wanting when the then terminal joint carries two pectinations (Chapman).

γ. ab. *minor*, Chapman.—Exp. al. 9mm.-10mm. ; antennal joints 18 ; wings often more diaphanous than type. This is called an aberration rather than a variety as it occurs in odd specimens in different collections, and is usually probably a starveling form, rather than a distinct race (Chapman).

δ. var. *bowerella*, Chapman.—This is a very definite form in one special respect, and has been met with only in a certain number of specimens bred by Mr. B. A. Bower from Kentish localities. The general facies is much that of the typical form *casta* (*nitidella*), if anything it is rather smaller, being 11mm. in expanse, with anterior tibial spurs distinctly over ·77 of the length of tibia, dark in colour (being in good condition). The difference is in the antennæ. Instead of having 18 joints it has only 16 or 17. The antennal pectinations are of the same length as those of so many other species (or forms), *viz.*, ·50mm., but they are relatively with the antennal joints very short, *i.e.*, the antennal joints are long, *viz.*, ·240mm., a very constant group of *casta* specimens having then only ·202mm. in length (another specimen ·210, whilst the longest found in any other examples was one of ·227 in a large specimen of var. *intermediella*). After what has been said as to the fluid nature of the antennal joints, it may seem very doubtful, however, whether we should separate this as a distinct species (Chapman, *in litt.*, Dec. 15th, 1899).

Comparison of Fumea casta with F. germanica.—Besides *F. scotica* and *F. casta* the only other *Fumea* that Chapman is inclined to award specific rank is *F. germanica*. This he describes as: *Germanica*, n. sp., does not appear to be distinguishable from typical *casta* in general appearance, but has the base of the wing apparently slightly narrower, as in *M. mitfordella*, from which it differs, however, so much in the length of the anterior tibial spurs. Its expanse is 12mm., it has 19-20 antennal joints, but the length of the anterior tibial spur is far in excess of any other species examined, and obvious to the naked eye when compared with that of *F. casta*. It works out at ·86-·88 the length of the tibia (Chapman, *in litt.*, December 15th, 1899). The examples here named were sent by Voelschow, some as *intermediella* others as *affinis*; but they agree perfectly and are all one species. It may be that this form is the one generally known in Germany as *affinis*, but it is very different from the *affinis* sent by Staudinger, and described by Hofmann, which is closely allied to, if indeed distinct from, *crassiorella* (Chapman, *in litt.*, January 1st, 1900).

Comparison of Fumea casta with F. pellucidella.—In the *Wien. Ent. Monatschrift*, i., p. 147 (1857), Mann records a species under the name of *Fumea pellucidella* which he says occurs at Fiume in April and May, and notes as being "smaller and more thinly scaled than *F. nitidella*." [This must be *Bijugis perlucidella*, Brd., *Mon. des Psych.*, p. 77.]

Comparison of Fumea casta (intermediella) with M. crassiorella and M. var. affinis.—Bruand says that "the male of *F. intermediella* has the shape of *M. crassiorella*, but is very much smaller, and darker. The female is also much smaller than that of *M. crassiorella*, but it is, on the contrary, of a paler and less vinous colour; one might confuse it easily with that of *B. comitella*." Barrett notes this species as smaller than *M. crassiorella*, the apex of the forewings of the male more rounded, but the costa rolled back slightly in the middle so as not to interfere with the regular ovate form of the wings. It has a bright golden, or bronzy, gloss over its dark brown colour, and is well and generally known. The female is very like that of the last species, the anal tuft rather more brown, but it has slender drooping antennæ lying in a curve close to the head. Hofmann notes that in Germany, two species had been included under the name of *nitidella*, but that these had been separated by Reutti, chiefly from the females and times of appearance, under the names of *nitidella* and *affinis*; the males of *nitidella* are, he says, always smaller (5 lines), have shorter rounder wings, which are always uniformly shining black-brown; the body is also scaled with much darker brown; the antennæ shorter and containing sixteen segments. This and Hofmann's tarsal formula for the ♀ of his *affinis* make us suspect whether he did not still confuse *F. germanica* and *M.* var. *affinis* and include them under the latter name.

Ovum.—Length ·70mm., width ·42mm.; somewhat irregular, oval in outline; pale straw-yellow in colour. The eggs are laid in the case, and touch one another, but are separable without breaking; they have a very small quantity of wool very evenly scattered all over (♀ from Bournemouth).

Case.—The full-grown case is about 8mm. in length, consists of a silken tube covered with small particles of vegetable *débris* at its anterior end, and is surrounded, throughout its length, by about 12-16 pieces of fine grass of varying lengths, placed parallel to each other, and of these three or four extend beyond the posterior end. There is much difference in the coarseness of the materials used, and that of the females seems to be uniformly coarser than that of the males, whilst the cases of the former are also usually larger. The inside of the case is lined with white silk, but there appears to be no special spinning inside the case when the larva utilises it for a puparium, the caterpillar apparently simply turning round before undergoing pupation (Described June 12th, 1899, from Mecklenburg case). Bruand simply notes the case as being of very weak structure, and covered with small, very thin straws. Barrett says that the case is "rather thinly constructed of silk, covered with slender bits of dried grass placed longitudinally, some parallel, others rather diverging, so as to give it a rather loose appearance." There is a distinct difference in the size of male and female cases so that one can separate them readily before emergence. Hofmann also notes the female cases as being larger than those of the males, which he describes as being 3‴-4‴ generally covered with fine, closely laid grass stalks.

Comparison of the cases of Fumea casta, Masonia crassiorella and M. affinis.—The case of *F. casta* differs from that of *M. affinis* by its smaller size (3-4 lines), and is usually covered with finer and more closely attached grass-culms, the case of *affinis* being usually clothed with projecting material that gives it a bristling appearance (Hofmann). Caradja observes that the case of *F. casta* is readily distinguished from that of *M. crassiorella*, the pieces of grass standing off much less markedly in those of tho former than in those of the latter species.

Habits of larva.—The head, pro- and mesothorax are protruded when the larva is active, and as the case gets larger and heavier it is carried less perpendicularly, and hangs down vertically when the larva is crawling up or along any surface that allows the case to fall in this position. When disturbed the head is withdrawn and the anterior end is brought down close to the surface on which the larva is resting, so that the larva is entirely hidden. The larvæ as soon as they emerge construct a case from the maternal one, or from the silk covering the eggs and afterwards use outside material. They are carried perfectly vertical when young, and the young larvæ move at a very rapid rate. Hamm notes: A case found on a leaf on July 15th, 1895, at Mortimer, Berks, produced a batch of larvæ on 19th, which fed on knotgrass and made their cases with shreds of paper; they did well until the autumn when the whole lot died off. On July 4th, 1897, at Bagley Wood, Berks, another case found on a birch leaf gave a brood that hatched on July 18th, these were fed on birch until the beginning of November, when this food-plant failed; the larvæ lived on until December and then died. On July 14th, 1898, at Bovey Tracy, Devon, another case was found on a birch leaf which produced larvæ on July 18th, these constructed their first cases from that of the parent. Tearle notes (*Ent. Wk. Int.*, vi., p. 132) the newly hatched larvæ as having made cases of the tissue-paper lining the inside of a box each looking like a minute pillar of pith to the naked eye, but, "under a microscope, something like a thimble 2in. long and $\frac{3}{4}$in. wide at the opening, supported by something inside like a Jack-in-the-green, presently the thimble fell back, and a caterpillar crept half out, walked along on its six true legs, the thimble toppling about unsteadily, till at last it extinguished the tenant, then, a rest, the thimble fell back, and the walking commenced again."

Larva.—The larva is reddish-brown in tint; the head and thoracic plates have the dark and pale pattern so common in Psychids. Taking the dark as the ground colour, it is a very dark brown, almost black on the prothorax, especially laterally. There is a central, fairly broad, pale dorsal line, slightly interrupted by a dot or two at prothoracic anterior margin, which widens out on the head and is interrupted centrally by two dark lines running from the dots on prothorax which continue forwards along the margin of the clypeus. The subdorsal white band is fairly broad and interrupted at the centre of each segment by several black dots. Below this is a nearly lateral pale line along the line of junction of meso plate with the one beneath. The central part of each side of the head is pale with two dark lines or patches invading it from the dark posterior margin. The abdominal segments have the two dorsal transverse ridges well marked, and have also some paler spots along the anterior margin of segment and about thoracic region. These seem to be freer from skin points than elsewhere (Chapman. Larva Farnborough, May, 1899). Another larva is, on the whole, a little paler in tint, the white patch on head dimmed and obscured, so that it is only a shade paler than the dark area*, the marginal portions of plates of 2nd and 3rd thoracic, are more separated from the dorsal by a broader white line or band, but have the appearance of being on the same piece of chitin, the pale abdominal spots are more definite, almost forming a supraspiracular line from 4th abdominal backwards, they are more evident posteriorly and hardly exist on 1st abdominal segment, there are two on each side between the transverse ridges, making four dorsally across the centre of the segment. The prolegs vary in possessing from 18-23 hooks, having 18 on one side and 22 on the other in one instance, and are therefore of no specific value (Chapman. Larvæ Norwood and Bournemouth, May, 1899). The *full-fed larva* is about 6·5mm. in length when stretched, the thoracic segments are very slender, but the abdominal segments gradually increase in size to the 4th, the 4th-8th being almost equally wide, the anal segment very narrow. *Head*: Brown with paler markings and several hairs, ocelli black. *Thorax*: The prothorax covered with a dark brown corneous shield divided into a series of parallel bands by a pale mediodorsal and two subdorsal lines; the meso- and metathorax also covered with paler, somewhat reddish-brown, corneous shields and similarly divided into bands by the continuation of the pale lines on prothorax, an extra dark patch on either side, in the spiracular area, is found on these segments. *Legs*: The true legs blackish at base,

* There is, however, considerable variation in head-colouring, as another larva has two white subdorsal lines, and in another the head is almost entirely black.

brown towards the claw, the joints paler. *Abdomen:* The abdominal segments somewhat vinous or purplish to the naked eye, the 6th-8th segments, however, inclining to a yellowish tint. The 1st abdominal segment has the mediodorsal line of the thoracic segments continued over it, the remaining segments with a dark, slender, mediodorsal line. Each segment clearly formed of two subsegments. Tubercles ii inside i (· . . ·) ; iii shows a long and well-developed seta. The anal segment whitish with a well-marked, V-shaped, corneous shield (point of V backwards). *Prolegs:* Ill-developed and useless for walking on horizontal surface; the anal prolegs well-developed and used for walking out of case (body, therefore, arched when progression takes place out of case). *Spiracular flange;* A subdorsal (supraspiracular) longitudinal depression runs along the side of the body, and there is another similar subspiracular one ; the area between these forms the spiracular flange; the subspiracular depression rather darker and forms as it were a boundary or edge to the ventral area of larva, which is yellowish in colour (Described June 1st, 1899, from larvæ collected by Alderson, near Farnborough). Barrett says: The larva is deep purple-brown; head darkbrown or blackish with faint yellowish lines; three following segments yellowish, each with a transverse blackish plate, extending downwards to the legs, which are long and strongly made, blackish in colour.

Comparison of larvæ of Fumea casta and F. crassiorella.—Bruand says that the larva, as well as being much smaller, is to be distinguished from that of *F. crassiorella* by its obscure tint. The markings are the same, but the stripes are brown, approaching yellowish, instead of being of the intense vinous-brown that characterises those of *F. crassiorella.*

Pupa.—♂. The *male pupa* is about 4·75mm. in length, and 12mm. in width at the 4th abdominal segment. Head, prominent and projects both frontally and ventrally; the prothorax frontal, the mesothorax not prominent dorsally, nor is there any definite constriction at 1st abdominal segment to form a waist ; the thoracic segments very shiny and strikingly different from the abdominal ; the abdominal segments 8-10 turned ventrally, much smaller than the preceding segments, and united into a sort of coarse hook ; the two ventro-anal hooks well-defined ventrally. The wings reach to the 5th abdominal segment, the antennæ terminate almost at the same point, but do not meet medio-ventrally. The dorsal hooks especially well developed. *Dorsally:* The prothorax bulges frontally ; the meso- and metathorax shiny ; the 1st abdominal almost as wide (front to back) as the 2nd and 3rd, the 4th-7th gradually becoming narrower (beyond which the abdominal segments turn ventrally), the anterior median edge of the 8th forms a strong mediodorsal spine ; the whole of the segments striated transversely; the anterior transverse rows of spines most marked on abdominal segments 3-8, most strongly developed on 8. *Laterally:* The prothorax and dorsal head-piece prominent ; the eye at base of antenna also prominent ; the antennæ form a continuation of the constriction between the pro- and mesothorax at its base ; the forewing and antenna continued to anterior edge of 5th abdominal, both quite free at apices from the 2nd abdominal and standing out rigidly from the movable segments beneath them ; the hindwing reaches almost to anal angle of forewing ; not much trace of lateral ridge; spiracles distinct; abdominal segments 8-10 turned ventrally; the anal segment terminated on either side by a hooked point; dorsal spines very conspicuous on segments 4-8; meso- and metathorax and wings very shiny and smooth. *Ventrally:* The head-piece forms a sort of transverse ventral flange; the eyes prominent; the antennæ paler, segmented, extending to apices of forewings; between the latter the 3rd pair of legs extend; the face-parts present a somewhat oval (the long diameter transverse) labrum, with the cheeks and mandibles slightly lower than it on either side and with their lower borders in a nearly transverse line. There are the usual two hairs on either side of the labrum and one on face above it. The maxillæ and labial palpi project below this. The maxillæ are not separated from labium to the base and their rounded ends are free from the margins of the labium, so that there are four rounded processes pointing downwards (backwards), the two maxillæ laterally and the two divisions of labium centrally—the latter twice the distance of former from edge of cheek. The 1st femora are well marked, nearly twice length of labial palpi, and have a slight lateral mark basally; the 6th and 7th abdominal segments much contracted ventrally, less so, however, than 8-10, which are almost obsolete except for the anus and ventro-anal hooks. [The colour of the pupa almost entirely black, the abdomen least dark with brownish intersegmental rings. Imago emerged almost as soon as description completed.] The pupa-skin of the wings almost yellow, finely pitted, that of the abdominal segments wrinkled transversely, pale yellow-brown in colour; spiracles small, raised on slight elevations with a circular base, the scars of prolegs very distinct; the setæ appear to be as in larva; a dense transverse row of short black hooks on 3-8, rather towards anterior edge, points turned backward, collected into a large projecting mediodorsal point, covered with hooks on the anterior edge of the 8th abdominal; a marked series of triangular, medio-lateral depressions at front edge of each segment; each segment also has an almost circular depression below the spiracle, in a line with the triangular depression (these evidently due to modification of lateral flange (Described June 11th, 1899. Pupa from Mecklenburg-Schwerin). ♀. The *female pupa* is pale brown, slightly darker dorsally, and especially on the metathorax, and less so on wings and surrounding parts; free segments, as in all ♀ Psychids—2-3 free dorsally, with branching of incisions into 3 laterally; 3-4-5-6-7 incisions free; rows of spines along dorsal margin of 4, 5, 6, and 7; on 6 and (especially on) 7 the row broadens centrally, in a distinct patch, 4 or 5 deep on centre of 7. Intersegmental reflexed spines very marked on 5-6 and 6-7, less so on 4-5; spiracles very distinct, especially that on 7; prolegs well pronounced as wrinkled circles; wings to middle, 3rd legs to posterior margin of 2nd abdominal segment; hairs of tubercles all easily seen, trapezoidals i and ii partially reversed, iii above spiracle; a very minute one immediately in front and above spiracle, iv and v some way below spiracle, the posterior being the more dorsal; vi below these; vii is a solitary hair, then three in a row exist above the proleg, the lowest close to and above it, the other two upward and forwards of it; ventrally one hair on either side. On abdominal segment 7—ii and one of the three in proleg row appear to be missing; on 8 are four strong dorsal hairs, i and ii rather spines than hairs, and on 9 six in a transverse row, also very strong; 10 is without armature, strongly impressed ventral grooves on 8 and 10. Face-parts very much as in the ♂, except that cheeks project far downward laterally, like those of an exaggerated ♂ *M. crassiorella*, but larger and more pointed outwardly, and the maxillæ more pointed and appressed to labium, as in *P. betulina* ♂, very nearly as long as labium, division between labium and maxillæ to base, and nearly longitudinal in direction, making labium of equal width throughout; sides of labrum not incurved at top as in ♂; legs and antennæ very short (compared with those of ♂), hindwings very distinct at posterior margin of forewings.

Dehiscence of female pupa of F. casta.—The mesothorax splits dorsally, and separates from the metathorax, but remains firmly attached to the wing-cases and assumes a sloping position, its dorsal end being just outside the sack, its other extremity firmly fixed to the wings. These pieces, therefore, one on each side (or rather more dorsally), are all of the exposed pupal parts that occupy the narrow neck of the sack, and, by their elasticity, taking a firm basis by their attachment to the wings, maintain the opening. Outside the sack the prothoracic piece is attached to the anterior margin of the dorsal end of the mesothoracic piece in such a way that it lies along the edge of the opening of the sack, its inner surface sloping outwards so as to make the opening funnel-shaped where it is, and form the dorsal portion of the outer member of what I have compared (*vide*, *post*. p. 332) with a rivet. It carries at its anterior margin the dorsal head-piece, which has no other function than to slightly extend the slopes of the funnel. Round the rest of the opening of the sack, *i.e.*, opposite the venter of the pupa, extend from the ventral ends of the prothoracic pieces, two filmy but very tough shreds, united to the portion that includes the head-piece. This portion consists of the head, antenna- and mouth-parts, and the anterior legs. These filmy shreds are, in fact, the pupal investment of that part of the prothorax that is covered by the appendages in the pupa, as well as the basal portion of the leg-cases. It takes its attachment ventrally (one is apt to fall into familiar, but inaccurate, language and say in front, though front is opposed to back, and is so far correct, but is also synonymous with anterior, which would be wrong) to the points of the femoral pieces, the pieces that in these pupæ look so like maxillæ or labial palpi. The front piece thus tethered leans outwards, and forms the slope of the funnel-shaped aperture in front (as opposed to back). To the same point the second leg-pieces remain fixed by one end, the other ends slope outwards and form sides to the funnel. From this point also extends directly backwards (as opposed to forwards) another cable of filmy chitin, which is attached by its other extremity to the end of the wings where they form part of the solid pupal mass. This is no doubt the pupal covering of both the mesothoracic femora, and it fastens these face-pieces down solidly in position against the opening of the sack. We have, then, within the sack, the undivided mass of the pupa-case as far forwards as the 3rd thoracic and the anterior wing-cases of the 2nd thoracic, outside the sack, but closely appressed to its mouth, a ring formed of the 1st thoracic parts, both the dorsal portion that is exposed and the ventral portion that is covered, in the pupa. This ring carries other parts, so as to make a funnel-shaped opening, *viz.*, the head- and face-parts, the leg-cases of its own segment and of the 2nd thoracic. Its own plates, supplemented by the dorsal head-pieces slope outwards dorso-laterally, the first legs with face-parts slope out ventrally, and between these the second leg coverings. These two portions of the pupa are held firmly together in front by a ligament, formed chiefly of the 2nd femora, dorsally by the stiff mesothorax, continuous with its wings below and articulated to the dorsal end of the prothorax above, and forming at the same time a spring to keep the mouth of the sack and pupa-case open (Chapman).

Comparison of ♂ pupæ of Fumea casta and Proutia betulina.—In the ♂ pupa of *P. betulina* the cheeks and labrum are at the same level, their edges being in the same transverse line, the maxillæ are divided from the labium to the base, and are sharply triangular, with the pointed apex close to the labium, giving the latter the appearance of having a broadly bulbous end. The labium of *P. betulina* is much more square, transverse and longitudinal diameter equal (Chapman).

Comparison of ♂ and ♀ pupæ of Fumea casta and Masonia crassiorella.—In the *male* pupa of *M. crassiorella* the cheeks project downwards (backwards), so as to come, especially laterally, far below the labrum, looking like the hanging upper lips of a blood-hound; the maxillæ, proportionally to the labium, are larger and wider, but their general aspects and outlines (say as compared with *P. betulina*) are much the same. In the *female* pupa of *M. crassiorella* the cheeks are shorter and more rounded, and maxillæ smaller and shorter, labium wider and shorter. In the most conspicuous matter of the hanging cheeks ♂ and ♀ pupæ are reversed, *i.e.*, ♂ *M. crassiorella* has the hanging cheek, but in *F. casta* the ♀ has it (Chapman).

Food-plants.—*F. casta* appears to be almost polyphagous on low-growing plants and shrubs. We have noted: *Sedum*, grasses (Bruand), knotgrass, birch (Hamm), polyphagous on bushes and grasses (Reutti), grass and leaves (Heinemann), oak and *Rhamnus frangula* (Ver Huell), feeds on flies (Healy), elm (Burrows), moss (Fowler).

Parasites.—*Limneria fasciata*, Bridg., and *Lissonota obsoleta*, Bridg., bred by Fletcher (Bignell).

Habits and Habitat.—A male emerged June 16th, 1899, about 10.30 a.m., its wings being left over its body roof-shaped, and in about a minute had almost fully expanded in this position; they were then thrown over the back, the tips curled ventrally, in 30 seconds they were hanging perfectly vertically, the curving gone; it remained in this position for about three minutes when it dropped them to their normal roof-shaped position. On June 20th, 1899, a male was found to have emerged soon after 9 a.m. also two ♀s. The ♂ paired with one immediately they were placed together, copulation lasted four minutes—9.30 a.m.-9.34 a.m. At 12.15, noon, the same male placed with another ♀ which had just emerged, paired at once and remained paired about six minutes. Before pairing the ♀ sits on the case, the ovipositor in the case; to pair it raises the abdomen slightly, but without withdrawing the ovipositor, the male standing on the back of the female, the wings spread downwards on either side closely enfolding and hiding the ♀ and part of case. The male refused a third female both before and after copulation with the second, although it fluttered round her most vigorously on one occasion. When settled down on the case, the abdominal segments of the female are curved, the ovipositor in the case, the anal tuft filling up the aperture, and not visible, but when ovipositing the imago is well out of the case, and considerable movement of the first two pairs of legs appears to take place. Chapman writes: "The ♀ of *F. casta* after emergence sits at the end of her case with the extremity of the abdomen applied to the opening of the pupa-case, into which she is afterwards to place her eggs; she is, in many respects, so helpless that one jumps to the conclusion that she does so to enable her to keep in touch with it, and not to lose knowledge of where it is. She raises the extremity of the abdomen from this position only for a brief period, some five minutes altogether perhaps, during the visit of the male. There are two reasons, however, that show that the keeping-in-touch idea is probably erroneous, certainly not the whole matter. The dehisced extremity of the pupa-case is a very definite and recognisable structure, with a free aperture that the tactile arrangements of the ovipositor ought easily to recognise, and, more convincing, if the female be removed from her position she gets back to it without, apparently, much difficulty. My own belief is that she sits so closely to prevent the entrance of any parasites or enemies, the terminal wool forming a good *chevaux-de-frise* against anything from mites upwards. *Fumea* does not mix much wool with her eggs, but accumulates a good deal about the pupal opening during oviposition, and does a lot of work after, chiefly, apparently with the object of introducing as much as possible of this on the top of the eggs and about the opening, as a fence against marauders. These facilities for oviposition, and the necessity of these special protective devices on the part of the moth, are to be found in the method of dehiscence of the female pupa. The pupa-case is not brought out of the sack, as in Solenobias, nor is it left entirely within it, as in the Psyches, but comes forwards so far as to bring the mesothorax level with the mouth of the sack. At this point the 3rd thoracic and wing-cases remain together, aad form an impediment to the further advance of the pupa, whilst the parts in front are so disposed as to form a ring just outside the opening of the sack, and so, as it were, rivet the pupa-case in that position" (*vide, ante*, p. 330). Of a large number of males bred, almost all observed emerged between 2.0 p.m.-4.0 p.m., a few rather earlier, but none noticed to do so later. The male is active during the morning and afternoon sunshine, but is only occasionally taken on the wing, although Barrett notes that, after a night's sugaring at West Wickham in June, 1858, he took some 40 males that swarmed around him as he lay on the ground between 5.0 a.m. and 6.0 a.m., and suspected tbat they were assembling to a ♀ close by. We have taken it flying by hedges at 9.0 a.m. in Westcombe Park, whilst Farren notes it as flying in the evening in June, on Wicken Fen. Males began to fly around old birch stumps about 5.0 p.m. on Pilling moss the last week in June, 1865 (Hodgkinson). Flying in afternoon sunshine (4 p.m.), over a damp ditch at Perivale (Montgomery). Hofmann notes the males as being active during the day, flying freely, especially in the afternoon, in woods near Erlangen; the female remaining seated on her case until copulation, after which the eggs are deposited in the empty pupa-skin; the larvæ are found on the trunks of deciduous trees, especially hazel and oak. The early habits of this insect are very little known, but Fowler notes that he "has repeatedly found minute cases under moss upon oaks in the New Forest during the winter, that they then disappear and are to be found again in May, when they crawl up for pupation." At this time the cases can usually be found in abundance on tree-trunks, fences, bushes, grass culms and similar situations in or near woods, and may be sometimes beaten from bushes. Bacot also notes the cases as about one-quarter inch long in January, situated chiefly on the gauze covering the tub in which they are confined, but many are on the sides of the tub and on twigs. Hamm finds them near Reading on trunks, fences, and foliage, from the middle of May onwards, those found earlier being the empty cases of the previous year; he suspects the larvæ feed on, or near, the ground on grass, &c., going to the trees only to pupate; those cases found on leaves nearly always produce ♀s. Freer first observed full cases up on trunks in 1899, on May 2nd. Whittle notes larvæ found on slopes of river wall, bordering saltmarshes, cases on tree-trunks (oak, birch, elm, wild rose), and fences, in south-east Essex. Mrs. Cowl notes cases on *Erica*, near Bournemouth; and Dale on nut and alder at Glanville's Wootton; Bankes notes them as common in Dorset and occurring in many localities therein, though, owing to the inability of the ♀ to travel, each colony is confined to a restricted spot. The kinds of localities in which it occurs differ widely, *e.g.*, on hot dry rocky undercliffs, where the cases are found on the rocks, as there are no trees, in shady Scotch fir plantations and woods, on our heaths, and in the middle of a saltmarsh where there is hardly anything growing except quantities of short rushes. The spun-up cases are therefore found on rocks, tree-trunks, rush-stems, &c., according to the nature of the locality; tenanted cases are only to be found in the spring or early summer, when the full-fed larvæ have left their feeding-places near the ground and have crawled up higher to fix their cases for pupation. He adds: "I daresay the imagines fly at other times as well, but at any rate one of their flight times is in the sunshine at about 6.30 on still calm warm evenings, and I have then attracted the ♂ ♂ in the saltmarsh locality by enclosing virgin ♀ ♀ in small muslin bags and tying them to the rush-tops." Burrows notes cases on posts by roadside at Brentwood; on grass and tree-trunks on high land (not marsh) at Rainham; on various plants—elm, grass, bramble, nettles, *Ballota nigra*, &c., growing on high and dry ground at Mucking. Montgomery says that cases are common on posts in hedges at Ealing; cases on upper surface of sallow leaves, on bush growing in a damp ditch at Abbott's Wood. Freer observed cases common on swampy ground on Cannock Chase; Atmore notes them as spun up on palings, grass-stems, &c., near King's Lynn. Whittle observes that on June 15th, 1899, near Southend, two cases were found on bramble, one on cow-parsnep, and one on maple, whilst on July 2nd, when searching oak-trunks for larvæ of *P. betulina*, he found 22 cases of *F. casta*, imagines from which commenced to emerge July 11th, 1899. Bang-Haas notes that in breeding this species it often happens that one year one breeds only males, another only females, more rarely both together, suggesting that the sexes in the larval stage often select different places for pupation. D'Ailly states that he bred the species from the egg, obtaining only one imago at the end of the first year, the rest of the brood going over a second winter. Millière notes it as common in the Alpes-Maritimes in June, flying on the borders of woods with great rapidity. [His description of the case "composed of dry leaves," however, leads one to question his species.

Constant says that it does not occur in the Riviera.] Reutti notes the cases as spun-up on walls, fences and trees, being sometimes in great abundance in Baden. Cases found occasionally everywhere on grasses, old walls, rock, beech trunks. Hofmann says that the cases are generally found on the trunks of deciduous trees, especially hazel and oak. Rühl notes the larvæ as not rare in the neighbourhood of Zürich, the full-fed larvæ in their cases on trunks of hazel, sloe, oak, &c. Speyer obtained the cases on stems of privet and on fences, in May and early June, the imagines emerging from June until August. Schrank narrates (*Fauna Boica*, ii., 2, p. 91) circumstantially how he obtained parthenogenetic eggs after several failures.

Time of appearance.—Generally emerges in June and occurs until mid-July. June 4th, 1844, in the New Forest, June 30th, 1845, bred from cases found on fir trees in Black Park (Douglas); June 26th 1858, at West Wickham (Barrett); cases May 20th, 1860, on Addington fence, also on trees; cases at West Wickham fence from May 27th-June 10th, 1860, still abundant on Addington fence on July 1st, 1860, although some imagines had already emerged (Healy); last week in June, 1865, on Pilling Moss, July 4th and July 13th-15th, 1869, at Witherslack (Hodgkinson); case May 16th, imago June 13th, 1871, at Wanstead, case and imago June 14th, 1893, at Brentwood, case May 15th, 1894, imago June 5th, 1894, case May 19th, imago June 17th, 1894, imagines June 18th, 1893, June 27th, 1893 (assembled), June 20th, June 22nd, June 30th, 1894, at Rainham (Burrows); caught June 28th, 29th, 1892, June 2nd, 1893, June 20th, 1895, June 3rd-12th, 1896, bred July 13th, 1888, June 29th-30th from cases collected June 28th-29th, 1892, June 4th, from a case found May 4th, 1893, June 13th-23rd from cases found June 7th, 1894, all in the Isle of Purbeck, caught July 3rd, 1891, at West Moors, bred June 22nd, from cases collected June 6th, 1887, in the Isle of Portland, bred June 28th from case found June 19th, 1894, at Bloxworth, bred June 19th-21st, from cases obtained June 12th-14th, 1889, in the New Forest; bred May 31st from cases received May 14th, 1890, from Gosport; June 18th, 1884, a male, June 20th, female, bred from cases collected in New Forest May 28th-31st, 1884 (Bankes); August 1st, 1885, in Purbeck (Digby); June 14th, 1893, flying in afternoon sun at 4.0 p.m. at Perivale, pupæ and larvæ on sallow at Abbott's Wood June 14th, 1897, emerged (both sexes) June 23rd-30th, 1897 (Montgomery); imagines captured June 20th, 1895, June 24th, 1896, June 19th, 1897, flying in sunshine at King's Lynn (Atmore); June 24th, 1894, from Southend cases found May 6th, June 27th, at Eastwood, July 7th, 1898, at Hockley, imagines emerged July 11th, 1899, and onwards from Eastwood cases (Whittle), May 18th, 1894, cases on fences at Mottingham, May 22nd, 1894, cases made up on fences at Bexley, June 16th, 1894, cases made up on tree-trunks at Greenhithe, June 18th, 1895, cases made up on fences at Bexley, June 3rd, 1896, cases made up at same place, June 11th, 1896, cases made up on tree-trunks at Sidcup, from which imagines appeared June 11th-27th, 1896, May 27th, 1897, cases made up on fence at Bexley, June 10th, 1897, imago flying in afternoon at Eltham (Bower); June 9th, 1899, two males, June 12th, three males, June 13th, one male from Kingston-on-Thames cases; June 27th, 1899, one female from Byfleet case, June 10th, one male, June 12th, one male from Mecklenburg cases, June 13th, one female, June 18th, two females, and June 20th, one male, June 27th, three females from Farnborough cases, June 16th, one male and two females from Ringwood cases (Tutt); June 16th-18th, 1899, males and females from New Forest cases (Fowler); June 12th-20th, 1899, males and females from Farnborough cases (Alderson); June 14th, 1899, and following days, males and females, at Bournemouth (Cowl); June 20th, 1899, and following days from Hazeleigh cases (Raynor); cases on Dartford Heath, May 27th, 1899, imagines bred June 7th-26th, 1897, imagines July 1st, 1880, at the Brushes (Sang *teste* Gardner); case July 5th, 1898, at St. Helen's, Isle of Wight, ♀ bred July 14th (Hamm); July 1st, 1899, bred from Mucking larvæ (Bacot); cases in May and early June, imagines emerged from end of June until end of August (Speyer); cases at Pichtendahl, females bred June 19th-24th, case at Riga, June 25th, produced a ♂ similar to the others (Nolcken); captured in April, 1890, at Philippeville (Meyrick); rather later than *F. crassiorella*, from June 1st-20th at Besançon (Bruand); about June 15th, in the Auvergne district, common (Sand); June 10th, 1870, at Königswater in Drachenfels (Jordan); from May to July in the Baden district (Reutti); June 20th, on into July in Holland (Ver Huell); first half of July in Baltic provinces (Teich); larvæ common end of April and in May, the imagines emerging at end of May and beginning of June, at Ratisbon and Erlangen (Hofmann); in July in the neighbourhood of Zürich (Rühl).

Localities.—Berks: Wokingham, Crowthorne, Tilehurst, Sulham, Mortimer, Bagley Wood (Hamm). Bucks: Black Park, Slough (Mitford). Cambs: Wicken (Farren), Cambridge (Warren). Cheshire: Chester dist., Lower Bebington, Bromborough (Archer), Holywell (Walker). Devon: Bovey Tracey (Hamm), Oxton (Studd), Harpford Wood, between Honiton and Sidmouth (Riding), Torquay (Prout). Dorset: Purbeck (Digby), Bloxworth (Cambridge), Glanville's Wootton (Dale), West Moors, Portland (Bankes). Dublin: Hill of Howth (Barrett). Essex: Hazeleigh (Raynor), Snaresbrook, Wanstead, Brentwood, Rainham, Mucking (Burrows), Hale End, Walthamstow marsh (Bacot), Ilford cemetery (Mera), Eastwood, Hockley, Leigh, Southend (Whittle), Epping (Downing), Colchester, abundant (Harwood), Saffron Walden (Warren), Higham's Park, Chingford, abundant (Prout). Galway: Galway (Barrett). Gloucester: Durdham and Clifton Downs, near Stapleton (Hudd). Hants: Bournemouth (Cowl), Ringwood (Fowler), Pamber Forest, Basingstoke (Hamm), Gosport (Bankes), New Forest (Douglas). Hereford: Tarrington (Wood). Herts:* Broxbourne (Prout). Isle of Wight: Sandown (Prout), St. Helens (Hamm). Kent:* Farnborough (Alderson), Westcombe Park, Chattenden, Cuxton (Tutt), Mottingham, Bexley, Greenhithe, Sidcup, Eltham (Bower), Plumstead dist. (Butterfield), Dartford Heath (Studd), Darenth (Prout). Lancashire: Preston dist., Pilling Moss (Hodgkinson), Patrick Wood (Archer), Staley Brushes, near Manchester, Chat Moss (Chappell). Lincolnshire: Gainsborough (Tearle). Middlesex: Hammersmith (Gates), Hampstead (Mitford), Ealing, Perivale (Montgomery), Willesden (Warren). Notts: Mansfield (Brameld). Norfolk: King's Lynn (Atmore), Merton, Cawston, Foxley Wood (Barrett). Oxford: Hardwicke, Hanwood near Oxford (Hamm). Stafford: Cannock Chase, Burnt Wood (Freer). Surrey: Kingston-on-Thames (Lucas), Byfleet (Sich), Addington, West Wickham (Healy), Norwood (Chapman), Virginia Water (Merrin), Haslemere (Barrett), Leatherhead (Briggs), Shirley (Warren), Addiscombe (Riding). Sussex: Worthing (Fletcher), Abbott's Wood (Montgomery), Hastings (Bloomfield), Brighton (Cooke). Westmorland: Witherslack (Hodgkinson). Worcester: Wyre Forest (Bradley). Yorks: York (Anderson), Gledhow (Taylor), Huddersfield (Hobkirk), Sheffield (Doncaster), ? Doncaster (Corbett).

Distribution.—Algeria: Philippeville (Meyrick). Amurland:† Sutschen. China: Pekin (Staudinger). Asia Minor: Brussa (Mann). Austro-Hungary: Bohemia (Nickerl), Upper Austria, Wippach in Carniola, Buda, Salzburg (Speyer),

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* Also at Herts: Cheshunt (Boyd. Kent: Abbey Wood (Boyd).

† Staudinger notes (*Rom. Mém. sur Lép.*, vi., p. 303) as follows: "*Fumea roboricolella*, Brd.—Dörries brought a very small male (9mm.) from the Sutschen

Galicia, Brody (Klemensiewicz), Chemnitz (Pabst), Epiries (Husz), Kocsocz (Vángel), Brünn (Gärtner), Bucovina, Czernowitz (Hormuzaki), Hermannstadt (Caradja), Gurariului (Czekelius).* Belgium: Brabant, Liège (Donckier). Channel Islands: Guernsey—Grande Mare, Vuzon (Luff). Denmark: general (Bang-Haas). Finland: Nylandia, Karelia (Lampa). France: North France, but not in Riviera (Constant), Aube (Jourdheuille), Douai (Foucart), Bordeaux (Brown), Haut-Garonne, St. Béat (Caradja), Pûy de Dome, Thiers (Guillemot), Depts. of Meuse and Moselle, Lozère (Speyer), Nohant, St. Florent, Auvergne (Sand), [? Alpes-Maritimes (Millière),] near Paris (Duponchel), Doubs Dept. generally distributed, in high mountains at Jougne (Bruand), Loire-Inférieure—Nantes (Bonjour), Saone-et-Loire (Constant), woods of Eure-et-Loir (Guénée), Phalempin, Carvin (Paux). Germany: Generally distributed (Heinemann), distributed everywhere, and in most places very common (Hofmann), very common in the north-west (Jordan), Rhine Palatinate (Bertram), Würtemberg (Seyffler), Wandsbeck (Schmeltz), Frankfort (Koch), Erfurt (Keferstein), Halle (Stange), Munich (Kranz), Rudolstadt (Meurer), Mecklenburg, Schwerin (Tutt), Sülz, Neustrelitz, Wismar (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia, generally distributed (Schütze), Dresden (Steinert), Thuringia—Grossheringen, Gotha, Nazza, &c. (Krieghoff), Dantzig (Grentzenberg), Silesia (Wocke), Nassau, common everywhere (Rössler), Rastenburg (Klups), Pomerania (Hering), Dessau (Richter), Grubenhagen, Pennin (Paul and Plötz); Baden dist. (Reutti), Aachen, Holstein, Krefeld, Oberhessen, Bingen, Stuttgart, Frankfort-on-Oder, Berlin, Freiburg-im-Bresgau, Waldeck, distributed (Speyer), Brunswick (Heinemann), Hanover, common (Glitz), Ratisbon, Erlangen, very common (Hofmann), Alsace, in all the woods (Peyerimhoff), Hildesheim (Grote), Bavarian Pfalz (Bertram), Wiesbaden (Vigelius), Walportzheim (Maassen). Italy: North Italy—Tuscany (Curò), Lombardy, Brianza (Turati), Turin (Speyer). Netherlands: Common almost everywhere (Snellen), Luxemburg (Speyer), Arnhem (Ver Huell), Breda (Heylaerts). Roumania: Grumazesti (Caradja). Russia: Arctic Regions (Petersen), Livonia (Speyer), Baltic Provinces, Dorpat, Neu-Kasseritz, Finland (Sintenis), Moscow dept. (Albrecht), Wolmar (Lutzau), St. Petersburg (Erschoff), Cremon, Pichtendahl, Riga (Nolcken). Scandinavia: South Lapland (Zetterstedt), Vestre-Aker (Siebke), Gothland, Oland, East Gothland, Stockholm, Romsdals Amt (Schöyen). Spain; Bilbao (Rössler). Switzerland: Bergün, common (Zeller), Zürich, Genf (Frey), Lugano (Huguenin), Neuveville (Couleru), Jura, Schüpfen (Rothenbach). Turkey: (Mann).

Explanation of Plate III.

In order to give some idea of the comparative lengths of the anterior tibial spine or spur, which has been so frequently mentioned as characteristic of the various Fumeid (and other) species, Dr. Chapman has drawn them for most of the species, and they have been reproduced on Plate iii, reference to which will give probably a better idea of them than any amount of description. At the same time he has given us the neuration of the more striking Luffiid, Proutiid, and Fumeid species, which also have been reproduced on Plate iii. A few of these are aberrant, the difference being readily observable by comparison with the normal form.

Neuration (not to same scale):

Fig. 1. Luffia lapidella *aberr.* (f.w.)
2. Luffia lapidella (f.w.)
3. Luffia lapidella (h.w.)
4. Masonia crassiorella (f.w.)
5. Masonia crassiorella *aberr.* (f.w.)
6. Masonia crassiorella (h.w.)
7. Bacotia sepium *aberr.* (f.w.)
8. Bacotia sepium (f.w.)
9. Bacotia sepium (h.w.)

Fig. 10. Bacotia sepium *aberr.* (h.w.)
11. Bruandia reticulatella (f.w.)
12. Bruandia reticulatella (h.w.) (frenulum broken)
13. Proutia betulina (f.w.)
14. Proutia betulina (h.w.)
15. Proutia eppingella (f.w.)
16. Proutia eppingella (h.w.)
17. Fumea casta (f.w.)
18. Fumea casta (h.w.)

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district, which appear to agree with *roboricolella*, but which, considering the uncertainty relating to these species, I can only doubtfully refer to this species. A male *Fumea*, caught by Herz, on June 13th, north of Pekin, appears to belong to *F. intermediella*, Brd."

* Also in Austro-Hungary at Gössling (Schleicher).

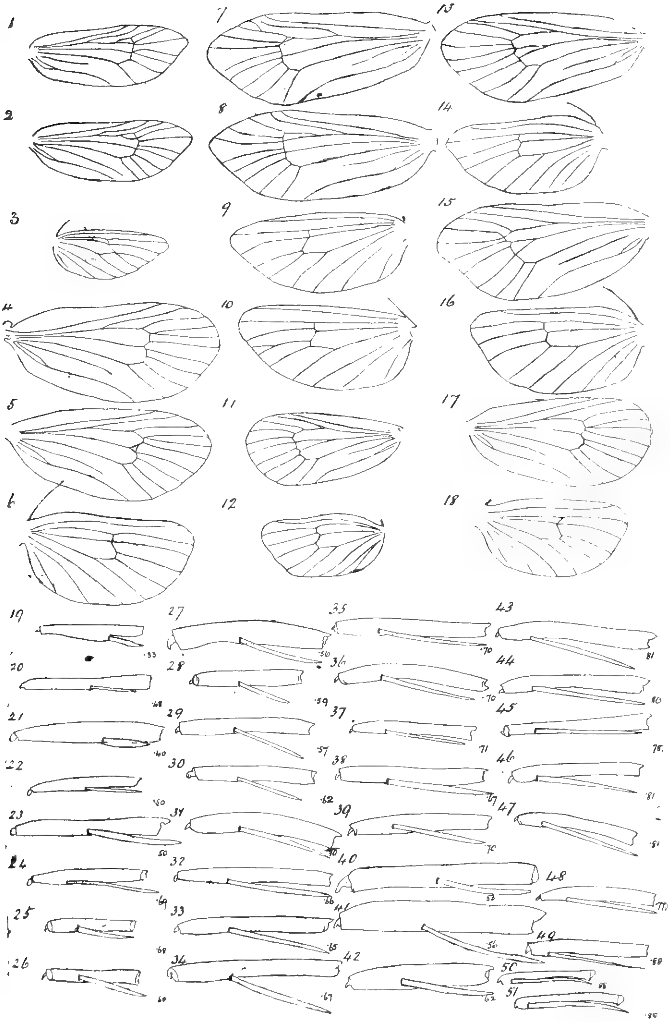

PLATE III.

NEURATION AND ANTERIOR TIBIAL SPURS OF PSYCHIDS.

ANTERIOR TIBIAL SPUR (enlarged 23 diameters):

Fig. 19. Bankesia staintoni (·38)
20. Solenobia wockii (·48)
21. Taleporia tubulosa (·40)
22. Luffia lapidella (·50)
23. Bacotia sepium (·50)
24. Proutia betulina (·69)
25. Proutia eppingella (France) (·68)
26. Proutia eppingella (Epping) (·68)
27. Bruandia reticulatella (·56)
28. Bruandia *var.* obscurella (·59)
29. Bruandia *var.* obscurella (·57)
30. Bruandia comitella (·64)
31. Masonia crassiorella (England) (·70)
32. Masonia crassiorella (Cannes) (·66)
33. Masonia crassiorella (Cannes) (·65)
34. Masonia crassiorella (Germany) (·67)

Fig. 35. Masonia affinis (·70)
36. Masonia subflavella (·70)
37. Masonia edwardsella (·71)
38. Masonia hibernicella (·67)
39. Masonia mitfordella (·70)
40. Bijugis bombycella (·53)
41. Bijugis proxima (·56)
42. Bijugis pectinella (·62)
43. Fumea scotica (Rannock) (·81)
44. Fumea *var.* intermediella (Portland) (·80)
45. Fumea scotica (Sutherland) (·78)
46. Fumea casta (·81)
47. Fumea casta (·81)
48. Fumea casta (·77)
49. Fumea germanica (·88)
50. Canephora unicolor (·88) (enlarged 8 diams.)
51. Pachythelia villosella (·88) (enlarged 8 diams.)

Family: EPICHNOPTERYGIDAE.

The Epichnopterygids have always been classed with the Fumeids with which they appear to have no very close connection, and as we have already pointed out they are the only family of the higher Psychids that retain the short anterior tibial spurs (when present) that characterise the Micro-Psychids. Largely on this account (and the structure of the antennæ) Chapman suggests that they have directly descended from Luffiid-like ancestors, and represent, as it were, a terminal branch of the more specialised Psychids in this direction. One suspects that the alliance hitherto assumed between the Fumeids and Epichnopterygids has perhaps been due to the fact that both use fine stems of grass, placed longitudinally, with which to cover their cases, although the character of the material and the mode of placing it differs considerably, fine flat leaves rather than rounded culms being used by the Epichnopterygids, and these are placed so as to make a close-fitting investment to the silken tube, drawn out in a somewhat pointed manner at the apex, and do not stand off bristling-like at the end of the case as do the culms used by the Fumeids. This spindle-shaped case is really very characteristic of the higher Epichnopterygids. The males of the two groups differ much in wing-scaling, the Epichnopterygids having very specialised, slender, filiform, hair-scales, with but few striæ, and, therefore, widely different from the broad scales of the male Fumeids, whilst the Epichnopterygid antennæ differ in that their pectinations are scaleless and have sensory hairs on all their aspects, like the Luffiids and Proutiids, and unlike the Fumeids and the Psychids proper.

The Epichnopterygids appear to fall naturally into two subfamilies, the *Bijuginae* and the *Epichnopteryginae*, the former with a ♀ structurally like the Micro-Psychids and the Fumeids, but not leaving the case for copulation, the latter with a ♀ structurally like those of the Macro-Psychids without articulated antennæ and legs, and with a very short ovipositor; it also of course remains within the case for copulation. There is some little variation in the length of the anterior tibial spurs (pl. iii) of the three described Bijugid species, those of *pectin-*

ella being somewhat longer than those of *bombycella* and *proxima*, the latter approaching rather to *Psychidea*, which tends to lose the spurs, a result that is achieved by *Epichnopteryx*. It is clear from this that, in these transitional groups, this spur is more or less a fluid quantity, not settled into the short (or obsolete) one of the Epichnopterygids or the long one of *Fumea*. The Bijugids, although thus affected by the Proutiid and Fumeid tendencies to lengthen the anterior tibial spurs, did not advance far in this direction; they did so, however, sufficiently to show that they are a separate side branch of the Epichnopterygid stem and not (as *Psychidea* might possibly be) intermediate between the short-spurred Luffiids and the higher Epichnopterygids where the anterior spurs are wanting. This tendency in *Bijugis* probably shows then not Fumeid affinities but a similar reaction to similar causes which *Epichnopteryx* either escaped or resisted. The curious circumstance that the ♀ imagines of *Proutia* and *Epichnopteryx* (not *Whittleia*) retain the pupal head-covering (as if to obtain something sufficiently firm to break open the silk at the free end of the case, so as to allow copulation to take place) is a further link between these groups, besides the antennal structure (scaleless pectinations).

Subfam.: Epichnopteryginae.
Tribe: Epichnopterygidi.

The *Epichnopteryginae* break up naturally into two tribes, one of which the *Psychideidi* is distinguished by having a short anterior tibial spine (or spur), the other the *Epichnopterygidi* having none. The former was separated by Rambur from the genus *Epichnopteryx* under the name *Psychidea* (*Cat. Sys. Lép. Andalousie*, pp. 289 *et seq.*), this author describing *nudella*, Och. (which he mistook for *pectinella*, Schiff.), as his type*. It was for the true *pectinella*, Schiff., and its allies (*bombycella*, Schiff., and *proximella*, Led.) that Heylaerts afterwards created the genus *Bijugis*.

We have unfortunately no Bijugids nor Psychideids in Britain, both our Epichnopterygids falling in the tribe *Epichnopterygidi*, although belonging to different genera. It is remarkable how different the males of the species of the two genera at present recognised in this tribe appear and yet how closely they are really related. *Whittleia* has the wings of the males strongly reticulated, and is well represented by *retiella* (*reticella*), its type, whilst *Epichnopteryx* has species whose males have uniform, sooty-black wings, *pulla* being the well known type. We have already discussed the position of the tribe in considerable detail (*ante*, pp. 268-270).

The main points of the Epichnopterygid economy appear to be as follows: The eggs are laid within the spindle-shaped case, agglomerated together, and are exceedingly fragile and delicate, whilst the larvæ are perhaps rather less robust than those of the allied Psychids, and with an abundance of pale markings on the head and thoracic segments. The male pupa has a distinct waist, well developed mouth-parts and appendages, and possesses two strong ventro-anal spikes; the maxillary palpi, however, are obsolete; the cheeks dip far below the jaws, the head-piece is minute, the metathorax with minute

* There is a printer's blunder (*ante*, p. 270, lines 29-30), where "*bombycella*, *sapho*, and *nudella*" should read "*bombycella*, *nudella*, and *pulla*," since *sapho* and *nudella* both belong to *Psychidea*.

hairs replacing the tubercles. The female pupa is cylindrical with the head, mouth-parts, wings and antennæ highly modified, but not showing that extreme obsolescence that characterises the female imago; the cheeks falling below jaws to end of maxillæ, the antennæ forming distinct knobs in centre of cheeks, the legs well-marked processes, three or four times as long as wide, the wings developed as slight lappets outside the legs; the intersegmental spines are blunt points in *Epichnopteryx*, sharp in *Whittleia*, whilst the anterior hooks are represented in both by flat blunt eminences. The male imagines are characterised by their specialised slender scales (almost like hairs in some instances), the unscaled pectinations of their antennæ, the absence of anterior tibial spurs, the presence of two pairs of posterior tibial spurs, whilst the cellula intrusa found in the Proutiids, *Bruandia* and Oiketicids, &c., is also present. The female imagines are specialised to the greatest extreme of helplessness, forming mere vermiform, almost inert, egg-sacs. A detailed description is given later of those of the British species.

Genus: Whittleia, Tutt.

Synonymy.—Genus: *Whittleia*, Tutt, "Ent. Record," xii., p. 20 (1900). *Psyche*, Newm., "Zool.," v., p. 1863 (1847); viii., pp. xciv-xcv (1850); Bruand, "Mon. des Psych.," p. 90 (1853); Cooke, "Merrifield's Brighton," p. 213 (1864); Merr., "Calend.," 2nd ed., p. 100 (1875); Parfitt, "Trans. Devon. Ass.," x., p. 550 (1878); Chapman, "Ent. Mo. Mag.," xxxv., p. 146 (1899). *Fumea*, Stev., "Zool.," 1850, p. 2857; H.-Sch., "Sys. Bearb.," v., p. 61 (1855); Sta., "Man.," i., p. 167 (1857); Hum. and Westd., "Brit. Moths," 2nd ed., p. 34 (1857); Staud., "Cat.," 1st ed., p. 28 (1861). *Epichnopteryx*, Staud., "Cat.," 2nd ed., p. 64 (1871); Heyl., "Tijd. v. Ent.," xxi., p. xxvi (1878); "Ann. Soc. Ent. Belg.," 1881, p. 72; "C. Ren. Soc. Ent. Belg.," xxviii., p. xciii (1884); Kirby, "Cat. Lep. Het.," p. 522 (1892); Barr., "Ent. Mo. Mag.," xxx., p. 250 (1894); "Brit. Lep.," ii., p. 350 (1895); Meyr., "Handbook, &c.," p. 772 (1895); Whittle, "Science Gossip," 2nd ser., v., p. 368 (1899).

This genus was first noticed in the *Entomologist's Record*, xii., p. 20, as follows:

Whittleia, n. gen., with reticulated wings, and well represented by *reticella*, which may be named as the type.

This genus may now be diagnosed as follows:

Ovum.—Large, irregular oval in outline, pale yellow in colour, no real sculpturing, glistening, covered with gummy substance, adherent, very fragile, laid in pupal skin.

Case.—Composed of grey silk, covered closely with grass stems, cylindrical, slightly more slender at ends, hence spindle-shaped, flexible mouth-piece, from which larva protrudes its head.

Larva.—Head large, black, chitinous, shiny, retractile; true legs not so thick nor strong as in most Psychids; thoracic segments small (prothorax very small) with black, corneous, polished plate (metathorax less corneous); pale mediodorsal and lateral stripes, anterior margins of thoracic segments whitish; abdomen bulky, pale brownish, each segment subdivided into two subsegments, the anal segment with a black shiny dorsal plate; tubercles with single setæ, on chitinous bases, thoracic in straight line on abdominal segments, i weaker and outside ii, iii well-developed, iv and v close together (v especially weak), vi below lateral flange, vii at base of legs; lateral flange well marked; spiracles slightly raised; prolegs short, circle of hooks incomplete, surrounding a central pit.

Pupa.—♂. Distinct waist at 1st abdominal segment; spiracles raised, almost subdorsal in position; scars of prolegs conspicuous; two ventro-anal spikes; sexual organs distinctly marked; apex of all four wings very pointed, extend to 4th abdominal; anterior row of dorsal spines on 4-8 well-developed, the posterior row on 4-7 less marked; tubercular hairs small; mouth-parts well-developed, face very smooth and rounded, labrum square, projects beyond mandibles, the end of maxillæ very rounded; the labium projects beyond maxillæ, its extremity notched; antennæ without distinct segmentation; the 3rd legs and apices of wings terminate together. ♀. Cylindrical, anus rather more pointed than head, abdominal segments 4-6 free; no waist; abdominal segments 3-6 of almost equal size; anus smooth, scars of prolegs distinct; spiracles black and raised; sexual organs well-defined; anterior dorsal spines on abdominal segments 4-8, posterior row on segments 4-6 sharp; wing-cases small, folded ventrally, but do not quite reach end of metathorax nor meet ventrally; antennæ short and small; legs short laterally, sloping outwards, the 3rd pair very short; the labrum well marked; jaws full and rounded; labium and maxilla together form a large 3-lobed lappet; dorsal head-piece forms a narrow strip along front of prothorax.

Imago.—♂. All four wings strongly reticulated; antennæ 15 joints, pectinations scaleless, no anterior tibial spur; the scales specialised, very slender, still clearly defined scales with a few striæ on costa. ♀. Vermiform, no ovipositor, but ovipositing segments possess rods fairly developed; does not carry pupal head-parts after breaking case open; has definite chitinous plates on dorsa of abdominal segments; the thoracic segments delicate, without dark plates; dark head-parts include very modified mouth structures; no antennæ; no wings.

Neuration.—Median forming a cellula intrusa in the cell.

We have already named *retiella* as the type of the genus. There are probably only two species yet described belonging to this genus, *W. retiella* and *W. undulella*, the former at present only reported from England and Holland, the latter from Hungary and southern Russia. They are both exceedingly pretty, *undulella*, although slightly larger, being even more delicately marked, than *retiella*. They are true Epichnopterygids, the delicate eggs, spindle-shaped case, unscaled pectinations of male antennæ, absence of the anterior tibial spurs, and vermiform female, all pointing to a close alliance with the "*pulla*" group in spite of the very different looking ♂ imagines. It is remarkable though that the peculiarity presented by the latter (*Epichnopteryx*) and by the Proutiids, *viz.*, the female carrying the pupal head-piece on emergence after using it as it were as a lever to break open the puparium, is not found in *Whittleia*, where the ♀ pupa itself forces open the free end of the puparium before the female imago emerges from the pupa (of course within the puparium).

Whittleia retiella, Newman.

Synonymy.—Species: *Retiella*, Newm., "Zool.," v., p. 1863 (1847); Stevens, "Zool.," 1850, p. 2857. *Reticella*, Newm., "Zool.," viii., p. xciv (1850); Bruand, "Mon. Psych.," p. 90, pl. ii., fig. 65 (1853); H.-Sch., "Sys. Bearb.," v., p. 61 (1855); Sta., "Man.," i., p. 167 (1857); H. and Westd., "Brit. Moths," 2nd ed., p. 34 (1857); Staud., "Cat.," 1st ed., p. 28 (1861); 2nd ed., p. 64 (1871); Cooke, "Merrifield's Brighton," p. 213 (1864); Merr., "Lep. Cal.," p. 100 (1875); Parfitt, "Tr. Devons. Ass.," x., p. 550 (1878); Heyl., "Tijd. v. Ent.," xxi., p. xxvi (1878); "Ann. Soc. Ent. Belg.," 1881, p. 72; "C.-R. Soc. Ent. Belg.," xxviii., p. xciii (1884); Kirby, "Cat. Lep. Het.," p. 522 (1892); Whittle, "Ent. Rec.," iv., p. 340 (1893); "Science Gossip," 2nd ser., v., p. 368 (1899); Barr., "Ent. Mo. Mag.," xxx., p. 250 (1894); "Brit. Lep.," ii., p. 358 (1895); Meyr., "Handbook, &c.," p. 772 (1895); Chapman, "Ent. Mo. Mag.," xxxv., p. 146 (1899).

Original description.—Mr. Ingall has captured a small *Psyche* with beautifully mottled wings; it is very different from the known British species, but in some degree resembles *Psyche undulella* of the continent. It is proposed to call the new species *Psyche retiella* (Newman, *Zoologist*, v., p. 1863). [It will be seen from the above that the insect was named *retiella*, not *reticella*, the latter name having been adopted (*Zoologist*, viii., pp. xciv-xcv) by Newman in 1850, three years later. He then diagnosed it as: "*Psyche reticella*, mas.—Antennæ corporis dimidio vix longiores quasi 13-articulatæ articulis 2-12 ramulos duobus ad apicen emittentibus, alis albidis fuliginoso

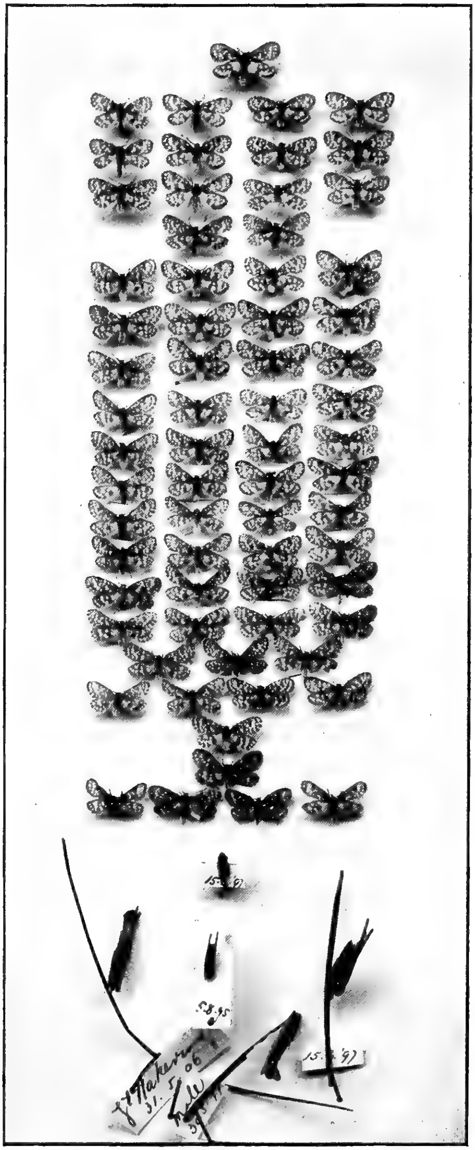

PLATE IV.

Imagines and cases of Whittleia retiella.

reticulatis, corpore nigro lanugine albido vestito. Alarum latitudo ·375 unc. Corporis longitudo ·135 unc.," &c.]

Imago.—Anterior wings 9mm.-10mm. in expanse, whitish with fine broken transverse fuscous lines and dark nervures, giving the wings a reticulated appearance. Posterior wings similar to the forewings but basal area without reticulations.

Sexual dimorphism.—♂. The male is fully winged with well developed antennæ, legs, &c. The antennæ have 15 joints with scaleless pectinations, the anterior tibiæ have no spur, the posterior tibiæ very dilated, the wings clothed with highly specialised narrow hair-like scales, some slightly broader and with defined striæ, principally along the costa. The female is vermiform, 6mm. in length, 1·8mm. in width, and with proportionately much less hard dark chitin anteriorly than a species such as *Pachythelia villosella*, but it has some dorsal plates on the abdominal segments, and possesses, in fair development, the rods of the ovipositing segment. The dark head-parts consist of a horseshoe-like ring, with subsidiary parts that may represent various mouth-parts, but altogether a very small amount. The thoracic segments have no dark plates; on the abdomen, apparently on segments 3, 4, 5, 6 abdominal, there are transverse dark chitinous plates dorsally; they are not black, but smoky tinted; each carries four pale round spots, apparently the trapezoidals, nearly in a transverse line, but the outer (i) a little anteriorly. There are two rods to the 12th, and two to the 13th segment (following Dr. Wood's descriptions), *i.e.*, the two terminal segments; the latter ·33mm. in length, the former twice as long, each simple except in its spreading out in the chitin of its segment of attachment, which is, however, uncoloured, except close to the attachment (Chapman). The living female is banded with yellow like a larva of *Euchelia jacobaeae*, but turns nearly black after death (Merrin.)

Variation.—The reticulated pattern of the forewings of the male is subject to much variation (*vide*, pl. iv, which is taken from Mr. Whittle's unequalled series of this species). This variation occurs not only in the intensity of colour of the lines, but also in their width and direction, asymmetry being very frequent on the opposite wings of the same specimen; the tendency for the external line of the forewings to end on the outer margin and not at or within the anal angle, and also the tendency for the two median lines to form a transverse band, are very evident in some examples, whilst in the hindwings some specimens exhibit the dark fuscous markings as distinct lines rather than reticulations. In one example in Dr. Chapman's possession, the outer fuscous line is thrown quite on the margin, forming a conspicuous black marginal edge to all the wings. There is also considerable variation in the shape of the wings, some being quite elongated when compared with the ordinary squarish form with rounded apex, and the peculiar pointed apex of the pupal wings leaves one in doubt whether this elongation of the imaginal wings is really due to some slight crippling or a tendency to atavism. A peculiar specimen, in which the hindwings show a tendency to divide symmetrically, is to be seen at the head of Mr. Whittle's series, and whilst some show a tendency to suffusion, others exhibit a falling off in the usual quantity of dark markings. A very good idea of the general range of variation exhibited by the shape and markings of this species may be derived from the plate (iv).

Comparison of Whittleia retiella with W. undulella.—*W. undulella* is described by Fischer von Röslerstamm as follows:

Psyche undulella, Tr. (Tab. 38, fig. 3*a-c*). Antennis pectinatis, alis omnibus rotundatis albis fusco-reticulatis. This true *Psyche* is a discovery of Kindermann, who found a few males at Buda several years ago. It is one of the prettiest Psychids, white throughout except that the strongly pectinated antennæ and the nervures of all the wings are brown-grey in colour, and between the nervures stand two more or less distinct transverse streaks which give the whole surface a reticulated appearance. The fringes are pure white, and at their bases there are, on the nervures, grey dots which are most strongly marked towards the costa, becoming fainter (or entirely absent) towards the inner margin. The underside is like the upper but fainter (*Abbild. Schmett.*, pp. 86-87).

Our own notes read as follows: *W. undulella* has 19 joints to the antennæ; the wings are paler than those of *W. retiella*, the dark reticulation less pronounced, and hence the former looks a more delicate species than the latter. This is perhaps more particularly due to the fact that the nervures, sometimes a conspicuous feature in the reticulation of *W. retiella*, are scarcely darkened in *W. undulella*. *W. undulella* is, too, rather larger, although, of course, both species vary in this respect. Bruand, strangely enough, does not compare *retiella* with *undulella*, although he notes it as having "the same shaped wings as *undulella*, *reticulatella* and *pulla*, the male being scarcely half that of *reticulatella* in size, the colour more diaphanous, the strigæ brown; the posterior wings especially in the middle tessellated; the nervures ending on the margins in dark dots." As a matter of fact there is no close connection at all between *retiella* and *reticulatella*, the latter being a *Bruandia*, but the alliance between *retiella*, *undulella* and *pulla* is a very close one.

Egglaying.—There is no record of how this species lays its eggs, but we have a note to the effect that "the eggs (when fertilised) are laid in a close mass within the case, but most of the unfertilised females lay only a few eggs and these often outside the case. A fertilised female that had laid all her eggs collapsed at once like an empty bag." This we have no doubt is correct, although we are not sure of its origin, but Bacot notes that all the ♀s he "observed, came out of their cases and laid their eggs outside, mostly only two or three infertile eggs, although one female laid an irregular mass of eggs, of considerable size." This is exactly what one would suspect unfertilised females of this species to do. Whittle has no doubt that the eggs are laid in nature within the case, as young larvæ have hatched from collected cases, so that the eggs must have been within the cases when found.

Ovum.—The eggs are large, ovoid, 1·1mm. long, 0·7mm. wide. They are pale yellow, very shiny, and glistening, possibly still coated with a gummy substance, as they adhere to each other when laid. They are exceedingly fragile and delicate (a slight touch with a camel-hair brush is enough to rupture them), rather irregular in shape, but roughly forming a long oval in outline; they vary, however, in the shape of the oval (pointed or blunt at the ends) and are occasionally pear-shaped. No regular sculpturing observable, but slight facets and longitudinal ridges or wrinkles may be distinguished (Bacot).

Case.—Length 6mm.-10mm. or with projecting straws 9mm.-15mm.; appear to be covered with grass stems, certainly very like the rounded blades of *Sclerochloa* (*Poa*) *maritima*. They are not laid on straight as in *Fumea*, nor do they lie quite close like the grass blades on the case of *F. pulla*, still they follow the curve of the case, especially approximating at the free end, so that the case is like that of *F. pulla*, a little spindle-shaped, and the unattached end usually flattened, so as to have two flat sides and two edges, on one flat side two or three pieces of grass project beyond the end of the case, but so closely together as to look like one piece. These project from half as long to quite as long as the case itself. There is a good deal of muddy-looking material between the straws, and there is, as usual, a flexible mouthpiece covered with smaller chips (Chapman). The case is made of fine grey silk, is about 9mm.-10mm. long, with six or eight slender grass stems attached longitudinally to the outside, three of these, on dorsal area, project beyond the end of the case. A coating of dried mud and small particles of earth is noticeable on the silk between the straws (Bacot). The case is soft, slender, close fitting, hardly cylindrical, but curved in a little at the ends, composed of silk, mixed with morsels of *Conferva*, and partially covered with short bits of very slender dead grass, which look half decayed, and are dotted over with the confervoid matter so plentiful in salt marshes. The case has been found on *Artemisia maritima*, in salt marshes, but there is no doubt that it is usually concealed low down among the tangled mass of *Spartina stricta*, with which the drier portions are often covered (Barrett). Chapman notes that when fixed up for pupation the case is generally attached to a grass stem, often high up and at an angle of about 45°, that it is found among *Sclerochloa maritima* (not *Spartina stricta*), and often occurs where no *Conferva* is to be found.

Larva.—The head large, thoracic segments small, compared with the larvæ of *Fumea*. Head slightly retractile; meso- and metathorax not much larger than prothorax, the metathorax the shorter. The abdomen very large and bulky compared with thorax (probably a ♀ larva). Head and chitinous parts of thoracic segments black with polished surface; the metathorax does not seem so horny and completely covered with chitin as in many other larvæ examined. A white, mediodorsal stripe commences on prothorax, widening gradually to metathorax. A less defined lateral stripe is also present; the anterior margins of the thoracic segments and intersegmental areas whitish or flesh-coloured; the abdomen pale brownish or drab in colour with a faintly marked mediodorsal line. The anterior abdominal segments are both less in girth and in width than the posterior, the 6th and 7th abdominals being the largest. The abdominal segments are composed of two subsegments, but the divisions are not distinct on the posterior segments—6th and succeeding ones; the anal segment bears a black polished dorsal plate. The hairs are fine and tapering, long on thoracic segments and head, short, weak, and tending to become atrophied on all the abdominal segments except the 10th. The tubercles are single-haired, with spreading chitinous bases on the abdominal segments, this character being especially noticeable in the dorsal tubercles on the 1st, 2nd and 3rd abdominal segments. The tubercles are arranged as follows: i and ii dorsally as trapezoidal tubercles, i outside of and weaker and smaller than ii; iii is supraspiracular, and well-developed; iv and v are subspiracular, placed close together, and weak, especially v; another (vi) is placed below the lateral flange, whilst the marginal (vii) is also present at the base of the legs. The tubercles on the thoracic segments (and hairs arising therefrom) appear to be arranged as in the other species, at least dorsally, *i.e.*, they are placed in a single line on the anterior portion of each segment. The lateral flange or ridge is well marked. The spiracles are almost central on the segments, except those on the 1st thoracic and 8th abdominal, that on the prothorax being well towards the posterior edge, that on the 8th abdominal somewhat less so; the thoracic spiracle is much larger than those on the abdominal segments, that on the 8th abdominal also slightly larger than those on the other abdominals; all the abdominal spiracles are slightly raised, the surrounding area darker than the skin. The segmental incisions are clearly and sharply defined. The legs are neither so thick nor strong as are those of other Psychid larvæ examined. The prolegs are short, with an incomplete circle of hooks and a slight pit in the centre of the ring; the anal prolegs have a more completely circular ring. [Bacot. Described May 18th, 1898, from larvæ obtained by Mr. F. G. Whittle.]

Pupa.—♂. The *male* (empty, imago emerged) pupa-skin is thin and transparent, pale yellow in colour. Abdomen rather curved; distinct constriction dorsally at 1st abdominal segment. Spiracles raised, rather subdorsal than lateral in position, placed rather anteriorly on segments; scars of position of prolegs evident. Anal segment evenly rounded; cremaster bearing two conical, spine-ended processes on its ventral aspect; these spines similar to those in pupa of *Fumea* and other Psychids, but smaller. Sexual organs distinctly marked. Wing-cases (forewings) extend nearly to the end of the 4th abdominal; the base of the hindwings show slightly beyond forewings on dorsal area of 1st and 2nd abdominal segments. A row of well-developed, recurved spines is present towards the anterior edge of the dorsal area of the 4th, 5th, 6th, 7th and 8th abdominal segments; a trace of a similar row but pointing forwards can be made out on the posterior edge of the abdominal segments 4-7. Hairs are present dorsally but they are small and difficult to locate, lateral ones are not to be detected. The mouth-parts are very well developed, the face wonderfully smooth and rounded, two frontal bristles as usual, labrum with four frontal bristles as usual, labrum square except that the sides at lower exterior angle are hollowed out by the mandibles, the chitinous septum marking them off being very strong and deep, the labrum itself projects a little way beyond the mandibles (downwards) which is unusual, the cheeks extend a good way beyond these; the ends of the maxillæ are very rounded, about equal in length and breadth, and the labium projects a little way beyond them, its extremity notched rather than bifid; no marks of antennal segmentation except waving of hind margin which suggests it; 1st legs extend a little beyond antennæ, the 2nd legs, beyond these, and the 3rd legs and forewings (which terminate together) an equal distance further, the fore- and hindwings both show an angular tip (? remnant of Solenobiid structure). ♀. The *female* pupa forms a smooth somewhat long cylinder, with anus rather more pointed than head; bright red-brown in colour, somewhat darker at head and anus. Length about 6mm. The thorax and head occupy about one-fifth of the length of pupa. Abdominal segments 4, 5 and 6 free. There is no waist, abdominal segments 3, 4, 5 and 6 almost equal in size, the 4th abdominal of rather greater bulk, the 6th rather longer than the others. The anus is smooth; scars in position of prolegs distinct; spiracles black and raised; rudimentary sexual organs well-defined. The surface of the pupal skin shiny, but the skin itself somewhat wrinkled, the dorsal area covered with minute spicules; lateral hairs as in other Psychid pupæ as regards position; scattered dorsal hairs appear to be present on each segment, but the surface is so covered with silk threads from the cocoon that it is difficult to define their position. Distinct, dark-coloured, recurved spines, are present on anterior edge of the dorsal area of abdominal segments 5-8, also traceable on 4, but little more than enlarged spicules on this segment; on the posterior edge of abdominal segments 4-6, traces of a row of forward-pointing spines may be detected. The wing-cases are present but very small, folded down ventrally, sloping very slightly towards anus; the hind margins of the hindwings overlap a portion of the 1st abdominal segment, but the apices of the forewings do not quite reach to the end of the metathorax and the wings do not nearly meet ventrally, being in fact lateral, and hardly encroaching on the ventral area proper at all. The antenna-cases are extremely short and small, they do not reach to the costa of the 1st pair of wings. The legs are most strange; they appear to be short lateral structures and slope outwards from base on the meso- and metathorax; the third pair are especially short, the tip only projecting outwards for a short distance over the 1st abdominal segment; the second pair are longer and project outwards almost across the metathorax; the first pair extend nearly at right angles from the base, the tip curving upwards and standing out slightly from the surface of the pupa, they hardly project at all over the mesothorax. The head stands out prominently and has a distinctly hymenopterous facies. This appears to be chiefly due to the structure of the ? labium. Below this, is a narrow transverse strip, with a suture in the centre, and bounded on either side by the ends of the first pair of legs, the bases of the legs appear to lie under this plate (Bacot). The ♀ pupa of *W. retiella* has the labrum well marked, and the jaws full and rounded, the cheeks descend very low on each side of these, their lower margins ranging with the ends of labium and maxillæ, which together form a large three-lobed lappet, the central lobe (labium) having hardly a sign of median divisions. The antennæ are two lobes or lappets on the middle of the cheeks, of a size about twice that of the jaws or half the labrum; below the labium are the legs as three pairs of lappets following each other, each lateral lappet consisting of an inner (femur) and outer (leg) portion, the latter rather the longer, the forewings fold down beside these, the hindwings behind the forewings almost uncovered by them. They hardly pass the 3rd thoracic segment. The dorsal head-piece of the pupa is a narrow strip along the front of the prothorax. The mesothorax splits only half way down, the head-piece remains attached to the rest of the pupa (Chapman).

Dehiscence.—The male pupa-case when empty is thin and transparent, pale yellow in colour. The antennæ, eye-cases, legs and mouth-parts separate as a single shield-like piece (although easily separable) from the rest of the pupa on dehiscence, leaving the wing-cases and dorsal head-pieces attached to rest of pupa (Bacot).

Parasites.—*Lissonota commixta* bred by Whittle (*teste* Bignell).

Food-plant.—*Sclerochroa* (*Poa*) *maritima* (Whittle).

Time of appearance.—The imago appears at the end of May and throughout June. June 1st-2nd, 1850, at Sheerness, by sweeping plants on coast skirting the sea (Stevens); cases May 20th, 1892 (one on a post, another on a stem of *Artemisia maritima*), imagines (♂ and ♀) bred, June 5th, 1892, imagines flying in afternoon sun among *Artemisia*, June 7th, 1894, on the Essex salt marshes (Bower); imagines at Benfleet, June 1st, 1899 (Chapman); June, 1870, at Southend, cases May 17th, 1894, May 7th, 1895 (one case the result of a whole day's search), imago bred May 27th, 1895, imagines captured May 17th, 1894 (2), June 5th, 1894 (4), June 15th, 1894 (8), at Canvey Island (Burrows); May 6th, 1893, on Essex coast (Thurnall); June 14th, 1891, at Shoeburyness, June 6th, 1892, at Benfleet, May 24th-June 2nd, 1893, at Leigh, May 28th-June 17th, 1894, at Pitsea, May 26th-June 4th, 1895, at Vange, May 17th-June 5th, 1896, May 30th-June 5th, 1897, at Canvey (Whittle); a case on April 24th, 1898 (sole result of a whole morning's work at Canvey); three cases (♂ and two ♀), in 1876, near "den Enmer," at Breda, the male emerged June 4th, the females on the 9th (Heylaerts).

Habits and Habitat.—The male flies in the afternoon and is readily attracted by a newly emerged female, Whittle having captured large numbers by this means. He writes: "The female never leaves the case, is parthenogenetic, and yet able to strongly influence the other sex, as I have occasionally successfully used her as a decoy for assembling the males. I once observed a male moth settled on a dead flower-disk of *Aster tripolium*, a beautiful example of colour assimilation. The males can be readily found on patches of *Sclerochloa maritima*. There is a scattered growth of this grass all over the salt-marshes, but quite clean patches of it to the exclusion of *Atriplex portulacoides* are not common, but on such patches I have often seen dozens of these most charming little moths, which love to flutter from grass-blade to grass-blade, although on windy (yet sunny) days their flight is decidedly more than a flutter." When ready to emerge the ♀ (being very soft anteriorly) opens the end of the cocoon by pushing forward the pupa in order to burst it (Chapman). This species appears to be almost confined to the saltings of the south and south-eastern coast of Britain, the larvæ living low down almost on the mud at the roots of *Sclerochloa* (*Poa*) *maritima*, although the cases are sometimes found higher up on the grass stems. On Canvey Island they appear to prefer the bottom of the sea-wall, but Burrows notes that in June, 1870, he captured a specimen at Southend, quite high up on the cliff, just past the end of the Royal Terrace. Chapman notes that on May 7th, 1899, cases were found attached to green leaves of *Sclerochloa maritima*; one ready for pupating high up and conspicuous, others were found low down near the roots (possibly still feeding larvæ), none were found upon *Spartina stricta* to which Barrett suggests that it is attached, nor was there any green *Conferva* (with which this author also associates the species) on the spot where the cases were found. The specimens met with were all found within a few square yards and it would appear that the individuals of one brood often occur thus in a limited space, with large intermediate vacant areas. Whittle generally finds the cases low down on *S. maritima* or on the soil under this plant. Of four cases found during the Easter of 1899, two were found flat on the mud at the roots of a plant of this species.

LOCALITIES.—[DEVON: very rare, on coast (Parfitt)]. ESSEX: Southend, Canvey Island (Burrows), Shoeburyness, Benfleet, Leigh, Pitsea, Vange (Whittle). [HANTS: (Barrett).] KENT: Sheerness (Stevens), Sheppey (Ingall), below Gravesend (Stainton). [SUSSEX: Brighton (Cooke)].

DISTRIBUTION.—NETHERLANDS: Breda (Heylaerts).

Genus: EPICHNOPTERIX, Hübner.

SYNONYMY.—Genus: *Epichnopterix* (rect. *Epichnopteryx*), Hb., "Verz. bek. Schmett.," pp. 399-400 (? 1816); Fiori, "Bull. Soc. Ent. It.," xii., p. 214 (1880); Czek., "Verh. Sieb. Ver.," xlii., p. 44 (1892). *Epichnopteryx*, Speyer, "Geog. Verb. Schmett.," i., p. 310 (1858); ii., p. 279 (1862); Hein., "Schmett. Deutsch.," i., p. 185 (1859); Wilde, "Zeit. Nat. Halle," xvi., p. 306 (1860); "Pflanz. und Raup. Deutsch.," ii., p. 76 (1861); Nick., "Lotos," xi., p. 155 (1861); Schmidt, "Schr. Ges. Königsb.," iii., p. 73 (1862); Staud., "Cat.," 2nd ed., p. 64 (1871); "Hor. Soc. Ent. Ross.," xiv., p. 350 (1879); "Rom. Mém.," vi., p. 302 (1892); Paul and Plötz, "Mitt. Nat. Ver. Neupomm.," iv., p. 68 (1872); "Arch. Meckl.," xxxiii., p. 64 (1880); Wocke, "Zeit. Ent. Bresl.," iii., p. 26 (1872); Glitz, "Jahresb. Ges. Hannov.," xxiv., p. 36 (1874); Meur., "Schmett. Rudolstadt," p. 31 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 103 (1875); Curò, "Bull. Soc. Ent. It.," viii., p. 144 (1876); Sint., "Arch. Nat. Liv.," (2), vii., p. 335 (sep. p. 15) (1876); Höfn., "J.-B. Landesm. Kärnt.," xii., p. 18 (1876); Weiler, "Verz. Schmett. Innsb.," p. 15 (1877); "Lep. Tauf.," p. 17 (1880); Rozsay, "Cat. Lep. Pos.," p. 8 (1878); Sand, "Cat. Lép. Auv.," p. 32 (1879); Mart. y Peña, "Cat. Ins. Catal.," p. 115 (1879); Pfütz., "Deutsch. Ent. Zeit.," xxiii., p. 37 (1879); Turati, "Bull. Soc. Ent. Ital.," xi., p. 170 (1879); Fritsch, "Denks. Akad. Wien," xli., p. 64 (1879); Rehberg, "Abh. Nat. Ver. Brem.," vi., p. 467 (1879); Peyer., "Cat. Lép. Als.," ed. 2, p. 59 (1880); Frey, "Lep. der Schweiz," p. 92 (1880); Erschoff, "Trudy Ross.," xii., p. 203 (1881); Heyl., "Ann. Soc. Ent. Belg.," 1881, p. 72; Heller, "Ber. Ver. Innsb.," xi., p. 90 (1881); Rossl., "J.-B. Ver. Nat. Nass.," xxxiii-xxxiv., p. 226 (1881); Kill., "J.-B. Nat. Ges. Graubünden," xxiii-xxiv., p. 64 (1881); Alb., "Bull. Mosc.," lvi., pt. 4, p. 381 (1881); Her., "Stett. Ent. Zeit.," xlii., p. 154 (1881); Husz, "Magy. Karpat. Evkön," viii., pp. 251, 283 (1881); Snell., "Vlind. Ned. Microlep.," p. 440 (1882); Donck., "Ann. Soc. Ent. Belg.," xxvi., p. 27 (1882); Jourdh., "Mém. Soc. Aube," xlvii., p. 46 (1883); Klem., "Sprawoz. Konis. Fizy.," xvii., p. 205 (1883); Hom., "Stett. Ent. Zeit.," xlv., p. 424 (1884); Schmid, "C.-B. Nat. Ver. Regensb.," xxxix., p. 84 (sep. p. 35) (1885); Kriegh., "Mitt. Geog. Ges. Thür.," iii., p. 121 (1885); Vángel, "Rovart. Lapok," iii., p. 143 (1886); Jord., "Schmett. N.-W. Deutsch.," p. 94 (1886); Hudák, "Rovart. Lapok," iii., p. 243 (1886); Fisch., "Schr. Nat. Ver. Harz," i., p. 12 (1886); Calb., "Iris," i., p. 154 (1887); Hug., "Mitt. Sch. Ent. Ges.," vii., p. 320 (1887); Zimm., "Verh. Ver. Nat. Hamb.," vi., p. 21 (1887); vii., p. 20 (1881); Pal. and Ted., "Nat. Sic.," vii., p. 228 (1888); Rühl, "Soc. Ent.," ii., p. 180 (1888); v., p. 154 (1891); Teich, "Arb. Nat. Ver. 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Württ.," v., p. 97 (1850); Vig., "J.-B. Ver. N. K. Nass.," vi., p. 57 (1850); Hein., "Stett. Ent. Zeit.," xii., p. 63 (1851); Ghil., "Elenco," p. 24 (1852); Freyer, "Neu. Beit.," viii., p. 90 (1856); Now., "Lep. Hal.-Or.," p. 30 (1860); Kranz, "Schmett. Münch.," p. 35 (1860); Kell. and Hoffm., "Verh. Nat. Württ.," xvii., p. 288 (1861); Pritt., "Stett. Ent. Zeit.," xxiii., p. 504 (1862); Cooke, "Merrifield's Brighton," p. 213 (1864); Zell., "Verh. z.-b. Ges. Wien," xviii., p. 579 (1868); Gn., "Lep. Eure-et-Loir," p. 56 (1875); Tutt, "Brit. Moths," p. 343 (1896). *Fumaria*, Haw., "Lep. Brit.," pt. 3, p. 473 (1811). *Fumea*, Haw., "Trans. Ent. Soc. Lond.," p. 340 (1812); Stephs., "Ill. Brit. Ent.," ii., p. 82 (1829); Curt., "Brit. Ent.," vii., p. 332 (1830); Wood, "Ind. Ent.," p. 27 (1839); H.-Sch., "Sys. Bearb.," v., p. 61 (1855); Sta., "Man.," i., p. 167 (1857); Mann, "Wien. Ent. Monats.," i., p. 147 (1857); Ramb., "Cat. Lép. And.," p. 315 (1858); Bert., "Pollichia," 1859, p. 319 (1859); Hofm., "Berl. Ent. Zeits.," iv., p. 28 (1860); Kef. and Wernbg., "J.-B. Ak. Erfurt," i., p. 156 (1860); Staud., "Cat.," 1st ed., p. 27 (1861); Led., "Wien. Ent. Monats.," vii., p. 23 (1863); Röss., "J.-B. Ver. Nat. Nass.," xix-xx., p. 140 (1866); Const., "Cat. Lép. Saone-Loire," p. 91 (1866); Gärt., "Verh. Nat. Ver. Brünn," iv., p. 165 (1866); Mill., "Ann. Soc. Linn. Lyon," xiv., p. 360 (1867); Nolck., "Lep. Fn. Est.," p. 120 (1867); Hint., "Zeit. Ferdinand.," (3), xiii., p. 232 (1867); Maassen, "Stett. Ent. Zeit.," xxix., p. 439 (1868); Stange, "Verz. Halle Schmett.," p. 18 (1869); Cuní y Mart., "Cat. Lep. Barc.," p. 63 (1874); Kretsch., "Mitt. Ver. Frankf.-a.-O.," ii., p. 27 (1884). *Canephora*, Hdrch., "Lep. Eur. Cat.," ed. 3, p. 24 (1851); Reutti, "Lep. Bad.," 1st ed., p. 49 (1853); Wocke, "Cat. Lep. Siles.," p. 2 (1853); Koch, "Schmett. S.-W. Deutsch.," p. 72 (1856); Assmuss, "Symb. Faun. Mosq.," p. 14 (1858).

The diagnosis of this genus reads (*Verz. bek. Schmett.*, p. 399) as follows:

Die Flügel schittern beschüppelt, doch ziemlich bedeckt.

Hübner's genus includes six divergent species—*pennella*, *plumigerella*, *plumella*, *pectinella*, *nitidella*, and *bombycella*. Of these, *pennella* belongs to *Heterogynis*, *plumigerella* is undetermined, *plumella* =*pulla*, *nitidella* is a *Fumea*, whilst *bombycella* (considered by Staudinger an *Epichnopterix*) and *pectinella* (considered by Staudinger a *Fumea*) are united to form the genus *Bijugis*, Heylaerts. This leaves only *plumella* = *pulla* of the known original species, as the type of the genus *Epichnopterix*, this species being included in the genus by Staudinger and Heylaerts. But almost all recent authors have used *Epichnopterix* as a genus equal in value to something rather more than our *Epichnopterygidae*. Staudinger includes therein species of the Fumeid genus *Bruandia*, of *Bijugis*, and *Whittleia*, besides the true species of *Epichnopterix*, Rambur's *Psychidea* being placed by this author in *Fumea*; whilst Heylaerts includes *Whittleia* and Rambur's *Psychidea* in *Epichnopteryx*, but eliminates *Bijugis* and *Bruandia*. In addition both authors treat the *graecella* of Millière (which has an anterior tibial spur and hence should be a *Psychidea*) as a variety of *E. pulla*. The recognised species of *Epichnopterix* appear to be *E. mentonella*, *pulla*, *innitidella*, *hofmanni*, *ardua*, *flavociliella*, *tarnierella*, and ?*myrmidonella*. The genus as here limited may be diagnosed as follows:

Ovum.—Comparatively large, oval, laid in mass in pupa-skin, female then drops out of case.

Case.—Spindle-shaped; silken tube sheathed with flat grass leaves; particularly extended posteriorly.

Larva.—Abdominal segments bulky, tapers towards head. Head small, rounded, black, shiny, clypeus edged with white. Prothorax longer (front to back) than mesothorax and metathorax; thoracic segments corneous, polished black, with broad, white mediodorsal, subdorsal, and lateral bands. Abdomen red-brown, segmental incisions strongly marked; segments divided into two subsegments; tubercle i outside ii, iii supraspiracular, iv and v subspiracular, vi and vii below these, setæ long, slender, on small chitinous plates; anal plate chitinous, dark;

lateral flanges very marked; spiracles large raised on short tubes; prolegs of ordinary Psychid form with strong hooks.

PUPA.—♂. Labium bifurcate at tip; maxillæ long and square; jaws long; maxillary palpi obsolete; cheeks rather low down; dorsal head-piece very minute; antennæ slightly beyond 1st pair of legs; two stout ventro-anal hooks; scars of prolegs strongly marked; abdominal segments with anterior transverse rows of spines and posterior intersegmental series (4-5—7-8); tubercles much as in larva; metathorax wide, with tubercles as minute hairs; hardly to be detected. ♀. Head very similar to that of a larva (with clypeus, cheek-pieces with depression above clypeus), mandibles distinct; labrum almost a part of clypeus; antennæ form lappets low down on cheeks; labium forms another lappet; with maxillæ forming smaller lappets on either side; the three pairs of legs pass outwards from middle line; wings form small lappets almost reaching the legs; anterior spines flat and blunt; intersegmental spines quite blunt. The face-parts adhere to ♀ imago on emergence.

IMAGO.—♂. Uniformly coloured; clothed with hair-like scales; rather broader scales with a few striæ scattered over forewings and more abundant on costa and at apex; some scales on hindwings still more defined. Antennæ with scaleless pectinations. Anterior tibiæ without spur; posterior tibiæ with two well-developed pairs of spurs. ♀. Vermiform; naked; head small, ventral, mouth-organs modified, not functional; legs appear as minute warts; antennæ as warts; eye-spots dark; wings obsolete; thoracic segments with whitish corneous dorsal shields, the head carrying pupal head-parts; skin transparent (some of the internal organs visible); reddish-yellow in tint with faint anterior transverse dorsal abdominal plates.

The peculiar spindle-like case of this genus, in which flat grass leaves swathe closely as it were the silken tube, and the drawing together of the materials at the free end of the case are in striking contrast with *Fumea*, where they often widely diverge, and the effect is increased by the materials being often apparently blades instead of stems of grass, which lie very flatly to the case. The materials used appear to be always grass—often culms, sometimes blades, especially of those with thick fleshy triangular leaves. The older material is well in evidence, and always so rotted and wasted that it looks like the remains of flat leaves when probably really stems, and an appearance of dirt and *Conferva* is due rather to this condition of the material than to such natural materials. The chips covering the collapsible mouth are longer and narrower than the short angular pieces of *Fumea*. The large quantity of pale markings on the head and thorax of the larva, and the peculiar pupal structure showing in the male pupa an absence of maxillary palpi, the cheeks dipping far below the jaws, and a very minute headpiece, whilst the face-parts of the female pupa adhere to the head of the imago on emergence, and the characteristic anterior row of transverse hooks are represented by flat and blunt eminences, and the posterior intersegmental row of hooks as blunt points (whilst those of *Whittleia*, have points bearing sharp hair-like processes) are perhaps worthy of notice. The males of the genus have the uniform grey or black tint characteristic of most of the higher Psychids.

EPICHNOPTERIX PULLA, Esper.

SYNONYMY.—Species: *Pulla*, Esp., "Schmett. Abbild.," iii., p. 232, pl. xliv., fig. 3 (1785); Vill., "Ent. Linn.," ii., p. 155 (1789); Bork., "Sys. Besch.," iii., p. 287 (1790); Brahm, "Ins.-Kal.," ii., p. 501 (1791); Jung, "Alph. Verz.," ii., p. 144 (1792); Ochs., "Die Schmett.," iii., p. 167 (1810); Germ., "Mag. Ent.," i., p. 44 (1813); Meig., "Hand. Schmett.," p. 121, pl. xi., fig. 9 (1827); "Eur. Schmett.," iii., p. 11, pl. lxxxviii., fig. 13 (1830); Stephs., "Ill.," ii., p. 82 (1829); Curt., "Brit. Ent.," fig. 332, *nec* case (1830); Wood, "Ind. Meth.," p. 27, fig. 82 (1839); Bdv., "Gen. Ins. Meth.," p. 79 (1840); Her., "Stett. Ent. Zeit.," iii., p. 7 (1842); Dup., "Hist. Nat.," supp. iv., p. 72, pl. lvi., fig. 11 (1842); "Cat. Méth.," p. 65 (1844);

Evers., "Faun. Volg.-Ural.," p. 136 (1844); Heydrch., "Syst. Verz.," ed. 2, p. 6 (1846); "Lep. Eur. Cat.," ed. 3, p. 24 (1851); Richter, "Stett. Ent. Zeit.," x., p. 85 (1849); Dick., "Ber. Oberhess. Ges.," ii., p. 94 (1849); Fuss, "Verh. Sieb. Ver.," p. 58 (1850); Seyff., "Ver. Vat. Nat. Würt.," v., p. 97 (1850); Vig., "J.-B. Ver. N. K. Nass.," vi., p. 57 (1850); Hein., "Stett. Ent. Zeit.," xii., p. 63 (1851); "Schmett. Deutsch.," i., p. 185 (1859); Humph. and Westd., "Brit. Moths," i., p. 78, *nec* pl. xvi., fig. 12 (1851); Ghil., "Elenco," p. 24 (1852); Reutti, "Lep. Bad.," 1st ed., p. 49 (1853); 2nd ed., p. 306 (1898); Wocke, "Cat. Lep. Siles.," p. 2 (1853); "Zeit. Ent. Bresl.," iii., p. 26 (1872); H.-Sch., "Sys. Bearb.," v., p. 61 (1855); Freyer, "Neu. Beit.," vii., p. 90, pl. 653, fig. 1 (1856); Koch, "Schmett. S.-W. Deutsch.," p. 72 (1856); Mann, "Wien. Ent. Monats.," i., p. 147 (1857); Assmuss, "Symb. Faun. Mosq.," p. 14 (1858); Ramb., "Faun. And.," p. 315 (1858); Spey., "Geog. Verb. Schmett.," i., p. 310 (1858); ii., p. 279 (1862); "Nat. Ver. Preuss. Rheinl.," xxiv., p. 132 (1867); Bert., "Pollichia," 1859, p. 319; Now., "Lep. Hal. Or.," p. 30 (1860); Hofm., "Berl. Ent. Zeits.," iv., p. 28 (1860); Kranz., "Schmett. Münch.," p. 35 (1860); Kef. and Wernbg., "J.-B. Ak. Erfurt," N.F.i., p. 156 (1860); Wilde, "Zeit. Nat. Halle," xvi., p. 306 (1860); "Pflanz. und Raup. Deutsch.," ii., p. 76 (1861); Staud., "Cat.," 1st ed., p. 27 (1861); 2nd ed., p. 64 (1871); "Hor. Soc. Ent. Ross.," xiv., p. 350 (1879); "Rom. Mém.," vi., p. 302 (1892); Nick., "Lotos," xi., p. 155 (1861); Kell. and Hoffm., "Verh. Nat. Württ.," xvii., p. 288 (1861); Mitfd., "Zool.," 1861, p. 7452; Schmidt, "Schr. Ges. Königs.," iii., p. 73 (1862); "Arch. Mecklenb.," xxxiii., p. 64 (1880); Ted., "Wien. Ent. Monats.," vii., p. 23 (1863); Röss., "J.-B. Ver. Nat. Nass.," xix-xx., p. 140 (1863); Const., "Cat. Lép. Saone-Loire," p. 91 (1866); Gärt., "Verh. Nat. Ver. Brünn," iv., p. 165 (1866); Nolck., "Lep. Faun. Est.," p. 120 (1867); Hinterwaldner, "Zeit. Fedinand.," (3), xiii., p. 232 (1867); Maassen, "Stett. Ent. Zeit.," xxix., p. 439 (1868); Zell., "Verh. z.-b. Ges. Wien," xviii., p. 579 (1868); Stange, "Verz. Halle Schmett.," p. 18 (1869); Heyl., "Tijd. v. Ent.," xiii., p. 148 (1870); "Ann. Soc. Ent. Belg.," xxv., p. 72 (1881); Paul and Plötz, "Mitt. Nat. Ver. Neupomm.," iv., p. 68 (1872); Glitz, "J.-B. Ges. Han.," xxiv., p. 36 (1874); Cuní y Mart., "Cat. Lép. Barc.," p. 63 (1874); Meur., "Schmett. Rudolstadt," p. 31 (1874); Gn., "Lép. Eure-et-Loir," p. 56 (1875); Mill., "Cat, Lép. Alp.-Mar.," p. 103 (1875); Curò, "Bull. Soc. Ent. It.," viii., p. 144 (1876); Sint., "Arch. Nat. Liv.," (2), vii., p. 335 (sep. p. 15) (1876); Höfn., "J.-B. Landesm. Kärnt.," xii., p. 18 (1876); Weiler, "Verz. Schmett. Innsb.," p. 15 (1877); "Lep. Taufers," p. 17 (1880); Rozsay, "Cat. Lep. Pos.," p. 8 (1878); Sand, "Cat. Lép. Auv.," p. 32 (1879); Mart. y Peña, "Cat. Ins. Catal.," p. 115 (1879); Pfütz., "Deutsch. Ent. Zeit.," xxiii., p. 37 (1879); Tur., "Bull. Soc. Ent. Ital.," xi., p. 170 (1879); Fritsch, "Denks. Akad. Wien," xli., p. 64 (1879); Rehbg., "Abh. Nat. Ver. Brem.," vi., p. 467 (1879); Peyer., "Cat. Lép. Als.," ed. 2, p. 59 (1880); Frey, "Lep. der Schweiz," p. 92 (1880); Fiori, "Bull. Soc. Ent. Ital.," xii., p. 214 (1880); Erschoff, "Trudy Ross.," xii., p. 203 (1881); Hell., "Ber. Ver. Innsbr.," xi., p. 90 (1881); Röss., "J.-B. Ver. Nat. Nass.," xxxiii-iv., p. 226 (1881); Kill., "J.-B. Nat. Ges. Graub.," xxiii-iv., p. 64 (1881); Alb., "Bull. Mosc.," lvi., pt. 4, p. 381 (1881); Husz, "Magy. Karpat. Evkön.," viii., pp. 251, 283 (1881); Snell., "De Vlind. Ned.," p. 440 (1882); Donck., "Ann. Soc. Ent. Belg.," xxvi., p. 27 (1882); Jourd., "Mém. Soc. Aube," xlvii., p. 46 (1883); Klem., "Sprawoz. Komis. Fizy.," xvii., p. 205 (1883); Hom., "Stett. Ent. Zeit.," xlv., p. 424 (1884); Kretsch., "Mitt. Ver. Frank.-a.-Oder," ii., p. 27 (1884); Schmid, "C.-B. Nat. Ver. Regensb.," xxxix., p. 84 (sep. p. 35) (1885); Krieghoff, "Mitt. Geog. Ges. Thür.," iii., p. 121 (1885); Váng., "Rov. Lapok," iii., p. 143 (1886); Jord., "Schmett. N.-W. Deutsch.," p. 94 (1886); Hudák, "Rov. Lapok," iii., p. 243 (1886); Fisch., "Schr. Nat. Ver. Harz," i., p. 12 (1886); Calb., "Iris," i., p. 154 (1887); Hug., "Mitt. Schweiz. Ent. Ges.," vii., p. 320 (1887); Zimm., "Verh. Ver. Nat. Hamb.," vi., p. 21 (1887); vii., p. 20 (1891); Pal. and Ted., "Nat. Sic.," vii., p. 228 (1888); Rühl, "Soc. Ent.," ii., p. 180 (1888); v. p. 154 (1891); Teich, "Arb. Nat. Ver. Riga," vi., p. 20 (1889); Pabst, "Iris," iii., p. 120 (1890); Zap. and Korb, "Ann. Soc. Esp. Hist. Nat.," xxi., p. 113 (1892); Kirby, "Cat. Lep. Het.," p. 520 (1892); Garb., "S.-B. Akad. Wiss. Wien," ci., p. 933 (1892); Stein., "Iris," v., p. 413 (1892); Czek., "Verh. Sieb. Ver.," xlii., p. 44 (1892); xlvii., p. 26 (1897); Brown, "Act. Soc. Linn. Bord.," xlv., p. 55 (1892); Carad., "Iris," vi., p. 201 (1893); viii., p. 87 (1895); Werch., "Sprawoz. Komis. Fizy.," xxviii., p. 203 (1893); Barr., "Ent. Mo. Mag.," xxx., p. 249 (1894); "Lep. Brit.," ii., p. 347 (1895); Mab., "Bull. Soc. Aude," vi., p. 158 (1895); Meyr., "Handbook," p. 773 (1895); Rebel, "Ver. z.-b. Ges. Wien," xlv., p. 391 (1895); Tutt, "Brit. Moths," p. 343

(1896); Schütze, "Iris," ix., p. 335 (1896); Lutz., "K.-B. Ver. Riga," xxxix., Bomb. no. 48 (1896); Horm., "Verh. z.-b. Ges. Wien," xlvii., p. 323 (1897); Whittle, "Sci. Gossip," 2nd ser., v., p. 368 (1899). *Muscella*, ? Fab., "Mant.," ii., p. 132 (1787); ? View., "Tab. Verz.," i., p. 68 (1789); ? De Vill., "Linn. Ent.," iv., p. 453 (1789); ? Lang, "Verz. Schmett.," p. 215 (1789); Stephs., "Ill.," ii., p. 82 (1829); Wood, "Ind. Ent.," p. 27, fig. 83 (1839). *Plumella*, Hb., "Eur. Schmett.," p. 14, fig. 7 (1796); "Verz.," no. 3863, p. 400 (? 1816); Curt., "Brit. Ent.," supp., fig. 332 (1830); Humph. and West., "Brit. Moths," ii., p. 82, *nec* pl. xvi., fig. 14 (1851). *Muscea*, Haw., "Lep. Brit.," iii., p. 473 (1811). *Pectinea*, ? Haw., "Lep. Brit.," iii., p. 473 (1811); Stephs., "Ill.," ii., p. 83 (1829). *Plumistrea*, Haw., "Lep. Brit.," iii., p. 474 (1811). *Plumea*, Haw., "Lep. Brit.," iii., p. 474 (1811). *Bombycella*, Stephs., "Ill.," ii., p. 83 (1829); Wood, "Ind. Ent.," p. 27, fig. 84 (1839). *Radiella*, Curt., "Guide," gen. 827, no. 3 (1829); "Brit. Ent.," exp. fig. 332 (1830); Bdv., "Gen. Ind. Meth.," p. 79 (1840); Dup., "Cat. Méth.," p. 65 (1844); Hdrch., "Syst. Verz.," ed. 2, p. 6 (1846); Bruand, "Mon. Psych.," p. 87 no. 61 *ter*, pl. ii., fig. 61 *ter* (1853); Sta., "Man.," i., p. 167 (1857); Cooke, "Merrifield's Brighton," p. 213 (1864); Staud., "Cat.," p. 64 (1871). *Pectinella*, Curt., "Brit. Ent.," expl. fig. 332 (1830); Stephs., "Ill.," p. 53 (1829); Wood, "Ind. Ent.," p. 27, fig. 85 (1839); H. and West., "Brit. Moths," ii., p. 82, *nec.* pl. xvi., fig 15 (1851). *Pulella*, Bruand, "Mém. Soc. Doubs," ii., livr. 1-2, p. 63 (1845). *Pullella*, Bruand, "Mon. des Psych.," p. 85, pl. ii., figs. 61*a-c* (1853); Mitford, "Ent. Mo. Mag.," vi., p. 94 (1869); Merr., "Lep. Cal.," pp. 55, 67, 100 (1875). *? Pontbrillantella*, Brd., "Ann. Soc. Ent. Fr.," (3), vi., p. 467, pl. xi., fig. 1 (1858); Staud., "Cat.," 2nd ed., p. 64 (1871); Kirby, "Cat. Lep. Het.," p. 521 (1892). *? Gruneriella*, Brd., "Ann. Soc. Ent. Fr.," (3), vi., p. 468, pl. xi., fig. 4 (1858); Kirby, "Cat. Lep. Het.," p. 521 (1892).

Original Description.—*Phalaena Bomb.* eling. al. depres. dorso lævi. Die Mücken-Phalene. *Bomb.* elinguis atra, alis latioribus margine piloso undique cincta, squamis capillatis sparsim tectis. [*System. Verz. der Wiener Schmett.*, p. 133. Tineæ. Schaben. Fam. A. Scheinspinner Schaben. Phal. Tin. Bombyciformes. Sp. 3: *Tin. muscella.* Fliegenflügellichter Schabe. Unbekannte Raupe.*] Das Strittige dieser Phalene in Rücksicht des Systems habe ich bereits in Beschreibung der vorigen Gattung erwahnt. Hier ist nun lediglich der Unterscheid derselben zu bemerken. Es scheint zwar, dass Herr von Linné unter dem Nahmen *atra*, diesen vorliegenden Falter eigentlich gemeint habe. Es ist wenigstens auch in weiter nördlich gelegenen Erdstrichen unseres Welttheils vorhanden. Doch hat derselbe nicht so beträchtlich gefiederte Antennen wie jener, und diess ist nach übereinstimmender Grösse der vorzüglichste Abstand. Es kommt einmahl auf die Venennung nicht an, genug wenn ich die hier vorliegende Art, um Verwirrung zu verhüten, genauer bezeichne. Die Flügel sind in wergleichung der erst beschriebenen Phalene um vieles breiter gebildet, wie die hier beygefügte vergrosserte Abbildung deutlich erweisst. Sie sind minder durchsichtig und von düsterem Schwarz. Doch liegen die Schuppen nur einzeln, in Gestalt kurzer Haare darauf. Sämtliche Flügel haben noch das Eigene, dass der Rand derselben in seinem ganzem Bezirk mit Franzen bordirt ist. Es sind parallelausstehende Borsten, wiewohl von feinstem Gewebe. Der Leib ist zwar sehr haarig, doch lange nicht in der Dicke und so zottig wie sie die *atra* führt. Die Fühlhörner fand ich niemahlen von der beträchtlichen

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* Hieher wird auch von den Herren V. nach Beyfügung des Linneischen Nahmens die *atra* gerechnet, und *Tinea graminella* geheissen. Es ist aber wahrscheinlich, dass damit unsere *vestita* möchte gemeint sein, oder ihre erste Gattung, *Tinea graminella*, Grassschabenraupe. Es stimmt die angeführte Beschreib. des Geoffroi "Teigne a fourreau de paille composé," mit solcher am nächsten überein. Doch ist es wegen Aehnlichkeit anderer Arten abermahl nicht mit Gewissheit zu bestimmen.

Stärke, wie bei ersterer Art. Diess kann das Characteristische einer eigenen Gattung genugsam bestimmen. Ich bemerke noch, dass zuweilen die Flügel ganz durchsichtig erscheinen, da die haarigte Schuppen sehr leicht durch den Flug sich verlieren. Man findet diese Phalene zu Anfang des Sommers im Gras auf Wiesen, oder in Waldungen auf blumigten Platzen. Mehrentheils trift man sie in einem kleinen Bezirk zahlreich beisammen an. Doch sind sie schwer zu entdecken, und noch mühsamer zu fangen. Sie entgehen schon auf ein paar Schritte dem Gesicht. Ihre Farbe, und der durchirrende Flug schützt sie für Nachstellung mehr, als durch würkliche Waffen. Man trift sie auch zuweilen in einiger Betäubung auf den Grasstengeln sitzend an (Esper, *Die Schmett.*, &c., p. 232.)

Imago.—Anterior wings 10mm.-16mm. in expanse, uniformly black, with black cilia, apices rounded, posterior wings also uniformly black with black cilia. (Quite freshly emerged examples are much blacker, more densely scaled, and opaque than those that have flown).

Sexual dimorphism.—♂. The *male* is black (jet-black when newly emerged), densely clothed with slender hair-scales (which soon rub off), on the forewings, slightly broader scales with a few striæ being scattered over the wing and occurring more densely on the costa and at the apex where some of the scales have quite bifid apices. The scales on the hindwings are more defined although slender and their apices are generally pointed. The antennæ have 18 joints*, pectinations unscaled. The anterior tibiæ are without spurs, the posterior tibiæ have two well-developed pairs. ♀. The *female* may be described as a bag of eggs; the following structures, however, exist: A small head (with a distinct neck) that remains enclosed in the pupal head, but how attached or whether only held on by the narrowness of the opening of the pupal head does not appear. The imaginal head presents several mammillæ in front, which no doubt correspond more or less with the antennæ, maxillæ, &c., noted in the pupa. The true legs are represented by six mammillæ, nearly twice as long as broad, but apparently soft and structureless. The ova and uriniferous tubercles are easily seen through the parietes, the former appear to be ovoid and about ·5mm. in length. Two joints of the ovipositor are very evident; the first one containing two rods attached to the second. The number of segments is, therefore, the same as in the araneiform females of the lower Psychids, *viz.*, two with an intermediate membrane (frequently described as a third segment) (Chapman). Barrett describes the living female as "about half an inch long, stout and very like a maggot, reddish-yellow, redder on the back, especially at the segmental incisions; head very small and tucked down, a mere brownish mask, browner where the mouth should be; no mouth organs, antennæ, wings, nor scales; legs just indicated by minute, jointed, yellow, glassy points, without claws—mere papillæ, apparently without motion or function; seemingly without dorsal shields; pretty even in thickness to about the 11th segment, which, with the following, tapers off rapidly, the 13th being small, bluntly terminated, except a small point or ovipositor case projecting from its centre. This portion of the body

* The antennæ of ordinary British *E. pulla* vary in having from 17-20 joints, typically there are 18; large specimens from Italy and the French Riviera have 21-22 joints, and one of Zeller's from Bergün has 21 joints; *sieboldii*, from Staudinger, has the normal number, 18.

has a vermicular motion, otherwise the creature seems quite inert. Preserved specimens which have laid their eggs shrink very short and small and become curious little squared objects, ribbed closely at the insertions of the segments." Bruand describes the female as vermiform, but comparatively stouter than that of *C. unicolor*. It is stout, short, with the head very small and bent under ventrally, the legs scarcely noticeable, and the ovipositor very slightly projecting. The general colour is yellow-brown, inclining to reddish, a little darker anteriorly; the dorsum of the thoracic segments is whitish, and downy. Hofmann describes the ♀ (from "inflated" examples received from Reutti) as $2\frac{1}{2}'''$ long, $\frac{2}{3}'''$ wide; extremely similar to ♀ *sieboldii*, bright red-brown in colour, with yellowish-brown corneous dorsal plates on the pro- and mesothorax, whilst in *sieboldii* there is also one on the metathorax. His description of the ♀ *sieboldii* (*post.* p. 355) which is probably also referable to this species, is a much better account of the insect.

Variation.—One would suspect from the long array of named forms that this was a variable species, but the variation is simply that of size, intensity of colour, and density of scaling. The examples from the Riviera (and judging from the account of Cuní y Martorell, the Spanish specimens also) are intensely black, well scaled, and usually of large size. These, Chapman says, have 20-22 joints to the antennæ, and this must be the form looked on as the type by continental entomologists, who note *sieboldii* as browner, rather smaller, less strongly scaled, &c., than the typical form. Certain *sieboldii* received from Staudinger appear to be indistinguishable from our largest British *pulla* (known on the continent as *radiella*) and differ from the latter only in the apparently rather denser scaling, although our British examples, when large and in fine condition, are very well scaled. How far the suspicion that *pulla* may consist of more than one distinct species is sound we cannot say; much more material is needed from the various parts of its geographical range. We have, certainly, only one species in Britain, and the males vary much in size. We have specimens extending from 10mm. to 16mm. in wing expanse, all caught in the same locality (Chattenden), but on the whole those from the drier chalk hills are smaller than those from damp meadows. It would also appear that on the continent the mountain forms incline to be of small size, and Wocke notes that on the crest of the Riesen, a smaller and much weaker-scaled form (reminding one of *E. ardua*, Mann) is to be found; the small examples which Zeller captured in the Albula Pass at 7200ft. elevation (Brit. Mus. coll.) are also very similar, whilst Zeller notes the specimens from Kerasdere in Asia Minor as being small. On the other hand, the forms from lowlying and marshy ground are usually larger, *e.g.*, the ? type form of the Riviera, var. *silesiaca* from Reinerz, the marsh form mentioned by Bruand as occurring near Besançon, the latter also being noted as later in its time of appearance. Much, however, must be done by comparison of the life-histories of the various forms before satisfactory results as to their value can be reached. Millière's *graecella** (at least so far

* The *graecella* in the British Museum coll. from Greece are distinctly a *Psychidea*, whilst the others named *graecella* from different parts of Europe are all large examples of (*i.e.*, typical) *E. pulla*. We suspect Millière's south French *graecella* are *pulla* or an allied species certainly not identical with that from Greece.

as the specimens from Greece are concerned) is not only, not a variety of *pulla* as it is generally catalogued, but is not even an *Epichnopteryx*, since it possesses an anterior tibial spur as in the species of *Psychidea*, to which it probably belongs. Chapman informs us that of two large typical Italian examples (received from Rothschild) one has well-developed cellula intrusa in the forewings, whilst the other has none, and that a specimen of var. *sieboldii* has an extra nervure on one side. Summarising our knowledge of the forms they appear to us to fall roughly into the following:

1. The large, 15mm.-17mm., densely scaled, intensely black, type form, with 21-22 joints to antennæ, from Cannes (Tutt), Alassio (Chapman), Bergün, Glogau, Stettin, Schneeberg, Zürich (Brit. Mus. coll.) = *pulla*, Esp.

2. A large, 14mm.-16mm., very well scaled (but rather less opaquely so than the type), blackish (but with a grey tinge absent in the type) form, with 18 joints to the antennæ, from Albula, Zürich, Silesia, Bergün, Ratisbon, Stelzing (Brit. Mus. coll.). The very largest British examples perhaps fall here although possibly rather less black = *sieboldii*.

3. A rather smaller, 12mm.-14mm., well scaled, blackish form, with 18 antennal joints, from Raibl, Preth, Posen (Hering's own examples) (Brit. Mus. coll.), and exactly similar to some British specimens = *heringii*, Hein. (= ? *pullisimilella*, Bruand).

4. A variable, 10mm.-16mm., greyish-black form, paler, somewhat weakly scaled and rather transparent, with brownish (or yellowish) tinge under lens towards apex, with 17-20 joints to antennæ, including most of our British examples, and a great share of the central European ones = *plumistrea*, Haw. (= *radiella*, Curt.).

The fact that certain of our larger British examples are indistinguishable from the continental *sieboldii* (both in the larger size and darker colour, which seem largely to be united in the same individuals), and that many of the central European examples are as small, thinly scaled, and pale as the greater number of our British examples, suggest that these are identical, whilst individuals practically indistinguishable from the south European type, appear to occur as aberrations of (coming from the same localities as) *sieboldii* in various German localities. We know nothing of the exceptionally large mountain form *silesiaca* (which possibly is referable to the type form, although mountain examples are usually small), nor of Bruand's *innitidella*, referred to this species by Heylaerts and Kirby. Barrett says that specimens that have been more worn in the middle of the wing than at the margin appear to have been mistaken for *E. marginepunctella*, Bruand, but we are unable to trace any insect of this name allied to *E. pulla*.

a. var. *silesiaca*, Standf., "Ver. für Schles. Ins. Zeits.," 1850, p. 55; Hofm., "Berl. Ent. Zeits.," iv., p. 28 (1860); Snell., "De Vlinders," p. 440 (1882).—A *Psyche* like *E. pulla*, only a third larger, also flew in the sunshine over *Betula nana*, but as I am insufficiently acquainted with the species of *Psyche*, I do not propose to raise it to the rank of a species, although I have sent it to friends under the name of *silesiaca* (Standfuss).

Wocke says that on the "Seefeldern" and the Iser meadows at the end of June and in July a rare form is obtained, which is almost twice as large as the ordinary form, and is mentioned in the magazines as *silesiaca*, Standfuss. Hofmann observes that the insect known as *Fumea silesiaca* (of which he had a specimen from Wocke) from the sea-plains of Reinerz, appears to him to be only a larger form of *pulla*, and that he is unable to distinguish between the example sent him and two equally large ones from Lahr.

β. ? var. *sieboldii*, Reutti, "Lep. Bad.," 1st ed., p. 48 (1853); 2nd ed., p. 306 (1898); Koch, "Schm. S.-W. Deutsch.," p. 72 (1856); Spey., "Geog. Verb. Schmett.," i., p. 310 (1858); "Verh. Nat.Ver. Preuss. Rheinl.," xxiv., p. 182 (1867);

Hein., "Schmett. Deutsch.," p. 185 (1859); H.-Sch., "Neu. Schmett.," p. 9 (1856); figs. 6-7 (1861); Hofm., "Berl. Ent. Zeit.," iv., p. 25 (1860); Staud., "Cat.," 1st ed., p. 27 (1861); 2nd ed., p. 64 (1871); Wilde, "Pflanz. Raup. Deutsch.," ii., p. 76 (1861); Nick., "Lotos," xi., p. 155 (1861); Const., "Cat. Lép. Saone," p. 91 (1866); Röss., "J.-B. Ver. Nat. Nass.," xix-xx., p. 140 (1866); Mill., "Ann. Soc. Linn. Lyon," xvi., p. 44, pl. 89, figs. 8-9 (1868); Stange, "Verz. Halle Schmett.," p. 18 (1869); Wocke, "Zeit. Ent. Bresl.," iii., p. 26 (1872); "J.-B. Schles. Ges.," liv., p. 205 (1877); Weiler, "Verz. Schm. Innsb.," p. 15 (1877); Rehbg., "Abh. Ver. Brem.," p. 467 (1879); Frey, "Lep. der Schweiz," p. 92 (1880); Peyer., "Cat. Lép. Als.," ed. 2, p. 59 (1880); Röss., "J.-B. Ver. Nat. Nass.," xxxiii-xxxiv., p. 226 (1881); Heyl., "Ann. Soc. Ent. Belg.," xxv., p. 72 (1881); Snell., "De Vlind.," p. 440 (1882); Mösch., "Zeit. Ent. Bresl.," ix., p. 31 (1884); Schmid, "C.-B. Nat. Ver. Regensb.," xxxix., p. 84 (sep. p. 35) (1885); Jord., "Schmett. N.-W. Deutsch.," p. 94 (1886); Kirby, "Cat. Lep. Het.," p. 521 (1892). ? *Plumella*, Ochs., "Die Schmett.," iii., p. 168 (1810). *Pulla*, Freyer, "Neu. Beit.," p. 90, pl. 653, fig. 1 (1856).—*Canephora sieboldii*, n. sp.—*Canephora* alis atro-griseis, fusco mixtis, subhyalinalis; ciliis concoloribus, alarum anteriorum apice flavescentibus; margini anteriori nigro-piloso (Reutti). *Male*: Varies in size, generally about as large as *E. pulla*, sometimes larger, sometimes smaller. The body and bases of the wings dark brownish-black, the outer area of the wings pale or brownish-grey with dark borders, these and the apex sometimes tinged with yellow, so that, in this respect, *sieboldii* differs from the uniform dark-brown *pulla*, which, moreover, appears much later. *Female*: Vermiform, 3 lines long, 1 line wide, somewhat pointed towards the head, yellowish red-brown in colour, with small dark brown, transverse, dorsal stripes on segments 6-10, very weak in some specimens. The small head and prothorax are bent ventrally, the head round, brown, bears two short antennæ, beneath which are small black eye-spots; the rudimentary mouth-parts as in *Psyche*. The meso- and metathorax are somewhat broad, and, like the prothorax, carry white corneous dorsal plates edged with brown; on the venter of the thoracic segments are three pairs of small, unjointed, whitish leg-rudiments; the body is conical posteriorly, ending in a short blunt point, which is slightly retractile and forms a sort of ovipositor. On the dorsum of the penultimate segment are two brown, corneous, longitudinal stripes, between which part of the viscera shows through as a bright yellowish spot; on the venter of the same segment is a small not very prominent protuberance. Freshly emerged specimens have a little loose whitish wool in front of the short ovipositor, and on the prothorax, but this is soon lost. The expansion of the alimentary canal forming the stomach is visible ventrally between the legs through the naked and thin skin as a rather broad black longitudinal stripe; the ventral chain of nervous ganglia is also visible as a row of black dots. *Case*: The case is 5-6 lines long, cylindrical, of equal thickness at both ends, covered with dry grass leaves, which all extend the whole length of the case and lie smoothly against it, a tube (such as occurs in the cases of *Psyche*) is not present at the posterior end. The ♀ case is but little larger, but somewhat more swollen medially, than that of the ♂. *Larva*: 3-4 lines long, red-brown, covered with small tubercles bearing single upright setæ. The head and legs are black, the thoracic segments having black-brown corneous dorsal plates divided down the middle by a yellowish longitudinal stripe; a second subdorsal yellowish stripe is on prothoracic plate and sometimes observable on those of meso- and metathorax; below the dorsal plates are three dark brown spots on each side. The anal plate is black-brown and glossy. At the base of the legs are two small dark brown spots. *Pupa*: Bright yellowish-brown, darker dorsally, and the wing-cases are darker in the male. *Parasites*: *Campoplex*, sp., *Pezomachus*, sp. (Hofmann). Localities.—Austria: Prague, Bohemia (Nickerl), N. Tyrol, Innsbrück (Weiler). France: Saone-et-Loire, Autun (Constant), Nohant, very rare (Sand). Germany: Ratisbon, Erlangen, Taunus, Black Forest (Hofmann), ? Stettin (Heinemann), Waldeck, Rhoden, Wismar (Speyer), Munich (Hartmann), Halle (Stange), Bremen, common (Rehberg), Nassau (Rössler), Alsace, Saverne (Peyerimhoff), Franzenshöhe (Wocke), Hinterzarten, Lahr, Karlsruhe, Maxan in April and May, in July in the mountains of Baden, Würtemberg (Reutti), Hanover (Glitz), Zittan (Moeschler). Switzerland: Zürich, Albula Pass, Stelvio (Frey).

Reutti says that it is of the shape and size of *C. pulla*, the wings shorter than usual, in *pulla* more rounded, the nervures especially on the underside strong and very distinct, darker than the ground colour; black-grey with black hairs at the base, mixed with brown towards the borders. The fringe with darker marginal line as of the ground colour, and only the tip of the forewings yellowish. June, 1849, on the turf moor near Hinterzarten (2700′). Herrich-Schäffer received it from Schmidt from Frankfort-on-Main. His figures (*Neu. Schmett.*, pl., figs. 6 and 7) of the case are apparently well-grown ones of *E. pulla*, formed of thin grass leaves placed close together and identical with those sent by Bankes, Burrows and Whittle for our inspection. The case is almost of uniform width throughout, slightly drawn together, however, at the two ends, so as to make it slightly spindle-shaped. Hofmann (who stated that he knew practically nothing of *E. pulla*) considered *sieboldii* to be distinct, but suggests that it is most likely to be mistaken for *E. pulla*, from which it differs, however, as proved by hundreds of bred specimens. He states that the larvæ (which probably feed on grass and various low plants) are found in early spring in sunny open places in woods, generally a large number in a limited spot, but are only to be found after great experience, as they hide low down among the grass roots and are only active in the warm sunshine. Rössler (*J.-B. Ver. Nass.*, xxxiii., p. 26) says that *sieboldii* flies at the same time as the preceding species (*pulla*), but is much rarer. Its life-history is the same, but it is more confined to marshy meadows. The differences of the two, more particularly the smaller size of *sieboldii*, the reddish tinge on the costa, and somewhat weaker antennæ, do not appear sufficient to constitute a specific difference. Wocke says that the Franzenshöhe examples are a little smaller than those from Breslau. Imagines were captured on July 15th, and fullgrown larvæ a little later, hence he assumes it takes two years to reach maturity. Heinemann received two examples from Hering as *heringii* and *sieboldii*, but was unable to distinguish them, noting the antennæ to vary from 15-12 joints (evidently only accounting for the pectinated segments). Speyer notes obtaining cases at Rhoden from May 25th-30th, imagines being obtainable at the end of May and in June.

γ. var. *heringii*, Hein., "Schmett. Deutsch.," i., p. 186 (1859); Heyl., "Ann. Soc. Ent. Belg.," xxv., p. 72 (1881); Kirby, "Cat. Lep. Het.," p. 521 (1892). ? *Sieboldii* var. Staud., "Cat.," p. 64 (1871).—*Epichnopteryx heringii.* Schwarz mit gleichfarbigen Franzen, die Fühler mit sehr langen, gegen die Spitze schnell abnehmenden Zähnen. 2½l. The forewings as in *sieboldii*, but the apex and margin slightly more rounded, the inner angle at least indicated; the hindwings shorter not reaching beyond the inner angle of the forewings, the apex rounded off. The scaling thin, the colour (including fringes) blackish. The antennæ vary in the number, thickness, and length of the pectinations, usually there are 13 or 14, rarely 12 or 15. Stettin, Brunswick—Wolfenbüttel. May (Heinemann).

δ. var. *pullisimilella*, Bruand, "Cat. Lép. Doubs," i., p. 172 (1845). *Pulliparvella*, Bruand," Mon. des Psych.," p. 86, pl. ii., figs. 61 *bis a-b* (1853). *Palliparvella*, Kirby, "Cat. Lep. Het.," p. 520 (1892). *Pallisimilella*, Kirby, "Cat. Lep.," p. 521 (1892).—Envergure de la var. *pulliparvella*, 12mm. J'ai rencontré, pendant plusieurs années, un certain nombre de chenilles de *pullella*, dans les prés situés au-dessous de la Chapelle-des-Buis ; j'en ai receuilli des individus isolés dans diverses localités du département, principalement dans la partie basse : enfin j'ai trouvé, dans un pré gras et humide, à l'Enfer-de-Morre, près de Besançon, plusieurs fourreaux d'une taille bien plus forte que ceux provenant des prés secs ou montagneux. Les chenilles de ces grands fourreaux se sont chrysalidées au moins huit jours après les autres et ont produit des papillons à plus grande envergure (la *pullella* typique, suivant moi). Je pense que c'est de la localité plus ou moins humide, que provient cette différence de taille. Quoi qu'il en soit, j'ai figuré les deux variétés ; la grande, qui me paraît le type, sous le no. 61, et la petite, que j'ai designée par le nom de *pulliparvella*, sous le no. 61 *bis*. Celle-ci a, au moins, 3mm. d'envergure de moins que l'autre. [NOTE.—Dans le *Cat. du Doubs*, la variété *pulliparvella* est inscrite, par erreur, sous le nom de *pullisimilella* no. 1173] (Bruand).

This is the smaller form of *E. pulla*, found in the drier and more mountainous parts of the dept. du Doubs. The larger form from the damp meadows near Besançon was considered by Bruand to be the typical form. He further states his opinion that it is the humidity of the locality that produces the larger size, which we suppose may be correct so far as the humidity results in producing a more luxuriant vegetation, the latter being more directly responsible for the larger size. He also says that Lederer had noticed this difference in size but considered them only two forms of the same species; further, that the nervures are a little more robust in *pulliparvella* than in typical *pulla;* specimens received from England are also noted as having stronger nervures, whilst, on the other hand, examples from Austria have them so delicate that it is difficult to distinguish them even with a strong lens. The variety is named *pullisimilella*, in the *Cat. du Doubs*, no. 1173.

ε. ab. *plumistrea*, Haw., "Lep. Brit.," p. 474, no. 3 (1811); Kirby, "Cat. Lep. Het.," p. 521 (1892). *Muscella*, St., "Ill. Brit. Ent.," ii., p. 82 (1829). *Radiella*, Curt., "Guide," gen. 827, no. 3 (1829); "Brit. Ent.," viii., p. 332 (1830); Bruand, "Mon. des Psych.," p. 87, no. 61 *ter*, pl. ii., fig. 61 *ter* (1853); Sta., "Man.," i., p. 167 (1857); Staud., "Cat.," p. 64 (1871); Heyl., "Ann. Soc. Ent. Belg.," xxv., p. 72 (1881).—*Fumea* (The Chimney-sweeper's boy) tota atra hirsutissima. Habitat in Graminosis, at infrequens, apud Ulicis. Imago m. Jun. Expansio alarum 6 lin. (Haworth). "Antennæ dusky black, deeply pectinated; head, thorax, and abdomen black and hairy, the sides of the latter paler; wings slightly oblong, obscure hyaline, of a deep immaculate black with the margins darker, the fringes long and dusky black" (Stephens). "The woolly casebearer *radiella*, Curtis, *Guide*, gen. 827, no. 3. Male black, with a glossy purple tinge completely clothed with soft, hairy pubescence. Antennæ with 18 joints, 14 only pectinated, the rachis rather whitish; head, thorax, and body black; wings very thin, the nervures not strongly marked; superior with the costa black; the cilia long and dark; the tarsi pale, inclining to testaceous" (Curtis).

Curtis notes that his *radiella* (=*plumistrea*, Haw.) is found in grassy places among furze at Hampstead, Hertford, Epping, and Dartford. Haworth's description of *plumistrea* is very inadequate to determine the form of *E. pulla* it seems to represent. Curtis figures, with the imago of *pulla*, a case of *F. casta*. Bruand says that Curtis gave the name of *radiella* to this insect because the nervures of the forewings are very distinct on the outer margin. He describes some received from Doubleday presenting this character as being "intermediate between *pullella*, *intermediella*, and *innitidella*, being larger and blacker than *intermediella*, but less dark than *pullella*. . . . The ground colour is entirely shining brown, approaching blackish-grey, with the nervures of the anterior wings darker, and thus forming some longitudinal striæ. The last character makes me think that this must be the true *radiella*. The first examples of *pulla* I received from England under the name of *radiella* showed no characters that would justify this name."

ξ. ? var. *innitidella*, Bruand, "Mon. Psych.," p. 91, pl. ii., fig. 67 (1853); Staud., "Cat.," p. 64 (1871); Heyl., "Ann. Soc. Ent. Belg.," 1881, p. 72; Snell., "De Vlinders," p. 440 (1882); Kirby, "Cat. Lep. Het.," p. 521 (1892).—Envergure du mâle, 12mm.-13mm. Mas: Statura *pulliparvellae;* alæ posticæ paululò angustiores, necnon minores. Color brunneus, haud nitens; fimbria concolor; margine obscuriori. Antennæ acutæ; caput parvissimum, rotundatum. J'ai reçu de M. Delaharpe, de Lausanne, cette petite Psychide que je crois inédite et dont voici la description. Elle est à peu près de la taille d'une petite *pullella* (var. *pulliparvella*); mais elle a les secondes ailes un peu plus courtes et plus étroites. Sa couleur est un brun intense, très-uni, tirant légèrement sur le rougeâtre, et non luisant (d'où le nom de *innitidella*). La frange est de la même couleur que le fond, mais elle est précédée d'un liseré plus foncé. Les antennes sont longues, finement pectinées et aiguës. La tête très-petite et globuleuse. Le dessous est un peu plus clair que le dessus, passablement luisant, mais avec les nervures très peu distinctes (Bruand).

To this Bruand adds that he was informed by Delaharpe that he had collected this insect in the neighbourhood of Lausanne, but that he had not taken the male and knew nothing of the female nor of the case. His fig. 67 is poor enough and suggests a *Fumea* rather than an *Epichnopteryx*, but his figure of *radiella* (known to be *pulla*) is equally unsatisfactory. Zimmermann records it from the Lower Elbe, and Jordan doubtfully from Lüneburg.

Comparison of E. pulla with E. var. sieboldii.—Heinemann says (*Schmett. Deutsch.*, i., p. 135) that this and the following species (*sieboldii*) are very similar; *pulla* is larger, pure black, much more densely scaled, the forewings longer, truncate, the costa and margin straighter, the apex and inner angle distinctly marked, the former rounded into a smaller curve; the hindwings extended, reaching beyond the inner angle of the forewings, with rather distinct front angle. The antennæ with 16-17 pectinations decreasing a little towards the apex. Hofmann says that the female of *E. pulla*, is very close to that of *E.* var. *sieboldii*, both being of a light red-brown colour, with yellowish-brown, corneous, dorsal plates on the thoracic segments. The cases of the males and females do not appear to differ in any respect from those of *sieboldii*.

Comparison of E. pulla with E. ardua.—*E. ardua* is a delicate little species which looks exactly like a pigmy *pulla* of 7mm. or 8mm., and is described by Mann as follows:

Fumea ardua. Allied to *pulla* and *sieboldii*, but much smaller, 4 lines in expanse. Head, thorax, breast and legs black, scaled with wool, antennæ one-third length of wings, the flagellum and the long widely separated pectinations also black. The wings are yellowish-grey, rather darker at base, rather thickly set with fine long black hair-scales. Fringes long, yellowish, tinted at apex of forewings, on the costa shorter, thicker, black. Underside paler than above, rather shining, thinly set with short scales; the nervures are very prominent, the fringes coloured as above. The case is 3 lines long, cylindrical, set with fine grass stalks arranged lengthwise, I found it in the middle of July, on the Franz-Josef peak and the Gamsgrube of the Gross Glockner [Mann, *Verh. z.-b. Ges. Wien*, xvii., p. 845 (1867)].

The four examples in the British Mus. coll. appear to have been received from Mann by Zeller, and are labelled "Tyrol, vi. '67, Mann." It is a very small species very closely resembling *E. pulla* and evidently very closely allied thereto. The pale blackish-grey wings make it more like the paler forms of the allied species, but as two of the examples are distinctly darker than the others, there is probably a similar range of variation in this respect to that exhibited by *E. pulla*. Chapman notes *ardua* as of different form, being somewhat paler, and, therefore, looking much thinner scaled but not really so, it also has smaller antennal pectinations and only 17 antennal joints.

Egg-laying.—The eggs are laid almost entirely in the pupa-case, but when the ♀ has almost finished her egg-laying, she emerges completely from the pupa and places some eggs between the pupa-case and sac towards the top, all being mixed with some wool. These are the last laid before the exhausted female drops out of the case.

Ovum.—The eggs are comparatively large, ·73mm. long, ·48mm. broad, and oval in outline.

Case.—The case, of hybernating size, is 8mm. long and 2·3mm. wide, but there is one long piece of grass-leaf attached, that projects at either end, and is almost 11mm. in length. It is spindle-shaped, tapering at both ends, less markedly at the head end, the anal end being somewhat rounded ; it is composed of silk, with small fragments of grass leaf or seed husks attached, and closely swathed for the greater part of its length in flat pieces of grass-leaf (Bacot, October 8th, 1899). The full-grown case is only 9mm.-15mm. long, with projecting grass leaves 26mm. (similarly constructed to that of *W. reticella*) ; cylindrical except that it narrows to the free end, and the covering grasses are so appressed to it and bent into a curve as to apply closely to it, that a surface line from end to end either of case or cover gives a curved and not a straight line. In addition the free end has its two sides appressed into a line rather than gathered to a point (sharp or blunt) as in most *Psychidae*, or, in other words, the projection of grass leaves beyond the end on one side makes the appearance of such flattening very strong although probably only slight. The projecting straws vary much in length, number, and curvature, usually two or three in number, side by side, on one side only of the case and following the curvature of the case, they pass across in some degree to the other side and have a length of about a quarter the case, but may be shorter or longer to nearly the full length of the case (Chapman). The case is covered with flattened straws, paler than those ordinarily found on the cases of allied species, placed longitudinally in an almost regular manner ; cylindrical in shape, diameter uniform, some of the straws extending slightly beyond the lower extremity of the sac. The cases found in the fields near Chapelle-des-Buis and various parts of the dept. du Doubs are smaller than those found in a damp meadow at Enfer-de-Morre, near Besançon, where the cases are also of a much larger size than those taken in the drier fields or in the mountains (Bruand). Made of silk, covered with short lengths of slender dried grass laid most carefully parallel lengthwise, not spreading, but of equal thickness at each end ; nearly cylindrical but in the smallest degree swollen in the middle. Usually two or three of the bits of grass are longer than the rest and project beyond the end of the case (Barrett).

Habits of Larva.—The eggs hatch during the summer and the young larva feeds up very slowly until the autumn when it hybernates, awaking early from its lethargy, and becoming fullfed in April, when it pupates. The larva appears always to feed very low down and to remain near the ground among the tangled mass of dead rush and grass stems, oftentimes crawling up but very little higher to pupate. This is probably due to the fact that it frequently haunts low marshy fields in this country. The female cases are to be found on rush and grass stems at Purbeck (Bankes), the cases always to be found low down among grass and tidal *débris* on the Essex coast (Burrows). The larva fixes its case for pupation on a somewhat elevated stem or even on the trunk of a tree if there be one in the field, generally then on the eastern side and rarely more than a foot from the ground (Bruand). Where walls are plentiful in its haunts the larva often climbs these before pupating. Millière notes the spun-up cases as especially abundant on the walls between Cannes and Golfe-Jouan. Freyer notes the larva as unable to crawl outside its case, but rather lively when within it.

Hofmann notes that the larvæ of the var. *sieboldii* are to be found in early spring in sunny meadows in woods usually in great numbers in one circumscribed spot, but can only be found readily among the dry grass culms after long practice as they rest near the ground and only move about freely in the warm sunshine.

Larva.—At what appears to be its hybernating stage, the larva is 6·25mm. in length, and about 1·5mm. at its greatest width, the middle abdominal segments being the stoutest, the thorax much less bulky, whilst it tapers slightly towards the head, the anal end being blunt. The head is small, rounded, polished and black, with a white dash beneath and up either side of the triangle bounding the clypeus. The prothorax long, the mesothorax shorter and the metathorax shortest, all these segments being horny, polished (the corneous portions exhibiting a minute and faint scale pattern as in other Psychid larvæ), black, with broad mediodorsal, subdorsal and lateral white bands (very broad relatively to the black areas); the folds of skin at the junction of head and prothorax are white, giving the head and thorax together a greyish appearance (to the naked eye). The abdomen is red-brown in colour, the setæ long and slender (longest as usual on the head, thoracic, and anal segments), their position on the abdominal segments being that usual in the more specialised Psychids; the venter is somewhat flattened, the larva having marked projecting lateral flanges; the small chitinous plates at base of setæ are large and towards anus very strong; the anal plate is almost black, rather rough, and has a very horny-looking surface. The abdominal segments are most distinctly subdivided into two subsegments, the contractions being more marked dorsally than in any other Psychid larvæ examined. The spiracles are not large, but are raised as short tubes (and are very prominent as seen from above), paler than the ground colour of the larva but with a dark brown rim. The true legs are dark in colour; the prolegs of the usual Psychid form, with strong hooks, the central depression of those on 3rd-6th abdominals being very marked, and apparently slightly horny; this depression is not noticeable on the anal pair, but there is instead just a suspicion of the horny lunule that replaces the central depression in the anal prolegs of *A. opacella* (Bacot. Described October 8th, 1899, from larvæ from case with eggs sent by Mr. Burrows from Mucking). The *full-grown larva* is 7mm.-10mm. in length, of ordinary Psychid build, the third legs on a projection making them look very large, whereas they are of about equal size to others. Head deep brown (nearly black), with a paler vertical mark on either side of clypeus. Thoracic segments with the usual chitinous plates, that on prothorax single, meso- and metathorax with accessory marginal plates; from the pro- to metathorax they become narrower from side to side, wider from back to front; the plates are deep black-brown in colour, but about half their area occupied by longitudinal bands of pale terra-cotta, (1) median, (2) subdorsal, (3) at margin of primary plates. The median pale stripe has two very dark spots in it (on prothorax) marginally; the subdorsal has three such marks, two in one dark cloud on mesothorax and one on metathorax (these are like processes of the outer margin of the pale band); the secondary plates are dark and are in line with a corresponding dark mark at the outer margin of the plate on prothorax. The head and these plates carry long hairs (two-thirds the diameter of larva). The anal plate is dark brown, slightly pale medially; the plates of the anal prolegs are also chitinous, and brown in colour. The remaining hairs are one-fourth, to one-third (for the longest) the diameter of the larva; the anterior trapezoidals are nearly twice as far from the middle line as the posterior, their setæ shorter, and placed on large chitinous plates; the plates of the posterior are, however, much larger; iii is a very long hair, like ii; the plates of tubercles i and ii make, to some extent, two subsegments. The prolegs have a strong chitinous circle at base and possess usually 20-21 (rarely 16) hooks, arranged in the normal horseshoe fashion, the anterior limb being the longer; the anal prolegs carry 21 or 22 hooks. The spiracles are small, raised, brown, chitinous rings (Chapman, from larvæ obtained at Cannes). Bruand notes the larva as being: "D'un blanc-sale tirant sur le vineux, avec deux raies latérales (de chaque côté) d'un brun-noirâtre, nettement indiquées; un très-petit point, de même couleur, entre ces deux raies supérieures; et une troisième ligne, peu régulière, située au-dessous des stigmates. Ces raies et ligne sont interrompues aux intersections. La tête est noirâtre, luisante, ainsi que les pattes écailleuses. On distingue à la loupe, sur les diverses parties du corps, des poils grisâtres, courts et très-fins." Freyer's description (evidently under low power) of the larva of var. *sieboldii* reads as follows: "Small, slender anteriorly, thickening posteriorly, thorax and head pale brown, dorsal line yellowish with similarly-tinted oblique subdorsal stripe on either side; abdomen red-brown without distinct dorsal line, but marked on the sides with a dark stripe; prolegs scarcely visible, merely warts." See also Hofmann's description *ante*, p. 355, which also refers to the *sieboldii* form of this species.

Pupa.—♂. The *male* pupa has labial palpi about as long as the head is above them, bifurcated at tip; the maxillæ are also longer and squarer than usual; the jaws long and obvious; the cheeks come rather low down; the dorsal head-piece minute, very narrow and spindle-shaped; antennæ slightly beyond first pair of legs, the mesothorax (but not metathorax) splits on dehiscence; two stout ventro-anal hooks; scars of prolegs very strongly marked; no hairs on anal segment; the abdominal segments dorsally consist of a smooth area (subsegment), then a rough or granulated patch medially, followed by a transverse series of spines just anterior to i, which is farther from the median line than ii, the latter some little distance behind i, followed in turn by the intersegmental membrane; the intersegmental membranes between 4-5, 5-6, 6-7, 7-8, with a fine row of spines or points; iii is above, iv and v directly below, the spiracles (v rather below iv); vi appears to be multiplied into four points, at least there are three points just above a slight lateral depression and one just below, whilst vii is single just above the scar of proleg, and viii consists of three other points just ventral to the scar. ♀. The *female* pupa is pale brown in colour, the head with very large and well-marked clypeus extending nearly to vertex, ending below in the well-developed labrum. The pupal head resembles the larval head in two points, not yet observed as occurring in other Psychid pupæ, *viz.*, (1) In the very large and well-marked clypeus, divided off from the cheeks by very definite lines of suture, meeting at vertex. (2) In the cheek-pieces extending backwards and gathering in to make quite a neck behind towards the 1st thoracic segment, *i.e.*, the face-parts are not a mere front plate a little hollowed out as in most pupæ, but tend to be actually globular, with a wide, but still narrowed, opening behind. The antennæ are placed on the cheeks a little above and outside the jaws and in close relation to the mouth-parts, and not at the vertex as is usual. They consist of a bulbous lappet, of about the same size as the jaws or maxillæ articulated to a base marked by a few lines on the cheek-piece. The mandibles are quite definite rounded knobs on each side of the labrum, and the labium and maxillæ are almost exact repetitions of the labrum and mandibles and placed just below them. The three thoracic segments carry below these three pairs of legs. These are not adherent to the pupa-case, but stand out separately though flatly applied to it. They appear to be definitely articulated to the pupa and each to its fellow in the middle line, they are directed outwards and backwards and are rather longer than the width of a segment, and about half this in width, narrowing to their rounded extremities and curved so that basally they proceed outwards, apically more downwards. Some obscure indications show that they are three-jointed. The pupa carries on dehiscence no dorsal head-piece, and there can be little doubt that this is what forms the greater part of the carapace portion of the head. In the middle line below the second and third pairs of legs are dark scutcheons of chitin, above the legs on meso- and metathorax are small lappets about one-fifth of a millimètre in length (the wings) directed ventrally. The spiracles are without colour or definite projections, the prolegs are well marked. The reversed trapezoidals and iii are very evident, also two pairs (iv and v) below and behind spiracle, a solitary one well below and in front of these, three in a row pointing upward and forwards above proleg, and one below it. The abdominal incision 2-3 is movable dorsally, it has the usual lateral branch of soft chitin, and is fixed ventrally. The anterior dorsal hooks are small, there are twelve on abdominal segment 4, 26 on 5 and 6, about the same number on 7; they are not in very definite alignment and show two (and even signs of three) rows. The inter-segmental spines small but very definite on 3-6. Eminences on 8-10 ventrally suggest the ♂ anal ventral hooks. The 1st abdominal segment is narrowed in front and impressed by third legs (Chapman). The pupa somewhat yellow-brown with marked segmental incisions and greenish-brown anterior parts (Freyer).

Dehiscence.—The *male* pupa emerges from the case to about the 5th or 6th abdominal segments. The face- and headparts remain with the legs, etc., in one piece, and separate from the rest of the pupa so far as superficial lines go, although retained largely in position by the internal dissepiments, especially towards the region of the 2nd and 3rd tarsi; the piece is pushed forwards and to one side, often looking as if one antennal margin were hinged to the adjacent wing. The thorax splits dorsally to not quite the posterior margin of mesothorax. It stands rather widely open and the dorsal head-pieces are very obvious through flimsy portions at its anterior margin. In the *female* pupa the head-piece is carried away on the imaginal head, the thorax splits dorsally and the leg region seems to be somewhat expanded without being definitely, if at all, separated from the lateral or wing-region.

Food-plants.—Grasses—*Holcus* species (Kranz), grasses (Bruand), ? grass and various low plants (Hofmann). [Assmuss records larvæ on *Prunus padus* and *Solanum dulcamara* in May. One suspects that these larvæ had only gone to these plants for pupation.]

Habits and Habitat.—The males fly in the morning sunshine, being very active between 10 a.m. and 2 p.m. on still quiet days, threading their way (like soot-flakes) rapidly through the long grass occasionally resting on the grass culms, with their wings drawn down roof-wise, or assembling to a newly emerged female. The vermiform female does not leave the puparium, but, having emerged from the pupa, she opens the end of the puparium by means of the pupal head which she carries on the imaginal head as a protection during the process. Whilst within the case she is fertilised by the male and lays her eggs in the empty pupa-skin, only dropping out herself when oviposition is quite completed, the last eggs being often laid about the mouth of the case. Hofmann notes that the case (of var. *sieboldii*) is generally spun up on a grass culm or fallen leaf so that it lies horizontally, the ♀s pushing themselves forward so that the head opens the free end of the case, whilst the dark brown pupal head-plate hangs on the head of the ♀ imago. He notes that the males usually emerge in the evening or morning, fly neither far nor high, but immediately seek out a ♀, pairing taking place as in the Psyches, the act of copulation lasting about a quarter of an hour, during which the ♂ sits with wings folded together on the case of the ♀, which immediately afterwards withdraws into the pupal-shell, packs this full of eggs, and finally emerges from the free end of the case as a mere shrivelled-up skin. The species is abundant in the damp meadows both within and just outside the woods at Chattenden, and almost equally so along the drier rides. It sometimes abounds in the marshes along the banks of the Medway, as in the fields in and around Chattenden woods, and is almost equally common on the steep chalk hills at Cuxton among the rough grass. The species also occurs on the slopes at Kingsdown and in the Warren at Folkestone. Bankes notes that at Purbeck, the insect is restricted to a spot at the inland edge of a salt-marsh on the coast, where the males fly over the tops of the rushes in the sunshine on calm days, and may be taken at rest on the stems after flight is over; their active period appears to be from about 12.30 p.m.-2.0 p.m., and he has never taken them later than 5 p.m. Whittle observes that the imagines may be found in Epping Forest, but most abundantly on the river-wall of the south and south-east Essex coast and the edges of the salt-marshes adjoining. In the Riviera it occurs almost everywhere, on the seashore, on all waste ground, and on the wooded slopes. At Golfe-Jouan, Millière says the cases are to be found freely on the stone walls as also at Cannes, the species being very common. We ourselves found many here, almost all, however, empty, in April, 1898. In the Netherlands it is most frequent in moist meadows (Snellen), but Zeller has taken it up to 7200ft. on the Albula Pass. Hofmann says that at Ratisbon the species frequents dry sunny grassy spots, especially in the neigbourhood of woods where the male is often to be found in the early morning hours, sitting on the grass culms as if drunk. Bruand notes that in the Doubs dept., it generally occurs in fields and is especially abundant in mountain meadows; he says that it also occurs in damp meadows near Besançon, where the cases are large, the larvæ here pupating at least eight days after those of other districts and producing imagines of larger size.

Time of appearance.—The imagines generally appear in May and June, in early seasons, however, they occur in April and May and, in late seasons, may be found well into July. In 1893 we captured specimens as early as April 19th, and in 1888 as late as July 17th, whilst in most seasons some five or six weeks elapse between the earliest and latest captures, *e.g.*, April 29th-June 17th, 1893, at Chattenden in the same meadow. In Spain, in the Barcelona district, this species occurs in March and April (Cuní y Martorell); in the Teruel district in April and May (Zapater); it is also out in March at Cannes, but more abundantly all along the Riviera during April, the earliest specimen in 1899 being taken at Mouans Sartoux on March 3rd (Tutt); March and April, 1899, at Alassio (Chapman); in Baden it appears from late April to June (Reutti); whilst at Bergün it occurs at the end of May, not appearing on the Weissenstein until July, and on the Albula Pass at 7200ft. is to be captured quite at the end of the latter month (Zeller); in Lombardy it is recorded in June and August (Turati); Calberla also notes the moth as common in July at Tivoli in the Roman Campagna, and Mina-Palumbo gives the same month for Sicily, late dates for such southern localities, a distinct suspicion of a second brood, especially as in Modena, it occurs in early spring (Fiori); Rehberg says that it is common in June and July at Bremen, possibly due to observations being made in a late season; Speyer notes cases on May 23rd, at Rhoden, imagines during May and June; in Ratisbon the species appears in May and June (Hofmann), and Reutti gives it as occurring from April to June in Baden; Bruand is more precise and says that emergence averages from May15th-May 25th, in the dept. of the Doubs. No great number of actual dates are available: June 26th, 1856, at Hampstead Heath (Trimen); May 19th-July 6th, 1871, at Wanstead, June 2nd, 1884, June 5th, 1889, May 19th-21st, 1890, July 7th, 1890, at Brentwood, May 30th, 1892, May 22nd-June 10th, 1893, May 14th-June 16th, 1894, June 25th, 1895, at Rainham, June 5th-15th, 1894, at Leigh, June 8th, 1895, at Leigh (Burrows); June 10th, 1877, in Epping Forest, June 9th, 1889, at Benfleet, May 22nd, 1892, at Shoeburyness, May 7th-20th, 1894, June 3rd, 1894 (imagines and cases), at Leigh, May 12th, 1895, at Pitsea, May 3rd, 1896 (case), at Vange, April 19th (case), June 3rd-7th, 1897, at Fobbing (Whittle); June 13th-15th, 1887, June 13th, 1891, May 29th, 1896, at Purbeck, whilst cases found at Purbeck, on May 22nd, 1890, yielded four females, June 1st, 3rd, 5th, and 8th, respectively (Bankes); May 6th, 1893, on the Essex coast (Thurnall); April 19th, 1893, at Southend (Battley); July 16th, 1887, at Cuxton, singly, May 19th-July 20th, 1888, at Chattenden, July 21st, 1888, at Cuxton, June 1st-18th, 1892, very abundant at Chattenden, April 29th, 1893 (common), May 13th, 1893 (swarming in thousands), June 10th, 1893 (still common), June 17th, 1893 (many fine specimens), at Chattenden, May 20th, 1893 (common), at Cuxton, &c. (Tutt); June 20th-July 5th (abundant on latter date but worn), June 12th, 1886, June 4th, 1892, very abundant at Chattenden (Fenn); June 10th, 1891 (common), June 22nd, 1892, two only, May 12th, 1893, June 14th, 1894, June 21st, 1895, June 1st-12th, 1896, at Chattenden, flying in afternoon sun (Bower); June 5th, 1897, at Brooke, I. of Wight (Kaye); August 1st-10th, 1897, at Dover (Page); female bred from Southend, May 4th, 1893, male at High Beach, April 25th, 1893 (Prout); June 22nd, 1898, May 24th, 1899, on Wimbledon Common (Gillespie); Czekelius gives April 19th, at Hermannstadt, and Staudinger captured two small specimens on May 2nd and 5th, at Kerasdere in Asia Minor. Fritsch notes the imago in Austria, from April 15th-June 3rd, also two early specimens at Salzburg, March 23rd, and April 2nd; both he and Zeller criticise Heinemann's indication of June for the imago, yet in the Brit. Mus. collection some of Zeller's examples are labelled Preth, June 8th, 1867, Raibl, June 28th, 1867. There are also bred examples from Stelzing, May 4th, 1862. Kretschmer says that the insect occurs in May, among grass on the banks of the Oder, the larval cases in April on such trees as have been under water in early spring. Oberthür notes it as appearing in May and June, in the fields in woods about Rennes. Freyer notes that cases from Ratisbon, in April, 1855, contained fully developed pupæ, and the first imago emerged April 21st.

LOCALITIES.—CAMBRIDGE: Wicken (Farren). DEVON: Ilfracombe (Nat. Coll.) DORSET: Purbeck (Bankes), nr. Poole Harbour (Dale). ESSEX: Wanstead, Southend, Brentwood, Rainham, Leigh (Burrows), Colchester (Harwood), Epping—Monk's Wood section (Prout), Benfleet, Shoeburyness, Leigh, Pitsea, Vange, Fobbing (Whittle). GLOUCESTER: Stapleton near Bristol (Mason). HANTS: I. of Wight—Brooke (Kaye). HERTS: Cheshunt (Boyd), Hertford Heath (Stephens). KENT: Strood, Chattenden, Cuxton, Chatham, Kingsdown, Folkestone (Tutt), Darenth near Greenhithe, Dartford Heath (Stephens), Dover (Page). MIDDLESEX: Hampstead Heath (Trimen). SOMERSET: Near Clevedon (Mason). SUFFOLK: Lakenheath (Eedle). SURREY: Wandsworth Common (Warren), Wimbledon Common (Gillespie). SUSSEX: Brighton dist. (Cooke).

DISTRIBUTION.*—AMURLAND: Chaibarowka (Staudinger). ASIA MINOR: Armenia (Speyer), Kerasdere (Staudinger). AUSTRO-HUNGARY: Brünn, Cilli, Kessen, Neutitschein, Rosenau, Vienna (Fritsch), Upper Austria, Carniola, Buda (Speyer), Bukovina, Czernowitz (Hormuzaki), Galicia, common (Garbowski), Sambow, Stupnica (Nowicki), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Pressburg (Rozsay), Prague, Karlstein (Nickerl), Raibl, Preth (Zeller), Innsbruck, Tyrol—Taufers (Weiler), Lavantthal (Höfner), Hermannstadt, Tihucza (Czekelius), Epiries, common (Husz), Chemnitz (Pabst), Hungary, Kocsocz (Vángel), Golmitz (Hudák), Tyrol, up to 6000ft. (Hinterwaldner), Frauhitt (Heller), Fiume (Mann), Salzburg near Fehrleiten at 3900 (German) feet, Siebenburgen = Transsylvania (Speyer), Nagyág (Fuss), Croatia—Crna Rieka (Rebel). BELGIUM: Local, Louvain, Liége, Mons, Brussels (Donckier). BULGARIA: Varna on Black Sea (Lederer). FRANCE: Doubs—Morteau, Saut-du-Doubs, Besançon (Bruand), Aude (Mabille), Saone-et-Loire (Constant), Marseilles, Savoy, Meurthe dept. (Speyer), Eure-et-Loir (Guénée), Sologne-du-Cher, Nohant (Sand), Haute Garonne, everywhere (Caradja), Bordeaux (Brown), The Riviera—Cannes, Auribeau, Nice, &c. (Tutt), near Paris (Duponchel), Eure—Forêt de Pont-de-l'Arche (Dupont), Rennes, rare, Châteaudun, Pyrénées (Oberthür). GERMANY: Generally distributed (Heinemann), north-west Germany, almost everywhere (Jordan), Rhine Palatinate (Bertram), Würtemberg (Seyffler), Giessen (Dickore), Eppendorf, Wohldorf (Schmeltz), Offenbach, the Taunus, Wiesbaden, Wehen, the Wetterau (Koch), Wismar, Erlangen, Holstein near Wismar, Göttingen near Nossen, Mulhausen, Black Forest to 2300ft., Hamburg, Nossen, Waldeck, Rhoden (Speyer), Halle (Stange), Erfurt (Keferstein), Munich (Kranz), Zeitz-on-the-Elster (Wilde), Sulz, Neustrelitz (Schmidt), Bremen, common (Rehberg), Saxon Lusatia, common (Moeschler), Dresden, singly (Steinert), Thuringia, common (Krieghoff), Prussia—rare, Dantzig, Königsberg (Schmidt), Silesia (Wocke), Nassau (Rössler), Ratisbon (Schmid), Dessau (Richter), Alsace, common (Peyerimhoff), Wernigorode, Stettin, very common some years (Hering), Brunswick—Helmstedt, locally abundant in the Hartz (Heinemann), Hanover, common (Glitz), Frankfort-on-Oder (Kretschmer), Baden, common, even high up the mountains (Reutti), Lechausen, Derching (Freyer), Hildesheim (Grote), Mero-

* Also in ASIA MINOR: Pontus—Amasia (Staudinger). AUSTRO-HUNGARY: Croatia—Josefsthal (Mann), Wienerwald (Schleicher). FRANCE: Lyon (Staudinger). GERMANY: Bavarian Pfalz (Bertram), Crefeld, Uerdingen (Stollwerck), Göttingen (Jordan), Annaberg (Junghans). ITALY: Tarracina (Costa), Tuscany, Turin (Staudinger). SPAIN: North and central Spain—Aragon, Castile (Staudinger), Bilbao (Rössler).

thal (Vîgelius), Bergün, Glogau, Schneeberg, Stelzing (Zell. coll.), Kieshof, Waldwiese, Pennin (Paul and Plötz) Walportzheim (Maassen). ITALY: throughout, not common (Curò), Lombardy, common (Turati), Modena (Fiori), Piedmont, Calabria (Speyer), Roman Campagna—Tivoli (Calberla), Sicily (Mina-Palumbo), Alassio (Chapman). NETHERLANDS: southern half of Netherlands (Snellen), eastern provinces not rare, Breda, &c. (Heylaerts). ROUMANIA: common, Slanic, Grumazesti (Caradja). RUSSIA: Baltic Provinces, Neu Kasseritz, St. Petersburg (Sintenis), Wolmar (Lutzau), Moscow (Albrecht), Volga dist.—Kasan (Eversmann), St. Petersburg (Erschoff), Livonia, Caucasus prov. (Speyer), near Kokenhusen (Nolcken). SPAIN: Barcelona, Tibidado, Vallvidrera (Cuní y Martorell), Grenada (Rambur), Catalonia (Martorell y Peña), Ronda (Speyer), Teruel (Zapater). SWITZERLAND: Bernese Alps, Gadmenthal (Jäggi), Upper Engadine (Pfaffenzeller), Albula Pass, Weissenstein (Zeller), Weissenberg, up to 1200m. (Huguenin), Chur, Fürstenau (Killias), Zürich (Frey coll.), Locarno (Chapman).

Family: PSYCHIDAE.

We have already noticed the principal facts relating to the habits and structure of the *Psychidae*. The males vary much in their general appearance, some having very wide ample wings and slender bodies, whilst others have stronger and more pointed wings and stouter bodies, nearly all are dark in colour, usually unicolorous, blackish or brownish, some clothed with well-formed scales, others with hairlike scales, and while some are practically opaque from the density of the wing-clothing, others are transparent owing to the lack of it. The abdomen and thorax are usually thickly covered with long hairs, and the antennæ strongly bipectinated, the dorsum of the shaft and pectinations being scaled, except where (in *Acanthopsyche*, &c.) the scales have, as a further development, been lost. There are no ocelli, the palpi are generally obsolete, and the tongue is wanting, whilst the anterior tibial spurs are usually long, the posterior short or wanting. The peculiar manner in which the abdomen can be stretched in order to insert it in the puparium for the purpose of copulation has already been noticed.

The females are naked*, vermiform, without traces of wings, the

* With regard to this statement there is much yet to be learned about the ♀s of the higher Psychids and their possible relationships, and one feature not yet thoroughly worked out is that relating to the woolly clothing of the 6th and 7th abdominal segments found in some of the higher Psychids, and its homology with the anal tuft of the araneiform females. Some females have no such clothing and others have it strongly developed. In the families already dealt with which have not araneiform females—we may note *Bijugis bombycella* as having the ovipositor surrounded by a small whitish downy riband, whilst that of *B. rotundella*, has a tuft of short scales; *Psychidea nudella* is more woolly around the ovipositor than *Epichnopteryx pulla* which is only slightly pilose. Of the higher Psychids, Bruand notes the female of *Scioptera plumistrella* as having some woolly tufts on the posterior segments, whilst that of *Ptilocephala angustella* (*stomoxella*) is said to have the last three segments ornamented with small downy tufts, and the ♀ of *Acanthopsyche opacella* is noted as possessing some small woolly tufts on segments 4-8. Chapman reports it in *Standfussia zermattensis*, and writes (*Entom. Record*, xi., p. 235): "The 7th abdominal segment is clothed with wool, anteriorly nearly all over, laterally for the posterior half, narrowing dorsally so as to be narrow or wanting at the dorsal line. The uncovered portion of this segment is so much telescoped into the 8th, that the segment appears to be completely clothed. The 6th segment has a similar clothing of wool, but so much less in amount as to form rather, perhaps, two ventral and two slighter lateral patches; a trace also occurs on the 5th segment. This wool is wavy, closely set, and of a bluish-green colour, so that it may easily be mistaken for a growth of blue mould, perhaps, because the contrast of the colour of the wool with that of the general surface is much that of blue mould on cheese." The female of *Ptilocephala sicheliella* is figured by Bruand with a grand anal tuft. Is this more developed in those whose ♀s finally drop out, from their cases, *i.e.*, the *Pupifugae* of Standfuss?

legs are excessively rudimentary, as also are the eyes, antennæ, and mouth-parts, whilst the ovipositor appears to be entirely wanting. They have as a rule the head and thoracic segments fused into a solid, corneous mass dorsally, but distinguishable by separating lines, and there is a series of nerve-ganglia obvious in abdominal segments 2-7 ventrally, as well as a larger mass in the thoracic region and another large one at the anterior margin of the 1st abdominal segment. There appear to be ten abdominal segments recognisable, but it is difficult to count them. The females do not leave the case on emergence, but press themselves forwards so as to break open the silken tube at the free end of the puparium, and remain at that end until copulation has taken place, the male inserting its extensile abdomen into the puparium for the purpose, and pushing in its body so completely that the wings are often more or less pushed upwards by the edge of the case. Copulation, as a rule, lasts but a few minutes and the males often pair with more than one female. Hofmann notes that a ♂ of *A. opacella* emerged on May 19th, copulated with two ♀ s almost immediately one after the other, and did not seem particularly weakened thereby. On the other hand, Bruand states that in *Hyalina albida* copulation lasts less than a minute ; the male is greatly excited until it is paired, but then separation takes place almost at once, and the male appears so exhausted that he flies only a very short distance, and then remains without moving some hours, and frequently dies without again recovering from his weakened condition.

After egg-laying is finished the females of the *Pupifugae* fall from the puparium, but those of the *Pupicolae* are reputed to remain within it. Bruand separates his section *B* (*Mon. des Psych.*, pp. 36 and 44) into two groups of *Pupicolae* of which he states : " Femelles à chrysalides (*a*) bicolores, (*b*) unicolores, d'où elles ne sortent pas, même lorsque l'accouplement n'a pas eu lieu." These groups are constituted as follows:

1. ***Atribombycella*** (***graslinella***), ***apiformella**** (***apiformis***), ***constancella****, ***viciella****, ***fasciculella***, ***stetinella***, ***tabanivicinella****.
2. ***Albivitrella*** (***albida***), ***lorquiniella****, ***plumosella****.

Standfuss divides the *Pupicolae* into three groups as follows :

1. ***Hirsutella***, ***standfussii***.
2. ***Viciella***, ***stetinensis***, ***viadrina***, ***turatii***, ***constancella*** (***praecellens***, **Stdgr.**), ***graslinella***, ***bruandi***, ***crassicornis***.
3. *Apiformis*.

There are still some points not at all clearly made out as to the females usually placed in this group, *e.g.*, Bruand includes some of the Oreopsychid females here, and says that that of *Hyalina albida*, does not leave the puparium after laying her eggs, but the shrivelled-up body remains in the aperture thereof, whilst the newly-hatched larvæ not only strip the case which contained them to build their cases, but use also the remains of their parent. Bruand, as we have noted (*ante*, p. 115) strangely fell into the common error of supposing that the ♀ sometimes turned round for the purpose of copulation, and writes of *H. albida* : " La femelle n'en sort pas pour s'accoupler ; elle se contente d'en fendre l'extrémité, après s'être retournée, de manière à présenter la partie anale à l'ouverture du fourreau," whilst of the ♀ of *Megalophanes constancella* he writes : " La femelle ne quitte jamais sa

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* Bruand evidently had never seen the females of these species.

chrysalide. . . . pour s'accoupler elle se contente de fendre son enveloppe à la partie anale." It is highly probable that, without exception, the head of the Psychid ♀ is towards the open end of the case and that copulation is effected by the insertion of the male abdomen. The marvellous development of the male generative organs (pl. v., fig. 2) of *Thyridopteryx ephemeraeformis* gives some idea of the specialisation that has taken place in order to meet the necessities of pairing whilst the female remains in the case, her head towards the aperture and the generative organs farthest removed from the point of entry.

The mode of pairing in the higher Psychids is well illustrated by Chapman's description of the process in *Standfussia zermattensis* (*Ent. Rec.*, xi., pp. 236-237). He notes that the female moth comes partially out of her pupal shell and sufficiently far out of the silken case to protrude her head and then retreats, the object of this movement being evidently to expand the tubular mouth of the silken case which remains open, the aperture being of nearly the same diameter as the opening in the male case by which the pupa emerges. The ♂ thrusts the extremity of his abdomen into the open end of the case, proceeding gradually to work into the case the whole of his abdomen, until, in perhaps two minutes, it is buried right up to the thorax, so closely as to push forwards the hindwings by the margin of the case pressing against their bases. The male then becomes quiescent, maintaining this position for about three minutes, when he somewhat rapidly releases himself and flies off. Examining him whilst *in sitû* in the case, the first and second pairs of legs could be seen, but no sign of the third pair, which appeared to be included with the abdomen in the case of the ♀ moth, and there appears no doubt that they entered the case with or before the abdomen and were used as a means of drawing the latter into the case. Assuming that it is the rule for the third pair of legs to be introduced in this way into the case, it would afford an explanation of the loss of the tibial spurs that are so well-developed in the earlier (Solenobiid and Fumeid) divisions of the superfamily.

We have already noticed (*ante*, vol. i., pp. 23-30) several species of the higher Psychids in which parthenogenesis is said to occur. We still want many definite experiments before we can claim to know anything satisfactory about it in the higher groups, although its occurrence is beyond question in the Solenobiids (*ante*, pp. 157-161, 171-181). Standfuss asserts (*Schles. Art. Psych.*, p. 18) that on May 27th he collected . . . . . 81 cases of *Psyche viadrina*, four already spun up, but even these four crawled on being disturbed, hence all larvæ. He then details his very carefully conducted experiments that proved that six out of the 41 ♀s of this species produced parthenogenetic larvæ. Their vitality appeared very slight, and as he had failed to breed parthenogenetic *P. stetinensis*, in 1877-1878, he did not try to breed them. He further notes that he had never observed parthenogenesis in *Sterrhopterix hirsutella, S. standfussi*, or *Stenophanes graslinella*, and suspects that it never occurs in *Acanthopsyche opacella*, *Pachythelia villosella* or *Canephora unicolor*.

The eggs are laid in the empty pupa-shell, filling the latter so completely as to leave one with the impression that one still has the pupa under examination. They are usually so delicate that the slightest touch ruptures them and one is at a loss to understand how the newly-hatched larvæ at the bottom of the case (which are hatched from the eggs first laid), manage to escape at all. The way in which the eggs are packed is suggested in pl. v., fig. 3*e*.

The young larvæ as soon as hatched (pl. v., figs. 4*a-f*) make themselves cases, usually robbing the maternal case for the purpose, forming first a small oval collar which is gradually increased in length (figs. 4*a-f*) until the case is completed. The young larvæ appear to be very generally more or less polyphagous, feeding on low plants, grasses, and more rarely upon the leaves of shrubs and bushes. The excrement is got rid of through the posterior end of the case. The larval cases are covered with rock or plant *débris*. As the larvæ increase in size, coarser material is used, with which to clothe their cases, and, although there is considerable variation in the materials used, there is a very general similarity in the cases of the same species, and, in nature, each species uses somewhat similar materials if available, or, if different materials be used, they are attached similarly. The case is spun down at each moult and at pupation, and the number of moults varies with the species, rarely, however, exceeding five. The larvæ are usually most active in the hot sunshine, because they chiefly feed by day, although Standfuss notes *Stenophanes graslinella*, *Sterrhopterix standfussi*, and probably *Pachythelia villosella*, as feeding almost exclusively by night. Some species feed up rapidly and undergo their transformations in one year, others feed up more slowly and hybernate the first winter as a small, and the second as an almost full-grown, larva, and thus take two years to complete their metamorphosis, whilst almost all the species pupate in the spring or early summer. Hofmann notes that *Ptilocephala atra* (*angustella*) and *Pachythelia villosella* are among those that are scarcely half grown during the first winter and hybernate a second winter fully grown, appearing as imagines the following summer. Hartmann observes that, in his experience, *C. unicolor*, *P. villosella* and *Stenophanes graslinella*, hibernate twice as larvæ, and Standfuss also allows *S. graslinella*, *Sterrhopterix standfussi*, *C. unicolor*, *Psyche viciella* and *P. villosella* two years before becoming full-fed. We have already noted that many of the larvæ are general feeders, although some few appear to be restricted to special food-plants—grass, plantain, lettuce, willow, &c., are given by various authors as being generally acceptable. The peculiar manner in which the larvæ walk, the third pair of legs being moved forwards together as if they were the prongs of a fork, has repeatedly been noticed.

Until the newly-hatched larva has constructed its case it is very restless and refuses to eat. Under artificial conditions the larvæ will sometimes utilise unusual materials for this purpose, fragments of paper, cork, &c., but in nature many species are somewhat particular as to the materials used, and the cases of such species as *Amicta quadrangularis* and *Chalia hockingii* are as remarkable for the accuracy of their construction and the regularity of the pieces bitten off with which to form the case, as are the snailshell-like cases of *Apterona*, the species of which construct, with silk and earth and vegetable *débris*, cases that are exactly like the shell of a snail. Although the female cases are usually much larger than those of the male, the latter frequently uses coarser material, and Hofmann specially notes the male case of *Oreopsyche muscella* as being of smaller size and more slender form than the female case. We have already observed that when full-fed the larvæ of the two sexes of some species take up different positions for pupation, but Zincken stated (*Germar's Mag. Ent.*, i., p. 31) that those of some species live separately on different food-plants, whilst Schedl (*Wien. Ent. Monats.*, i., p. 73) makes a similar observation concerning *Ptilocephala atra* (*angustella*). Hofmann considers that this is the explanation of our sometimes finding only males and at other times only females in a given locality, and adds that the male larvæ usually select a low open place for pupation, exposed to the sun, where they are influenced by the moisture of the dew, whilst the females select an exposed position, possibly for the purpose of fertilisation. There are, of course, many exceptions, and Hofmann further observes that he has always found the ♂ and ♀ cases of *Ptilocephala atra* (*angustella*) at Ratisbon in the same place, although elsewhere in different places.

The male pupa (described *ante*, pp. 109-110, 275) has two strong ventro-anal hooks, and, besides the anterior dorsal spines which point backwards, has a row of intersegmental spines directed forwards, on the posterior portions of the abdominal segments 5-8. Bacot and Chapman have noticed (*Ent. Record*, xi., p. 181) those of *Standfussia zermattensis*, and Chapman writes that these posterior spines are very remarkable and are on that portion of the intersegmental membrane that folds in, a very unusual situation for spines. When the segment is fully stretched they point forwards rather than backwards. As the segments close and the membrane rolls under, they will point outwards and then backwards, as they disappear into the incision. They act, therefore, not merely as points of purchase against the silken interior of the case, but as levers. They appear to be characteristic of all Macro-Psychid male and female pupæ. The head-parts, antennæ, and appendages are well-developed and the pupa before emergence moves freely up and down the silken tube of the case which serves as a puparium, and when emergence takes place the ♂ pupa is much protruded from the extremity of the case. The ♀ pupa is very different from that of the ♂, and structurally partakes, to a great extent, of the modifications exhibited by the ♀ imago. It is usually delicate, but in some of the exotic (and a few Palæarctic) species is robust and strong. The head-parts, wing-cases, mouth-structures, and appendages, all show extreme modification, and the anterior dorsal hooks that characterise the male pupa are usually much less well-developed in that of the female. The head-piece is ventral and ill-developed, the labrum small, the maxillæ reduced to a triangular wedge just outside the labial palpi, which are fully exposed; the maxillary palpi may be lost, but are generally represented by a short process at the outer angle of the maxillæ; the labium is divided into three portions; the antennæ are represented by small conical projections; the legs small and protuberant, &c. The ♀ pupa-case remains within the puparium and is filled with eggs by the ♀ imago. The pupal period appears rarely to last less than a month, often perhaps longer, and emergence usually takes place at a fairly constant time of day for the same species (*vide, ante*, p. 107). Hofmann notes 8 a.m.-11 a.m. for *Ptilocephala atra* (*angustella*), *Acanthopsyche opacella*, and *Oreopsyche muscella*, 5 p.m.-7 p.m. for *Canephora unicolor*, *Pachy thelia villosella* and *Sterrhopterix hirsutella*.

Bodine observes (*Antennae of Lepidoptera*, p. 31) that the males of the American Psychids have antennæ "quite highly developed in certain directions, yet, as a whole, they are of a very generalised type. As in the *Megalopygidae*, nearly the whole of the surface of the scape and pedicel is covered with long, narrow, hair-like scales, and all of the clavola excepting the ventral aspect is clothed with scales of but little higher type. The greatest development is reached in the pectinations. Relatively, they are the longest found among the lepidoptera. In *Psyche confederata* some of those near the middle of the clavola attain a length equal to one-half that of the whole antenna. The bases of the pectinations have migrated proximad and occupy a central position on the segments. Hairs of the third type are numerous on the ventral surface of both shaft and pectinations. They are well developed, but have no regular arrangement in their insertion. Pits are rare, and are limited in the forms studied to the two or three distal pairs of pectinations. Cones also are rare, and when present are situated at the ends of the pectinations. The antennæ of *Thyridopteryx ephemeraeformis* present a peculiarity in the joint between the scape and the pedicel. The latter segment is jointed, not at the apex of the scape in the ordinary way, but is set obliquely on the caudal edge of the apex." The interesting facts observed by the study of the Psychid antennæ give considerable clues as to the line of evolution of the superfamily, and, apart from the Epichnopterygid antenna already discussed (*ante*, p. 337), one finds that whilst the *Psychinae* have densely scaled shaft and pectinations, those of the *Acanthopsychinae*, tend to lose the scaling first from the pectinations and afterwards from the shaft (*vide*, *post*. pp. 375-376).

Kellogg notes (*Taxonomic value of scales of Lepidoptera*, p. 85) of the scales of *Psychidae* (which, in North America, comprise only ten known species in the five genera—*Psyche*, *Pseudopsyche*, *Platocoeticus*, *Thyridopteryx*, and *Oiketicus*) as follows: "Of four genera examined the correspondence in scale-specialisation is obvious. The wings are sparsely scaled (in *Thyridopteryx* the scales are disappearing, the wings being mostly clear and unscaled) and there is little arrangement of the scales into rows. The specialised scales in the family are small, narrow, strongly pectinated, usually with two short points (as in *Thyridopteryx* and *Pseudopsyche*), or with three short teeth (as in *Pseudopsyche*), or with one point (as in *Psyche* and *Oiketicus*). The line of specialisation is as follows: The hair-form shortens, widens, and divides at the tip into two very short points, which persist or disappear during the continued shortening and widening of the scale. The points are acute and never more than one-fifth the length of the whole scale. The striæ average about ·002mm. apart." One suspects that the clear wing-membrane found in many Psychids is the result of specialisation, normal scaling being characteristic of the most generalised Psychids. We find in the scale-clothing of these insects not only the generalised scale-hairs and well-developed scales, but specialised hair-scales in varying numbers in different species, the latter being more particularly abundant in those families that other structures suggest as the most specialised. We are inclined, therefore, to look on these hair-scales, as specialised by degradation, and leading up to the total suppression of all scale-structure, a line of evolution which finally culminates in the development of a perfectly transparent wing-membrane practically devoid of any scale-clothing.

The immense abundance of some species in their restricted localities is almost incredible. Chapman states that Constant informed him that *Apterona helix* was in thousands on the shore at the mouth of the Var, and that he himself saw certain tree-trunks, at the end of March, 1899, in the Albenga valley, covered with them, they were literally in thousands. These were of course empty cases, all firmly attached to the trees, and were probably an accumulation of several years. According to Ingenitzky (*Zool. Anz.*, xx., p. 473) *Psyche helix* is found in great numbers near Lake Issyk-kul in Central Asia, where the larvæ feed in their snailshell-like cases, on a grass, just like snails.

How far altitude governs emergence is well exhibited by observations on *Standfussia zermattensis*. On April 5th, 1899, Chapman found the cases abundant on the rocks, near Ancona, on the shores of Lake Maggiore whilst the male moths were observed on the wing on April 15th, but the empty pupa-cases found earlier showed that the species had been out for some time before this. It was still out on June 30th, at 1400ft. elevation, near Bignasco, and one was captured as late as August 5th at Simplon, at 4900ft. These dates all refer to the same season, 1899.

Petersen notes that the male of *S. standfussi* is reported to fly at night, and states that other Psychids have the habit, as he himself had taken *Amicta febretta*, in Persia, in the evening at light.

Our ignorance of the structural details of the higher Psychids, *i.e.*, the *Psychidae*, is so profound that it is practically impossible to check any system of classification suggested by a consideration of the imagines by reference to the oval, larval, or pupal stages, and even the ♀s of most of the species, except as cabinet mummies, are almost equally unknown. It is evident, therefore, that, in any consideration of the relationship existing between the various sections into which this family falls, we have less ground for safe generalisation than in the preceding portion of our work in the superfamily.

Study of the imagines, however, shows that the ♂ of the primitive Psychid, by the time that it had evolved sufficiently to be considered as belonging to the *Psychidae*, had antennæ scaled to the ends of the pectinations, an anterior tibial spur of considerable length (·80-·85), and a well-developed cellula intrusa, but had almost lost the posterior tibial spurs. It then appears to have divided into two branches:

1. Preserving the tibial spurs, but with a tendency to lose the antennal scaling.
2. Preserving the antennal scaling, but losing the tibial spurs.

In 1, the cellula intrusa was not frequently lost, in 2 it was usually lost. In a branch of 1 (Oiketicids) there appeared a strong tendency to a diminished size of the hindwings, and to a strengthening of the opposed (inner) wing-margin with accessory or newly-developed nervures. The other branch of 1 (Acanthopsychids) had tendencies more like those characterising section 2.

We have altogether insufficient material to form any valuable conclusion as to the Apteronids. They are clearly a branch of 2 that has developed the scaling of the antennal pectinations into very dense and thick masses of hair-scales. It is very possibly, however, fully entitled to subfamily rank with *Acanthopsychinae* and *Psychinae*.

The Oiketicids (*Oiketicus*, L.-G., and *Lansdownia*, Heyl.) and Psychids (*Animula*, H.-S., *Acanthopsyche*, Heyl., *Psyche*, Schrk., *Apterona*, Mill.) are defined by Heylaerts as follows:

Les ailes antérieures ont deux internes, dont la supérieure s'anastomose avec la dorsale, qui émet quelques rameaux vers le bord interne. La cellule discoïdale des ailes antérieures et postérieures a une cellule interposée. Les tibias antérieurs portent une épine tibiale trés longue.. .. .. *Oiketicina.*

Les ailes antérieures ont deux internes, qui s'anastomosent ou restent séparées. La dorsale émet toujours un seul rameau vers le bord interne. Il ne se trouve pas une cellule interposée sur les ailes antérieures et postérieures. Les tibias postérieurs portent une seule paire d'éperons très courts, et les pattes postérieures sont plus courtes que les antérieures, dont les tibias ont ou non un épine tibiale .. *Psychina.*

Although neuration is such an unsatisfactory character (when considered alone) in this superfamily, on which to rely for any classificatory purpose, it may be taken as supplementing the details available from the scaling, antennæ, and tibial spurs. Chapman considers, therefore, that the neurational characters on which the division *Oiketicina* is founded, are so variable and grade so regularly into *Acanthopsyche*, Heyl., a single species even presenting individuals of marked Oiketicid neuration, and others of the most simple Acanthopsychid neuration, that although neurational characters may be used conveniently to divide *Oiketicus* from *Acanthopsyche*, they are worthless when used to separate *Acanthopsyche* from *Oiketicus* and group it with the other spurless Psyches. He notes, for example, that (1) Heylaerts' *Oiketicina* has two or more nervures to the inner margin, (2) his *Psychina* has one nervure to the inner margin, (3) Moore's *Chalia* has no nervure to the inner margin, and yet, in the British Museum collection, *Thyridopteryx ephemeraeformis* presents some specimens with three, others with two, some with one, and yet others with no, nervures to the inner margin.

We have already discussed at some length (*ante*, pp. 272-275) our views as to the relationship of the *Psychidae* (*in sensu strict.*), and it will be observed that we are there inclined to separate the Oiketicids from the *Psychidae*, and to give equal rank to the Acanthopsychids, Psychids (Empedopsychids), and Oreopsychids. From the conclusions at which we there arrived Chapman dissents on two points, *viz.*, (1) The separation of the Oiketicids as a distinct family—these he would unite with the Acanthopsychids in the subfamily *Acanthopsychinae*. (2) The subfamily rank of the *Empedopsychinae* and *Oreopsychinae*—these he would make tribes of the subfamily *Psychinae*. As illustrating his view he suggests the following grouping of this family:

Fam.: Psychidae—vermiform ♀; antennal pectinations scaled.

- I. *Acanthopsychinae*—long anterior tibial spurs*; tend to lose scaling of antennæ (first on pectinations).
  1. *Oiketicidi*—with forked median (cellula intrusa); hindwings often reduced in size and with produced anal angle; accessory nervures developed at inner margin of forewing and costal margin of hindwing; wing-scales often well-developed.
  2. *Acanthopsychidi*—median nervure simple, strong tendency for 1*a* of forewings to dwindle; wing-scales ill-developed.
- II. *Psychinae*—no anterior tibial spurs, antennæ and pectinations retain scaling; wing-scales usually hair-like.
  1. *Psychidi*—hindwing with costal nervure.
  2. *Oreopsychidi*—hindwing without costal nervure.

It will be observed that the divisions here suggested are essentially those that we have previously set forth (*ante*, pp. 268, 274, 275), the main difference being that of the value to be assigned to them, nor

* A few branches of the *Acanthopsychinae* lose the anterior tibial spurs.

does our present knowledge enable us to offer any serious criticism to this scheme. One might object that, although the subfamilies are defined on antennal and tibial structural peculiarities, the tribal sections are separated on neurational characters, but it must not be overlooked that the same division has been made (*ante*, p. 274) on other grounds. So far as the Oiketicids and Acanthopsychids are concerned, one is led to suppose that Chapman is quite correct, at least an attempt to sum up the characters presented by these, shows much in favour of his view. The common characters presented by the antennæ (*ante*, p. 273), the anterior tibial spurs (*ante*, pp. 273, 274, 275), the presence of well-developed wing-scales (*ante*, p. 274), the development of supplementary wing nervures (*ante*, p. 275), and the not yet complete loss of the posterior tibial spurs (*ante*, p. 271), form an accumulation of details that unite the Oiketicids and Acanthopsychids, and separate them from the Psychids (*i.e.*, the Empedopsychids and Oreopsychids). Such an array of facts it would be idle not to recognise. One regrets not to be able to support them with characters drawn from the early stages, but, as we have already stated, our knowledge of these is as yet too imperfect to allow us to satisfactorily attempt the task. One suspects, however, that the Oiketicids are more generalised than the Acanthopsychids (*ante*, p. 274). This view would appear to be supported by the peculiarities exhibited by the better scaled antennæ, by the presence of the cellula intrusa, by the broader and generally less hair-like scales, by the somewhat less delicate condition of the ova, and the plentiful supply of soft silky hair* in which the ova are embedded (*Ent. Rec.*, vii., p. 123), a fact that suggests some marked constitutional difference in the females. With regard to the subfamilies into which the *Psychidae* are here divided, we have no Oiketicids in Britain, two Acanthopsychids, one Psychid, and no Oreopsychid. None of the known species of *Apterona* (*helix*, *? helicinoides*, *crenulella*, *gracilis*, *pusiella*) are found with us, so that our native list is a very poor and meagre one. Whether the Psycheoidids belong to this, or form a separate family, we are not in a position to judge, but Heylaerts excludes them, and gives them a rank equal to our *Psychidae*. He defines the group as follows:

> Les ailes antérieures ont deux internes séparées, dont la supérieure est très mince. La dorsale ne se bifurque pas. Point de cellule interposée ou il y en a une. Les tibias postérieurs ne portent qu'une seule paire d'éperons plus ou moins prononcés .. .. *Psycheoidina*, Heyl.

Explanation of Plate V.

Thyridopteryx ephemeraeformis presents in most of its characters well-marked and typical Acanthopsychid features. Its life-history, already referred to (*ante*, pp. 368 *et seq.*) was worked out by Riley, to whom we are indebted for the figures represented in the plate. These are:—

Fig. 1. *a*. Case showing ♀ at entrance. *b*. Female much enlarged.
Fig. 2. *b*. End of male abdomen showing, *k-i*, the detailed parts of male genitalia when extended. *c*. Genitalia from below. *d*. Genitalia from above.

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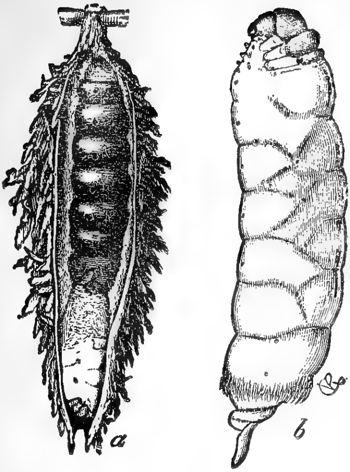
* Smith notes the eggs of *Thyridopteryx ephemeraeformis* as being surrounded by a delicate fawn-coloured, silky down. Kirby also observes that the ♀ of *Oiketicus kirbii* covers her eggs with down from her own body.



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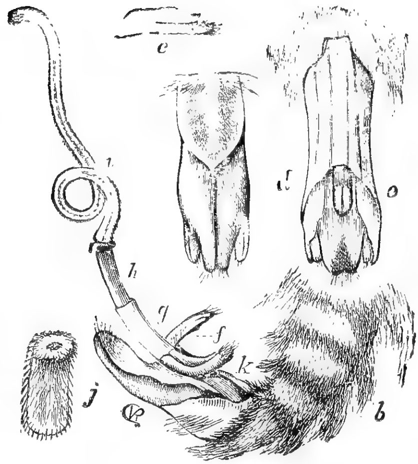

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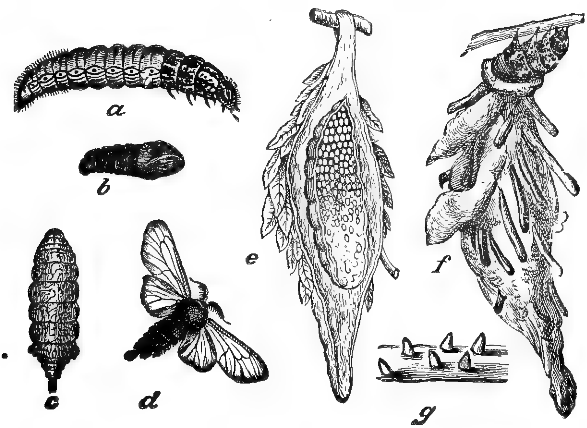

3 (Nat. Size.).

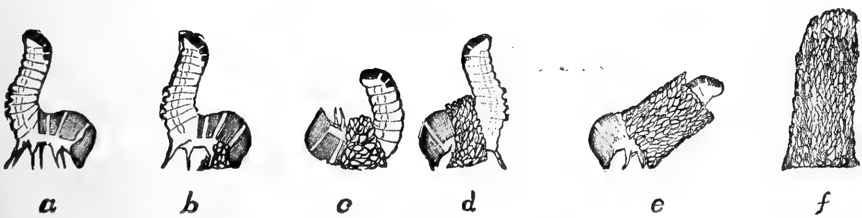

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PLATE V.

THYRIDOPTERYX EPHEMERAEFORMIS, Haw.

Fig. 3. *a*. Larva. *b*. Male pupa. *c*. Female. *d*. Male. *e*. Longitudinal section of case to show eggs. *f*. Crawling larva with case. *g*. Newly-hatched larva with case carried uprightly.
Fig. 4. *a*. Newly-hatched larva. *b-f*. Progressive stages in making case.

Subfam.: Acanthopsychinae.
Tribe: Acanthopsychidi.

We have already given (*ante*, p. 373) the characters on which Chapman suggests the subdivision of this subfamily into the two tribes *Oiketicidi* and *Acanthopsychidi* and have noted the main features that separate it from the *Psychinae* (Empedopsychids and Oreopsychids). Heylaerts' *Acanthopsyche* has almost the same value as our tribe *Acanthopsychidi*. He excludes, however, the genus *Animula* which we are inclined to include in this tribe. Heylaerts separates *Animula* on the ground that: "Les tibias antérieurs n'ont pas une épine tibiale," and places in the genus *hübnerii*, Westd., *herrichii*, Westd., and *dichroa*, H.-S.

The *Acanthopsychidi* are, in some respects, somewhat generalised, and this is noticeable in the development of the wing-scales, the long anterior tibial spurs, and the retention of a pair of ill-developed posterior tibial spurs. On the other hand, the loss of antennal scales must be looked upon as a somewhat specialised character. Though the wing-scales are better developed in *Acanthopsychidi* than in the *Psychinae*, they are still better developed in *Oiketicidi* being in many species of the latter as distinctly scales (not hair-scales) over the whole wing-surface as in *Fumea*. Still the character is sufficiently marked in *Canephora unicolor* for Wallengren to separate this species from all its congeners under the name *Lepidopsyche*, which he defines as "alæ squamæ tectæ." The Acanthopsychids differ strongly also from the Oiketicids in the absence of the cellula intrusa which is well-developed in the latter. Heylaerts diagnoses his *Acanthopsyche* as follows:

Antennes bipectinées jusqu'au sommet; les barbules diminuent en longueur du milieu vers le sommet. Les tibias antérieurs portent une épine tibiale très longue.

He then subdivides it into three sections as follows:

α. Les ailes antérieures ont onze nervures marginales. L'interne supérieure s'anastomose avec la dorsale comme dans le genre *Oiketicus*. Les ailes postérieures ont sept nervures marginales—*Oiketicoïdes*, Heyl. (*doubledayi*, Westd., *inquinata*, Led., *opacella*, H.-S., *zelleri*, Mann).

β. Les ailes antérieures ont onze à douze nervures marginales. L'interne supérieure s'anastomose avec un petit rameau recourbé de la dorsale—*Pachytelia*, Westd. (*villosella*, Ochs., *unicolor*, Hufn.).

γ, Les deux internes ne s'anastomosent pas—*Amicta*, Heyl. [*quadrangularis*, Christ, *heylaertsii*, Mill. (=*sera*, Wisk.), *tedaldii*, Heyl., *lutea*, Staud., *febretta*, Boy.-de-Fons., *ecksteini*, Led., *ritsemae*, Heyl., *uralensis*, Frr. et sa var. *demissa*, Led.].

The variation in the neuration of some of the individual species here enumerated makes this subdivision almost impossible of acceptance, *e.g.*, in the series of *Acanthopsyche opacella* in the British Museum collection, are some examples that would be *Oiketicoïdes* and others *Amicta*, the majority the latter, and the great variation among the Psychids in neuration, makes this character everywhere more than usually unsafe. Chapman notes further that the anterior tibial spur may perchance not be of absolute diagnostic value, on account of the possibility of its having been independently lost in different places. With regard to the antennæ, however, it would appear that, so far as Chapman's observations have gone, the Acanthopsychids have lost the antennal scaling whilst the other Psychids have retained it. The amount of loss in certain species, apparently representing different genera, appears to be as follows:

1. Partially from the pectinations not the shaft—*Canephora unicolor*.
2. From the pectinations not the shaft—*Acanthopsyche opacella*.
3. From the pectinations and almost completely from the shaft—*Pachythelia villosella* and *P. lutea*.

On this account Chapman considers *lutea* should come very near *P. villosella* despite any neurational differences, whilst *A. opacella* in its two extremes agrees neurationally with both; Meyrick figures the neuration of *A. opacella* as very close to *P. villosella*, but this form is very rare. *A. zelleri* seems very like a small *A. opacella* and *ecksteini* like a large one, but the case of the latter is very distinctive. A Cingalese species, *cana*, Hmpsn., seems very close to *P. villosella*.

Besides the objection to the general characters on which the subdivision of *Acanthopsyche* is founded by Heylaerts, one objects to his grouping of the species in these sections. Thus of the species which he includes in *Oiketicoïdes*, we find, besides *inquinata*, which Hampson fixes as the type of the genus, *doubledayi* the type of *Chalia*, and *opacella*, and *zelleri*, which we have grouped to form our genus *Acanthopsyche*, *in sensu strict.* *Pachythelia*, too, as used by Heylaerts is heterotypical and contains *villosella* (the type of *Pachythelia*, Westd.), and *unicolor* (the type of *Canephora*, Hb.), which have, in spite of their obvious differences, been placed by most authors in the same genus. *Amicta* contains no British representative but is separated from its congeners because "les deux internes (*i.e.*, the lower nervures at base of forewing) ne s'anastomosent pas," whilst these nervures are said to anastomose by means of a small branch bent from the dorsal in *Pachythelia*, and to anastomose as in the genus *Oiketicus* in *Oiketicoïdes*, an arrangement which we have already criticised as allowing extreme forms of *opacella* to belong to *Amicta* and *Oiketicoïdes* respectively. Some of the species referred by Heylaerts to *Amicta* appear to be very close indeed to *Pachythelia* and *Acanthopsyche*, *in sensu strict.* We may here note that although Wallengren refers *unicolor* to his genus *Lepidopsyche*, he places *villosella* and *opacella* with certain true Psychids and Stenophanids in his genus *Psyche*.

The early stages do not offer any very special Acanthopsychid features—the eggs and larvæ being very similar to those of the Psychids (*in sensu strict.*). The main pupal peculiarities of the subfamily appear to be that the male has the maxillary palpi clearly marked and forming quite a separate knob extending to the antennæ, the cheeks extending barely to the jaws, the head-piece evanescent, whilst the metathorax is narrowed, tubercles ii forming very obvious waist-buttons one-fifth of the width of the segment. The female pupa has the face-parts very flimsy, removed on dehiscence, only the mouth-parts and antennæ are brown, the rest colourless and shrivelled up; the antennæ lie close to the jaws, the legs are little more than buttons but with one or two circles representing joints (less obvious in *P. villosella* than in *A. opacella*); the wings are very uncertain, mere wrinkles; the anterior dorsal spines are obsolete or nearly so, whilst the intersegmental hooks are sharp (long in *Pachythelia*, short in *Acanthopsyche*).

The male imagines of the Acanthopsychids not only specialised with regard to their antennal scaling, but developed an anastomosis between nervures $1b$ and $1a$, and the development of these particular nervures is very characteristic of the Acanthopsychid section. Even when nervure $1b$ is devoid of branches it is elbowed so as to show that the branch to the inner margin and that which anastomosed with $1a$ once existed. In the Oiketicids this development is specially well-marked, $1b$ and $1a$ anastomosing strongly and at exaggerated angles, whilst extra nervules pass to the inner margin of the forewing and on the hindwing a similar strong nervule passes to thé costa. In *T. ephemeraeformis* not only does $1b$ and $1a$ anastomose, but it has rarely only one, usually two, and sometimes three or more branches towards the inner margin. *Chalia* has lost the branch of $1b$ that normally reaches the inner margin, and hence is a specialised Acanthopsychid form. The Acanthopsychid *Moffatia* is peculiar in having $1b$ and $1a$ separate and branchless as in the Micro-Psychids; it would appear, therefore, that this genus has lost the anastomosis of $1b$ and $1a$ and also the inner branch of $1b$ as has *Chalia*. The characteristic notch of the wing margin (especially the hindwing) at nervure 2 is evidently connected with the same cause. It would appear, therefore, that the Acanthopsychid branch specialised in its neuration in two directions: (1) To the Oiketicids which increased the subsidiary nervures along the opposed margins of the wings. (2) Through *Amicta*, *Chalia*, and their allies, culminating in such forms as *Moffatia*, and tending to lose the definite neurational characters of the group (Chapman).

The anterior tibial spur may be lost in the Acanthopsychids and when so it is quite evident that it was lost independently of, and at a later period than in, the *Psychinae*. *T. ephemeraeformis* is an Oiketicid in the general characters of wing-scaling, want of antennal scales on pectinations, branching of nervure 4 in discoidal cell, branching of the anastomosed $1b$ and $1a$, extra branch of costal nervure of hindwing, and distinct notch at nervure 2 on wing margins, yet it has lost the anterior tibial spur leaving only a minute tubercle on the inner aspect at the base of the tibia. The species placed in the genera *Manatha*, *Heylaertsia*, *Chaliodes*, and *Eurycyttarus* by Hampson also appear to be Acanthopsychids that have lost the anterior tibial spurs.

The Acanthopsychid section is very poorly developed in the Palæarctic area, the species much resembling in general appearance the Psychid division. On the other hand it is particularly well-developed in tropical and subtropical regions, taking on many specialised forms and comprising many extensive and well-marked groups.

Genus: Acanthopsyche, Heylaerts.

Synonymy.—Genus: *Acanthopsyche*, Heyl., "Ann. Soc. Ent. Belg.," xxv., pp. 66-70 (1881). *Psyche*, ? Meig., "Eur. Schmett.," iii., p. 11 (1830); H.-Sch., "Sys. Bearb.," ii., p. 20 (1845); vi., p. 175 (1856); "Neu. Schmett.," p. 7 (1856); Hdrch., "Syst. Verz.," ed. 2, p. 6 (1846); ed. 3, p. 24 (1851); Fuss, "Verh. Sieb. Ver.," i., p. 58 (1850); Newm., "Zool.," 1850, app. p. xcix; Led., "Verh. z.-b. Ges. Wien," ii., *abh.* p. 74 (1852); "Wien. Ent. Monats.," ii., p. 142 (1858); Speyer, "Stett. Ent. Zeit.," 1852, p. 324; "Geog. Verb. Schmett.," i., p. 306 (1858); ii., p. 278 (1862); "Verh. Nat. Ver. Preuss. Rhein.," xxiv., p. 182 (1867); Wocke, "Cat. Lep. Siles.," p. 2 (1853); "Zeit. Ent. Bresl.," iii., p. 25 (1872); "J.-B. Schles. Ges. Vat. Cult.," liii., p. 163 (1876); Bruand, "Mon. des Psych.," p. 59 (1853); "Ann. Soc. Ent. Fr.," 3rd ser., vi., p. 463 (1858); Mann, "Ver. z.-b. Ges. Wien," v., p. 156 (1855); Walk., "Cat. Lep. Het.," iv., p. 939 (1855); Müll., "Lotos," vi., p. 145 (1856); Sta., "Man.," i., p. 166 (1857); Moesch., "Neu. Laus. Mag.," xxxiv., p. 271 (1858); Hein., "Schmett. Deutsch.," i., p. 182 (1859); Kef. and Wernbg., "J.-B. Ak.

Erfurt," i., p. 144 (1860); Staud., "Cat.," 1st ed., p. 27 (1861); 2nd ed., p. 63 (1871); "Stett. Ent. Zeit.," xxii., p. 361 (1861); "Hor. Soc. Ent. Ross.," xiv., p. 349 (1879); Wilde, "Pflanz. Raup. Deutsch.," ii., p. 73 (1861); Nick., "Lotos," xi., p. 154 (1861); Cooke, "Merrifield's Brighton," p. 213 (1864); Wernbg., "Btr.," i., p. 376; ii., p. 167 (1864); Friv., "Mag. Tud. Akad.," xi., (4), p. 148 (1865); Nolck., "Lep. Fn. Estl.," p. 119 (1867); Hint., "Zeit. Ferdinand.," (3), xiii., p. 232 (1867); Bang-Haas, "Nat. Tids.," (3), ix., p. 407 (1874); xii., p. 172 (1881); Höfn., "J.-B. Mus. Kärnt.," xvi., p. 164 (1884); Sint., "Arch. Nat. Liv.," (2), vii., p. 335 (sep. p. 15) (1876); Curò, "Bull. Soc. Ent. It.," viii., p. 143 (1876); Mill., "Iconog.," iii., p. 208 (1877); Weiler, "Schmett. Innsb.," p. 15 (1877); Zell., "Stett. Ent. Zeit.," 1877, p. 434; Rozsay, "Cat. Lep. Poson," p. 8 (1878); Tur., "Bull. Soc. Ent. Ital.," xi., p. 170 (1879); Standf., "Zeit. Ent. Bresl.," vii., pp. 31, 42 (1879); Fritsch, "Danks. Akad. Wien," xli., p. 64 (1879); Tgstr., "Not. Sällsk. F. F. Fenn.," x., p. 300 (sep. p. 10) (1869); Peyer., "Cat. Lép. Als.," 2nd ed., p. 58 (1880); Frey, "Lep. der Schweiz," p. 90 (1880); Hell., "Ber. Ver. Innsb.," xi., p. 90 (1881); Schöyen, "Lep. Ark. Nor.," p. 176 (1881); Herg., "Stett. Ent. Zeit.," xlii., p. 154 (1881); Kill., "J.-B. Graubünden," xxiii-xxiv., *anh.* p. 64 (1881); Kemp., "Rovart. Lapok," i., p. 99 (1884); Rom., "Mém. sur Lép.," ii., p. 7 (1885); Lampa, "Ent. Tids.," 1885, p. 38; Schmid, "C.-B. Nat. Ver. Regensb.," xxxix., p. 83 (sep. p. 34) (1885); Rühl, "Soc. Ent.," ii., p. 13 (1887); Pet., "Btr. Kennt. Reuss. Reiches," (3), iv., p. 85 (1888); Auriv., "Nord. Fjär.," p. 59 (1889); Teich, "Arb. Nat. Ver. Riga," vi., p. 19 (1889); Pabst, "Iris," iii., p. 106 (1890); Dale, "Lep. Dors.," ed. 2, p. 9 (1891); Stein., "Iris," v., p. 413 (1892); Hoffm., "Stett. Ent. Zeit.," liv., p. 144 (1893); Barr., "Ent. Mo. Mag.," xxx., p. 218 (1894); "Lep. Brit.," ii., p. 339 (1895); Carad., "Iris," viii., p. 86 (1895); Meyr., "Handbook," p. 444 (1895); Schütze, "Iris," ix., p. 334 (1896); Lutz., "K.-B. Ver. Riga," xxxix., no. 46 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 307 (1898). *Pachythelia*, Humph. and Westd., "Brit. Moths," i., p. 94 (1851); "Proc. Zool. Soc. Lond.," 1854, p. 221. *Oiketicus*, Westd., "Proc. Zoöl. Soc. Lond.," 1854, p. 235. *Thyridopteryx*, White, "Proc. Ent. Soc. Lond.," v., p. 32 (1858). *Oiketicoïdes, in part*, Heyl., "Ann. Soc. Ent. Belg.," xxv., p. 70 (1881). *Chalia*, Kirby, "Cat. Lep. Het.," p. 507 (1892).

Heylaerts' diagnosis of the genus reads (*Ann. Soc. Ent. Belg.*, xxv., p. 166) as follows:

Acanthopsyche, mihi. Antennes bipectinées jusqu'au sommet; les barbules diminuent en longueur du milieu vers le sommet. Les tibias antérieurs portent une épine tibiale très longue.

This so-called generic description is really a subfamily one, and Heylaerts recognises this by subdividing it into three so-called subgenera—*Oiketicoïdes*, *Pachytelia*, and *Amicta*—all of which, however, are heterogeneous and heterotypical. These have already been dealt with at length (*ante*, p. 375). We would here restrict the genus *Acanthopsyche* to the little group of which *opacella* is the type.

The main structural points of the genus appear to be as follows:

Ovum.—Exceedingly delicate, oval (but compressed so as to lose shape); shell transparent; finely granulated; large but scarcely traceable surface reticulations; packed closely in empty pupa-skin.

Case.—Roughly cylindrical, slightly constricted at neck, mouth somewhat expanded, slightly tapering at opposite end, silk whitish, loosely spun outside, more closely inside; covered with fine particles of vegetable *débris* nearest silk, and with larger pieces outside, all pointing to free (emergence) end, standing off case at angle of 30°-40° near mouth (spun-down end); male case with slight silken tube at free end. [Much less bulky, covered with more varied materials, and less projecting sticks, than case of *Pachythelia*.]

Larva.—Head small, rounded above, very flat beneath, polished, black, antennæ prominent; body widest at 3rd and 4th abdominal segments, tapers gradually to head, abruptly to anus, latter rounded; segmental incisions distinct; prothorax long and narrow, mesothorax wider, metathorax shorter and broader, all with black polished dorsal plates, with white medio-dorsal line on pro- and mesothorax (fainter on metathorax); abdominal segments dark, incisions paler, divided into two subsegments, lateral and ventral areas yellowish; spiracles very large, oval; lateral flange strongly marked; tubercles i smaller and outside ii, iii with long seta, iv and v small, v less than iv; plates at base of setæ large; prolegs with marked central depression, the oval of hooks large and strong; lateral ridge large; anal segment with corneous plate; true legs, strong and stout (hence look short), first pair smallest, third pair largest.

Pupa.—♂. Fairly cylindrical; head, prothorax and mesothorax forming sloping truncate front, metathorax narrowed, abdominal segments tapering very slightly, last three abdominal segments curved forwards ventrally; wings fixed to abdominal segments 1-2, not adherent to front of 3, strongly marked neuration; face-parts ventral; antennæ large extending not quite to end of wings; second pair of legs same length, third pair of legs just beyond tips of wings, first pair of legs short; abdominal segments carry tubercles i, ii, iii, iv, v, vi, vii, each with bristle; row of dorsal anterior abdominal hooks on 6, 7 and 8; row of intersegmental (posterior) spines on 3 (faintly), 4 and 5; proleg scars well marked; anus with two ventral bosses each ending in a blunt point and outside hooks; ventrally on abdominal segment 9 is a median depression with rounded mammilla on each side; face-parts well developed, clypeus forms a boss above prominent labrum; mandibles rounded, maxillæ extend outwards as a separate piece (which looks like a max. palpus); labium large, maxillæ long, rounded at ends, extending below eyes to antennæ. ♀. Cylindrical, tapering slightly to head, more rapidly to anus; no anal armature; scars of prolegs and sexual organs well-developed; anterior margin of abdominal segments 6, 7 with a short row of blunt recurved hooks (dorsal); intersegmental row of hooks on 2-5 short and sharp; spiracles small; tubercular setæ as in ♂; antennæ close to jaws; legs little more than buttons but joints obvious; wings mere wrinkles; face-parts flimsy, removed on dehiscence.

Imago.—♂. Robust, wing-scales slender; antennæ scaled above, with hairs beneath, pectinations unscaled with long hairs beneath; legs long and slender, femora with long hairs, anterior tibial spur ·85; no posterior tibial spurs. ♀. Vermiform, projecting head, rudimentary antennal points, black eye-patches; rudimentary second and third legs, the second with definite claw-like seta; apterous; dorsal thoracic plates black-brown, shiny; smaller plate on 1st abdominal; ventral nervous chain from mesothorax to 7th abdominal; ventral mammillæ on 8th and 10th abdominals; anal segment with fleshy projection.

The three species which Chapman is inclined to refer to this genus are all Palæarctic—*opacella* having a distribution throughout the whole of Europe from Finmark to the Mediterranean, and from Asia Minor and Transcaucasia to England; *zelleri* is confined to south-east Europe, and *ecksteini* to Hungary.

Acanthopsyche opacella, Herrich-Schäffer.

Synonymy.—Species: *Opacella*, H.-Sch., "Sys. Bearb.," ii., p. 20, pl. xix., fig. 102 (1845); "Neu. Schmett.," p. 7 (1856); figs. 2, 3 (1861); Stphs., "List. An. Brit. Mus.," v., p. 310 (1850); 2nd ed., p. 52 (1856); Humph. and Westd., "Brit. Moths," i., p. 94 (1851); Hdrch., "Verz.," 3rd ed., p. 24 (1851); Spey., "Stett. Ent. Zeit.," 1852, p. 324; "Geog. Verb. Schmett.," i., p. 306 (1858); ii., p. 278 (1862); "Verh. Nat. Ver. Preuss. Rheinl.," xxiv., p. 182 (1867); Led., "Verh. z.-b. Ges. Wien," ii., *abh.* p. 74 (1852); Brd., "Mon. Psych.," p. 59, pl. i., figs. 35*a-b* (1853); "Ann. Soc. Ent. Fr.," 1858, p. 463; Wocke, "Cat. Lep. Siles.," p. 2 (1853); "Zeit. Ent. Bresl.," iii., p. 25 (1872); "J.-B. Schles. Ges. Vat. Cult.," liii., p. 163 (1876); Walk., "Cat. Lep. Het.," iv., p. 939 (1855); Müll., "Lotos," vi., p. 145 (1856); Frr., "Neu. Beit.," pl. 663, figs. 2*e-i* (1856); Sta., "Man.," i., p. 166 (1857); Moesch., "Neu. Laus. Mag.," xxxiv., p. 271 (1858); Hein., "Schmett. Deutsch.," i., p. 182 (1859); Hofm., "Berl. Ent. Zeit.," iv., pp. 20-21 (1860); Kef. and Wernbg., "J.-B. Ak. Erfurt," i., p. 144 (1860); Staud., "Cat.," 1st ed., p. 27 (1861); 2nd ed., p. 63 (1871); "Sett. Ent. Zeit.," 1861, p. 361; 1874, p. 58; "Hor. Soc. Ent. Ross.," xiv., p. 349 (1879); Wilde, "Pflanz. Raup. Deutsch.," ii., p. 73 (1861); Nick., "Lotos," xi., p. 154 (1861); Cooke, "Merrifield's Brighton," p. 213 (1864); Hint., "Zeit. Ferdinand.," (3), xiii., p. 232 (1867); Nolck., "Lep. Fn. Est.," p. 120 (1867); Tgstrm., "Not. Sällsk. F. F. Fenn.," x., p. 300 (sep. p. 10) (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 407 (1874); (3), xii., p. 172 (1881); Merr., "Lep. Calend.," 2nd ed., pp. 55, 67, 100 (1875); Höfn., "J.-B. Mus. Kärnt.," xvi., p. 164 (1884); Sint., "Acad. Nat. Liv.," (2), vii., p. 335 (sep. p. 15) (1876); Curò, "Bull. Soc. Ent. It.," viii., p. 143 (1876); Zell., "Stett. Ent. Zeit.," 1877, p. 434; Weil., "Schmett. Innsb.," p. 15 (1877); Rozsay, "Cat. Lep. Poson," p. 8 (1878); Tur., "Bull. Soc. Ent. Ital.," xi., p. 170 (1879); Standf., "Zeit. Ent. Bresl.," vii., pp. 31, 42 (1879); Fritsch, "Danks. Akad. Wien," xli., p. 64 (1879); Peyer., "Cat.

Lép. Als.," 2nd ed., p. 58 (1880); Frey, "Lep. der Schweiz," p. 90 (1880); Hell., "Ber. Ver. Innsb.," xi., p. 90 (1881); Heyl., "Ann. Soc. Ent. Belg.," 1881, p. 70; Schöyen, "Norg. Ak. Lep.," pp. 176-177 (1881); Hering, "Stett. Ent. Zeit.," xlii., p. 154 (1881); Killias, "J.-B. Graubünden," xxiii-xxiv., *anh.* p. 64 (1881); Kemp., "Rovart. Lap.," i., p. 99 (1884); Rom., "Mém. sur Lép.," ii., p. 7 (1885); Schmid, "C.-B. Nat. Ver. Regensb.," xxxix., p. 83 (sep. p. 34) (1885); Lampa, "Ent. Tids.," p. 38 (1885); Rühl, "Soc. Ent.," ii., p. 13 (1887); Pet., "Btr. Kennt. Reuss. Reiches," (3), iv., p. 85 (1888); A. Hoffmn., "Stett. Ent. Zeit.," xlix., p. 151 (1888); liv., p. 144 (1893); Auriv., "Nord. Fjär.," p. 59 (1889); Teich, "Arb. Nat. Ver. Riga," vi., p. 19 (1889); Pabst, "Iris," iii., p. 106 (1890); Dale, "Lep. Dorset.," 2nd ed., p. 9 (1891); Stein., "Iris," v., p. 413 (1892); Barr., "Ent. Mo. Mag.," xxx., p. 218 (1894); "Lep. Brit.," ii., p. 339 (1895); Carad., "Iris," viii., p. 86 (1895); Meyr., "Handbook," p. 444 (1895); Schütze, "Iris," ix., p. 334 (1896); Lutz., "K.-B. Ver. Riga," xxxix., Bomb. no. 46 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 308 (1898). *Furva* [*nec* Bkh., "Eur. Schmett.," iii., p. 282 (1790) =*unicolor teste* Chapman]; Wernbg., "Beit.," i., p. 376 (1864); Kirby, "Cat. Lep. Het.," p. 507 (1892). *? Nigrella*, Meig., "Eur. Schmett.," iii., p. 11, pl. lxxxix., fig. 2 (1830). *Hyalinella*, Stphs., "List. An. Br. Mus.," v., p. 56 (1850). *Fenella*, Newm., "Zool.," viii., app. p. xcix (1850). *? Atra*, Fuss., "Verh. Sieb. Ver.," i., p. 58 *teste* Czekelius (1850). *Villosella, in part*, Westd., "Proc. Zool. Soc. Lond.," 1854, p. 221 (♀ from Scotland). [*Maritimella*, Brd., sometimes given as a synonym of this species, is not *A. opacella*. It has (and is figured with) yellowish antennæ and prothorax.]

ORIGINAL DESCRIPTION.*—*Psyche opacella*, Supp., fig. 102, 7‴-8‴. Nigrocinerea, alis cinereis, parum hyalinalis. Fast nur halb so gross als *graminella*, die Hinterflügel kleiner, der Saum der Vorderflügel schräger, ihre Spitze gerundeter, also so ziemlich der Habitus von *villosella*, mit welcher sie auch hinsichtlich des plumpen Körpers und der langen Behaarung übereinkömmt. Die Fühler sind etwas länger. Hinsichtlich der Rippen findet mehr Uebereinstimmung mit *graminella* statt; nur Rippe 7 und 8 der Vorderflügel entspringen auf gemeinschaftlichem Stiel, die mittlere Abtheilung der Mittelzelle der Hinterflügel ist gerader gestutzt. Die Fühler sind braun, die Behaarung des

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* Some authors consider that Borkhausen's *furva* represents this species. Werneburg writes: "The description which Borkhausen gives, its size and comparison with *vestita*, the narrow more pointed forewings, the larval case (figured in Pt. xvii of the *Naturforscher* and here cited) all decidedly fit *opacella*." The translation of Borkhausen's description is as follows: "*Phalaena Bombyx furva*. The dark grey black-changing casebearer. This is hardly more than half the size of *B. detrita* or *B. vestita*. The forewings are narrower in proportion than the preceding species (*graminella*, *viciae*, *detrita*, *vestita*) and have a sharp apex. The colour of the insect on both sides is dark grey, strongly black in some lights. The wings are covered with small, somewhat lighter, hairs, which form a neat border. The antennæ are black and, as in the allied species, strongly pectinated. The larva of this species feeds on oak-leaves, and is found in spring. Its ground colour is dirty yellow, the head shaded with brown and yellow stripes. A straight brown lateral line on each side of the thoracic segments, and a narrow yellow dorsal line on the prothorax and mesothorax, terminating on the metathorax in a dark brown spot. The rest of the dorsal area is brown, with very fine and scarcely visible scattered yellow dots, but the posterior segments (as also the anal claspers) are entirely brown. The true legs are brown, corneous, the prolegs whitish-yellow, very small, looking like tiny protuberant warts. The case is very ingeniously made of soft splinters of bark, united by a fine white web. In the arrangement of the pieces of bark this case resembles a bursting fir-cone." Borkhausen notes that "Müller's observation that the larva does not attach the case at the opening, but by the posterior end, is surely a mistake. . . . The species also occurs in our district, as one sometimes finds the larva, although I have never been able to bring them through." Borkhausen's description is taken almost verbatim from Müller (*Hanauisches Magazin*, iii., pp. 241-3), who states that Kühn was elucidating the life-histories of certain case-bearers, that on May 15th, 1780, he (Müller) observed a crawling habitation containing a larva, that this larva agreed well in form with Kühn's, but

Körpers schwarzgrau, die Beschuppung der Flügel ist viel dünner als bei *graminella*, sie erscheinen desshalb schwarzgrau. Von Hrn. Keferstein und Heidenreich als *hirsutella*; von Hrn. Kaden drei Exempl. als neu, aus Oestreich (Herrich-Schäffer, *System. Bearbeitung*, &c., p. 20).

Imago.—♂. Anterior wings 18mm.-19·5mm., unicolorous, blackish-grey, thinly-scaled, semi-transparent, the nervures darker and distinct; the discoidal lunule clearly marked; fringes unicolorous. Posterior wings and fringes unicolorous and of the same tint as the anterior wings.

Sexual dimorphism.—♂. The *male* is fairly robust, with well-developed wings, the wing-clothing consisting of very narrow black scales, looking like hairs till magnified, the scales broader in fringes. The antennæ black, the first joint very large, urn-shaped, the second large and globular, 27 or 28 other joints beyond that carry long pectinations; length of antennæ 4·3mm., of longest pectinations 1·2mm. (from about joints 5-15) getting smaller towards apex; the joints carry hairs beneath, are scaled above (few left in specimen examined, but sockets plentiful), 19 or 20 to a joint, irregularly placed, but more numerous towards base of joint, pectinations carry long black hairs beneath, are quite smooth above, having completely lost all traces of scaling; the pectinations arise from nearly the middle of each antennal joint. The legs long and slender, the femora with very long hairs; the anterior tibial spur ·85, no spurs on the second and third tibiæ; the tarsi measure as follows: 1st = 1·8mm., 2nd = 1·7mm., 3rd = 1·0mm. ♀. The *female* is 10mm. in length, 3mm. in width, nearly cylindrical, white and maggot-like; the head projects forwards, and has two points that are apparently antennæ; also black eye-patches; four other points clearly represent the second and third pairs of legs, the anterior of these, at least, ending in a very definite seta (or claw); no trace of

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in respect of colour and size was very different. The case, very skilfully made of soft splinters of bark united by a fine white web, is shown at fig. 1; fig. 2 exhibits the larva outside its case. Its ground colour is dirty yellow, the head shaded with brown and yellow stripes, &c. (*vide* above, as Borkhausen has copied verbatim the descriptions of the imago, larva, and case). Müller then adds: "After the larva had been fed about fourteen days on oak leaves, it spun up on the cover of the box, attached by the end where the anal prolegs normally are, and so placed that the case hung vertically. Some time after the case was opened and a brown pupa, shown at fig. 3, was found therein. This pupa was provided with an anal hook, by means of which it held firmly, but it was also able to move abou with wonderful rapidity. After about six weeks a small male moth with pectinated antennæ was bred, its form and size shown at fig. 4. Its colour both on the upper and under-side was dark grey, showing a strong black gloss in certain lights, &c." Chapman believes that this was most likely *Canephora unicolor*. He writes: "*Furva* of the *Hanau. Mag.* (1780) and *Naturforscher* (1782)—the figures of the second are copied from those of the first work. (1) *Hanau. Mag.*—The figure of case is very like one of the leafy ones of *C. unicolor*, but the description says it is covered with "delicate strips of bark" ("zarten spänen des baumrinde"). This suggests rather *S. hirsutella* than *A. opacella* or *C. unicolor*. The pupa and larva give no help. The moth is very like *C. unicolor* in wing shape and not at all like *A. opacella*, the size of wings in proportion to thickness of body is more like *C. unicolor*, as well as the large round hindwings. (2) *Naturforscher*.—The figure in *Naturforscher* is really not at all bad for *C. unicolor*, a shade small (24mm.) The *Hanau. Mag.* figure is uncoloured, that in *Naturforscher* is coloured and is dense black (like *C. unicolor*); obviously no attempt made to represent such flimsier wing structure as *A. opacella* or *S. hirsutella*. I should say that it was much the most likely to be *C. unicolor*, just possibly *S. hirsutella*, and certainly not *A. opacella* (*in litt.*, January 24th, 1900).

wings apparent. Dorsal plates on pro-, meso-, and metathorax, black-brown and shining, and a less one on the 1st abdominal. On the venter of each segment, from mesothorax to 7th abdominal, is a small brown spot shining through (nerve ganglia); the tracheæ that are subcutaneous are also very evident as well as some whitish tubes in the 1st and 2nd abdominal segments (? urinary tubes full of urates, similar tubes occur further back in other ♀ Psychids); the interior is marked by white egg-masses; and except a posterior chitinous projection there is no very definite anal structure; abdominal segments 8 and 10 project ventrally as mammillæ (Chapman). The body of the *living female* has all the soft appearance of that of the larva of a wasp or bee, and is of a pale dirty whitish colour, except the upper side of the head and thoracic segments, which are brown; the 1st, 4th, 5th, 6th, 7th, 8th, 9th, 10th, and 11th segments of the body are furnished at the sides with a pair of spiracles, from which the tracheæ may be seen to radiate through the thin skin of the body; on the underside of the body is a row of nine small brown spots in the middle of the segments, commencing on the segment next to the head, those on the thoracic segments being close together between the minute rudiments of legs. The head has three deep circular impressions in front, forming a triangle; the eyes appear to be merely irregular black spots, with the surface continuous and destitute of facets; the antennæ are rudimental, consisting of a minute exarticulated pair of appendages on the underside of the front of the head; between the rudimental antennæ there is a transverse impression in the place of the mouth, which is alternately puffed out and withdrawn, but no opening is visible; the legs are minute tubercles; the body is terminated by a small fleshy lobe or appendage, beneath which is a fleshy proleg or wart. The insect has a very strong vermicular motion, contracting segment after segment, considerably resembling in this respect the incipient pupa of some Hymenoptera. It twists the extremity of its body about in various directions, especially upwards, with considerable energy* (Westwood). The *female* is 5-6 lines long, of a yellow colour. The head is horny, brown above, beneath somewhat whitish, with black eye-spots and short antennæ. The shoulder plates are shining dark brown, with white borders. On the back of the 1st abdominal is a brown corneous spot. Legs small, white, the horny plate on the anal segment dark brown. Many examples show the dorsal lines on the back between which is the dorsal vessel (Hofmann). Barrett describes the *living female* as "devoid of scales, wings, legs, and antennæ," and as being in appearance a mere maggot with a fat pinkish-white or brownish-pink body. The head is a mere mask of horny, brown, shining substance like that usual in larvæ, rounded in front, but without regular eye lobes or mouth organs, but having faint indications of rudimentary antennæ in the form of short glassy points. The 2nd and 3rd segments (pro- and mesothorax) are protected by, in each case, a large, thin, dark brown, horny plate, which covers the back and extends down the sides; the 4th segment (metathorax) has a smaller paler plate. Across the lower side of these three segments are slight ridges. The anal segment has a short, bluntly projecting, ovi-

* This ♀ is the Scotch species = *A. opacella*, but is wrongly referred (*Proc. Zool. Soc. Lond.*, 1854, p. 221) to *P. villosella*.

positor sheath, and beneath it two rounded papillæ. At the sides of the 7th-9th segments (3rd-5th abdominal) are small tufts of erect, soft, white hairs. Newman states on the authority of Doubleday that "the female possesses legs and antennæ, characters in which it very decidedly differs from the apod scolicomorphous females of several ascertained species." [The specimens here referred to came from the New Forest in Hampshire, where Weaver found larvæ in the summer of 1848.] Standfuss observes that the female when extracted from the pupa shows a distinct clothing of hair, but when it emerges this is immediately rubbed off owing to its movements. Bruand notes that the female has small woolly tufts on segments 4-8.

Variation.—The following appears to be the only named variety:

a. var. *senex*, Staud., "Cat.," p. 63 (1871); Rom., "Mém. sur Lép.," ii., p. 7 (1885); Kirby, "Cat. Lep. Het.," p. 507 (1892); Caradja, "Iris," viii., p. 86 (1895).—Alis hyalinalis, thorace abdomineque albido-hirsutis, antennis crassioribus (spec. propr.?). Bulgaria, Armenia (Staudinger).

Caradja has since recorded this variety from Roumania, noting that his cases were found at Grumazesti on grass and trunks in a birch wood, in 1893. Staudinger also records it from Tiflis in Transcaucasia. Heylaerts refers Zeller's Ober-Albula example, described as "being like *opacella* but with rather more hairy body," to this variety.

Comparison of Acanthopsyche opacella with A. zelleri and A. ecksteini.—Chapman suggests that the two species *zelleri* and *ecksteini* are congeneric with *A. opacella*. The following notes may be interesting:

A. zelleri, Mann, *Verh. z.-b. Ges. Wien*, v., pp. 756-7, pl. vi., figs. 1-8.—This species is very like *A. opacella*, but the ♂ has much shorter antennæ, and differently shaped wings, whilst the ♀ is reddish-yellow in colour. The male is of the size and colour of *A. opacella*, the head, thorax, and abdomen similarly covered with whitish-grey hairs. The antennal pectinations are similar, but whilst the antennæ are two-thirds the length of the forewings in *A. opacella*, they are scarcely half the length in *zelleri*. The wings of the latter are much shorter and rounder, the apex and outer margin more rounded; they are also more densely scaled, the scales thicker on the nervures and at the end of the discoidal cell, hence the nervures look thicker. The underside as the upper; the palpi, legs and neuration as in *opacella*. The ♀ vermiform, reddish-yellow, with glossy brown head and neck. The ♂ case is very like that of *A. opacella*; it is entirely covered with fine grains of sand, and over this with sharp, pointed, pieces of plant stems which are, however, so loosely fastened that they are readily detached when touched. The ♀ case almost entirely lacks this covering, the grains of sand are larger and coarser and are spun on with coarser white silk. The cases were found in the middle of April at Draga in Croatia, spun up on walls; the imagines emerged from the beginning to end of May, usually from 10 a.m.-12 a.m. Lederer also received the species from Pesth, the imagines (both sexes) agreeing with those from Draga, but the cases differ, the outside of the Pesth examples being covered with little pieces of bark firmly attached (Mann).

A. zelleri is rather smaller than *A. opacella* (5 : 6), the antennal joints of both are 29 in number; the scaling of *A. zelleri* a little more dense, the cases distinctly smaller, but the form and materials nearly identical (the *A. opacella* cases in the Brit. Museum collection are in fine order, those of *A. zelleri* very worn, as one usually sees the cases of *A. opacella* after weathering and the ravages of the young larvæ) (Chapman).

A. ecksteini, Led., "Verh. z.-b. Ges. Wien," v., pp. 755-6, pl. vi., figs. 1-6 (1855).—The imago comes nearest to *P. villosella*, the neuration as in the latter species, specimens of both sometimes having nervures 4 and 5 stalked, at others separate, and sometimes originating at one point; slightly smaller than *P.*

villosella, same shaped wings but rather more slender, the head, thorax, and abdomen less densely clothed, pale yellow-grey in colour (in *P. villosella* inclining to brown), the wings of the same tint, finely scaled, more glossy, with dark grey fringes. The head, antennæ, and legs as in *villosella* but in *ecksteini* the pectinations are more prominent and somewhat more regularly arranged. The underside similar to upperside, but breast and the costa of forewings blacker. The dried ♀ appears to have a lighter brown head and to be more brightly coloured than *villosella*. The ♂ case is of the same form as that of *C. unicolor*, that is it is only clothed for about half its length, ending in a long thin tube from which the pupa, on emergence, protrudes itself about halfway. The case is clothed with short dead grass-stalks which it arranges longitudinally but so few that they only cover the case at its base. The ♀ case ends in a far shorter silk tube, but is clothed with the same material, and has the upper half (unclothed in the ♂) covered with long thin grass-stems that project far beyond the end of the case. The larvæ, found in autumn and early spring at Pesth by Eckstein, hybernate fully grown in tall thick grass-tufts near the ground. Pupation takes place in March, the cases being attached to bushes, roots, or grass-culms, in such a way as to stand vertically upwards, or but slightly sideways. The imago appears in April. The ♀ according to Eckstein always comes quite out of the case like *P. villosella* and *A. opacella* (Lederer). [This remark concerning the ♀ suggests that the observation was made on unfertilised or spent examples.]

A. ecksteini is larger than *A. opacella* (7 : 6), the antennæ with 32 joints, otherwise the species are very similar. The cases differ materially, however, in that that of the former has numerous long pointed rushes fastened lengthwise, their sharp ends projecting in a point some distance beyond (rat-trap fashion) the emergence-end of the case (Chapman).

Egg-laying.—The eggs are packed closely within the empty pupal skin. Weaver notes them as "laid in a mass and covered with a glutinous moisture." Mrs. Cowl states that "the eggs are laid in the pupa-skin, which is literally filled with them, the eggs being packed exactly as are the ova in the roe of a herring."

Ovum.—Empty egg-skins (they cannot be called shells) are excessively thin, delicate and transparent. Under a 1″ objective, they look just like collapsed empty grape-skins, only much more delicate. Under a $\frac{1}{4}$″, the skin is seen to be covered with minute granulations, with just a trace of a rather large, but faint, reticulation, caused by the minute granulations being absent or very slightly marked on the line of the cell pattern (Bacot, May 14th, 1899).

Case.—The case of the larva in its first stadium is 2·25mm. in length, and about ·75mm. in diameter, cylindrical, tapering somewhat to anal end, made of fragments of leaf, sand, &c., worked into the silk, whilst traces of the flake or scale-like method of attachment can be already detected. The hybernating cases were noted in the middle of January (1900), as being nearly alike in size and general appearance. Two that were examined proved to be 22mm. and 20·5mm. in length, and 6·25mm. and 4·7mm. in width, respectively, but slight variations in size were largely due to the arrangement and size of the material used as a covering. The cases are made of silk with grains of sand, earth, fragments of vegetable *débris* (pieces of stem, leaves, bark, &c.). The larger and outermost pieces are (1) scale-like fragments (seed-capsules, flat thin pieces of bark, or stick), (2) fine pieces of grass stem, or dried roots. Altogether the case is very distinctive and differs markedly from that of *P. villosella* of equal size. When the case is open it is seen to be slightly constricted at the neck, the mouth when open being somewhat expanded (bell-mouthed); the attached fragments are decidedly fewer near the mouth than further back, the silk is loosely spun, thin in texture and the mouth is closed by drawing the sides together from the inside. The interior of the case is composed of whitish, smooth, closely spun silk, rather thin in texture (semitransparent if held up to the light). Adult cases from Bournemouth were 22mm. in length, 5mm. in thickness, cylindrical, tapering slightly posteriorly, covered with flakes of black wood or bark of pine trees, also some grains of sand and a few minute pieces of stone (Bacot). A spun-up case from Rannoch (taken by Mr. Reid) is nearly 22mm. long, and about 4·5mm. in width, at the broadest part, slightly tapering towards the free (emergence) end and with finer material there than lower down, the silken tube closely covered with small particles of plant *débris*, outside which are larger pieces of plant stems, pine-needles, pine bark, &c., fastened at about an angle of 30°-40°, the outer ends pointing towards the free end of the attached case. There are fewer needle-like pieces of grass, stems, &c., towards the anterior (spun down) end than towards the posterior, where the flattened pieces of pine bark are more abundant. Chapman notes of the cases in Constant's collection that "they are distinctly smaller than those of *P. villosella*, covered with various materials—leaves, grass, stems, &c.—whilst the colour of the silk and the terminal portions of the case are very much like those of *P. villosella*; the 'silken cap' is somewhat lengthened and, in some aspects, the case is not unlike that of *C. unicolor* although the front portion is not so bold." The case is about an inch in length, composed internally of soft, tough silk, and covered with small pieces of dried grass, pointing backwards, morsels of bark, seed-capsules, and other dried vegetable substances (Barrett). The case is from 10-12 lines long, 3 lines wide, generally dark-coloured, with short and thin pieces of plant stems, leaves laid lengthwise, and here and there grains of sand. It resembles that of *C. unicolor* but the pieces of plant do not stick out as is commonly the case in the latter. The male case ends in a long, very apparent white tube (Hofmann). A. Hoffmann notes the cases found on *Calluna* and *Vaccinium* in the moor region of the Upper Hartz, as being "nearly 2cm. in length, moderately uniform throughout in width, the diameter being about ·45cm.; the cases irregularly clothed with longish grass-culms, pine-needles, and other parts of plants placed longitudinally; the tube of the ♂ case about ·5cm. long, parchment-like, and white." Bang-Haas says that the case is narrow, 8 lines-10 lines long, covered to beyond the middle with grains of sand, small particles of leaf and fragments of grass, whilst the white silken tube projects beyond for about a third part of the length of the case at its free end.

Habits of Larva.—Mrs. Cowl writes that, in 1898, when the young larvæ of *A. opacella* hatched, they wandered about aimlessly on their two front pairs of legs, the abdomen in the air and refused to touch sallow or any other food, until they had first constructed themselves little cases of silk, covered with silver sand and minute particles of lichen which were woven into the silk. As soon as their bodies were covered they ate freely the sallow offered them, and a few fed up well all the summer and autumn. Two or three of them hybernated almost or quite full-grown, attached firmly to a sallow branch by silken threads (*in litt.*, February, 1899). Bacot notes that two larvæ emerged from a puparium (obtained at Locarno) on April 23rd, 1899, and were followed on the morning of the 24th, by some two or three hundred, all without cases, but crawling about in a most restless manner. They were provided with grass and dock about 9 a.m. and by 8 p.m. the majority had manufactured cases, utilising pieces taken from that of the female. The larva appears to commence the making of the case by forming a ring of silk, to which is added any suitable material obtainable. The ring is broadened extending around the abdomen, and the abdomen and case are carried erect at this period, as are those of the adult *Luffia*. The larva is still very active but not so hurried in its movements as before its case was constructed. It appears that the larvæ do but little feeding during the first two or three days of their existence, spending almost the whole time in the making and lengthening of their cases, as no frass was observed in the jar for the first four or five days. In its habits, the larva afterwards becomes sluggish, rests with its body contracted and curved, has the power of hanging by a silk thread if disturbed, and if taken from its case searches as it were for material as if to start a fresh case. These larvæ commenced to hybernate in October, the cases by this time being almost an inch in length, and, in the middle of January (1900), the cases appeared to be exactly the same as when hybernation commenced, nor did there seem to be any difference in the larvæ except that they appeared to have become rather compressed lengthwise (although this may have been due to a dislike of disturbance). For the purpose of hybernation, one or two had spun their cases to the top edge of the tub in which they were confined, but most of them were lying about among the dead leaves, quite sodden with wet and as if dead, but on opening the cases the larvæ were found to be quite lively and active. The larvæ were observed to be moving about on March 12th, and had evidently quite awakened from their hybernation (Bacot). Standfuss says that the larval stage of this species lasts only for one year in Silesia, and that it thus agrees with *S. hirsutella*; Mrs. Cowl and other observers state that, in Britain, it normally takes two years. Bacot's Locarno specimens, just referred to, evidently mean to take only one year.

LARVA.—The *newly-hatched larva* (April 23rd, 1899) has a large head and prothorax, smaller meso- and metathorax. The head black, the thoracic segments nearly so. The abdomen white, except the anal end, which is pale yellowish or brownish, and has a chitinous appearance. The pro- and mesothorax are completely armoured, but the metathorax appears to have a wide gap or suture on the mediodorsal line, dividing the dorsal shield into two plates. The head and thorax make up nearly half the length of the larva, and quite half the bulk. The hairs are very long in comparison with the size of the larva, and the length of those in adult larvæ of the same species. When three weeks old, but still in the *first stadium*, the larva is about 1·25mm. in length (of which the abdomen makes up three-fifths); the prolegs rather long; head and thorax large, rather wider than abdomen, which is about ·25mm. in diameter; the prothorax about twice the size of the meso- or metathorax; the hairs long, some of them on head and thorax being about ·25mm. in length, those on abdomen rather shorter. The head and thorax are black and horny, the abdomen white and soft, but with well-marked chitinous plates, those on anal segment being dark in colour. The dorsal setæ are a short outer i, and a long inner ii (as in adult Psychid larvæ, only the hairs are relatively longer in proportion to the size of the larva), both on basal chitinous plates; iii has a long seta with a large basal plate; iv and v are subspiracular (iv with a long, v with a short, seta), both close together beneath spiracle (as in adult larvæ of *C. unicolor* and *P. villosella*); the extra chitinous plate on the 1st abdominal is present as in larva of *P. villosella*. The gap between the dorsal and lateral plates on meso- and metathoracic segments is distinct, as also is the division of the dorsal plate on the mesothoracic; a wide and well marked suture on mediodorsal area divides this plate in two, the suture is white, the two parts of the plates black; the folds of loose skin between the thoracic segments and between the head and prothorax are quite marked (Bacot, May 14th, 1899). At the *hybernating stage* (October 8th, 1899) the larva is just about 13mm. in length, and about 3mm. in width (at the 3rd and 4th abdominal segments, the 1st, 2nd, 5th, 6th, and 7th, being almost equally wide). It tapers gradually to the head, and more abruptly from the 6th abdominal to the bluntly rounded anus; the segmental incisions are distinct and the abdominal segments are faintly divided into two subsegments. The head is small, rounded above, rather flat beneath, thin from dorsum to venter; the prothorax long and narrow, the mesothorax as long but it looks shorter owing to its greater girth, the metathorax is actually, as well as relatively, shorter and broader. The abdominal segments 1-5 are of about equal length to metathorax, 6 and 7 are rather longer. To the naked eye the head and thorax above look like polished ebony (some paler brownish areas are noticeable on the head if a lens be used); the dorsa of the abdominal segments are also black, but of a duller and bluer tone, showing pale coloration at the intersegmental areas when stretched. There is a sharp clear white mediodorsal line across the pro- and mesothorax, and, with the aid of a hand lens, it may be seen faintly continued over the metathorax as a dull greyish streak; there is also a subdorsal orange-red spot on each side of the prothoracic segment, placed rather posteriorly. The lateral and ventral areas of the abdomen are pale yellowish-white, whilst the unplated portions of the lateral and ventral areas of the thorax are pale smoky. The spiracles are most striking, oval, very large, dark brown in colour. The hairs on the head and elsewhere are slender, pale brown in colour, the setæ placed in usual specialised Psychid position—i outside and small, ii inside and longer, iii above spiracle long, iv and v subspiracular, both small, v, however, smaller than iv. The prolegs are as in *P. villosella*, the central depression is very marked, the skin is apparently horny, the oval of hooks large and strong, 24 on ventral, and 19 on anal prolegs, the hooks larger and bolder than on *P. villosella;* the anal prolegs have a lunular piece of chitin within the hooks in place of the usual pit. (Judging from memory this species appears to have better developed prolegs than any other Psychid larva examined.) The lateral ridge is large, but not greatly raised above surface. The true legs are blackish above, pale below. The antennæ are rather conspicuous, and the plates at base of hairs large and especially strongly developed on abdominal segments 8-10, the 10th of course bears the usual anal plate (Bacot. Described Oct. 8th, 1899). Hofmann describes the adult larva as 8-10 lines long, the back dark brown, with single warts and hairs, sides, belly, claspers, and the inner sides of the legs dirty yellow. Head and outer side of the legs shining black. The first three segments deep black, divided down the middle by a fine yellow line on each of these three segments, whilst on each side of the line is a round orange-yellow spot. Barrett describes the larva as "pale grey, whitish beneath, with black head, the three following segments having each a rather narrow, dark grey, horny plate, which almost embraces the segment; each has a blackish dividing line down the middle of the back and whitish spots on the sides; the legs are large and well-developed, with black claws." This description evidently does not belong to the larva of *A. opacella*, and Hamm notes that "the larva taken by Barnes at Wellington College did not agree with Barrett's description, for this larva had lateral orange spots on the prothorax." These orange-red spots are quite a character of the larva of *A. opacella*. They are sometimes found also on the metathorax.

Comparison of larvæ of Acanthopsyche opacella and Pachythelia villosella.*—The *heads* of the larvæ of both species are similar in shape, but whilst that of *P. villosella* is rough, almost granular, and dull in appearance, that of *A. opacella* is smooth and polished, showing only a very faint reticulation. In colour, the head of *P. villosella* is yellowish-white mottled with blackish (the pale and dark colour in about equal proportions), that of *A. opacella* is black with a narrow white line from apex of clypeus to crown. The *thorax* appears similar in each except that the central suture of the dorsal plate on the metathorax is hardly apparent in *P. villosella*, whilst it is distinct in *A. opacella* (this may be in part due to the darker colour of *A. opacella*). A difference is observable in the appearance of the thoracic plates similar to that exhibited by the heads, and the coloration is equally different, for whilst *P. villosella* has a pale yellowish-white mediodorsal band, very broad whitish subdorsal bands, and narrower lateral bands (the mediodorsal across the pro- and mesothorax only, the subdorsal and lateral across all three thoracic segments), the bands so broad as to leave only broad black bands of the ground colour, *A. opacella* has a polished black thorax, with a narrow white mediodorsal line across the pro- and mesothorax, and an orange spot on each side of the posterior subdorsal area of the prothorax. The *prolegs* are similar in shape and appearance, but the central depression of the foot is larger, darker, and consequently more marked in *A. opacella*. The number of hooks appears to be about four fewer in the latter than in *P. villosella*. The *plates* at base of setæ are more conspicuous in *P. villosella* than in *A. opacella*. The *abdomina* are very different in colour, that of *A. opacella* is smoky-black on the dorsum, whilst that of *P. villosella* is almost uniform pale whitish-brown (Bacot).

Pupation.—When the larva is fullfed it finds a suitable locality for fixing its case and the hitherto open end of the case is spun to the selected object and the larva turns round in its case. The hitherto closed end of the case is then lengthened in the shape of a funnel, the latter being soft and elastic, although the end is not quite open till after the female has burst from the pupa (Weaver). The larva (especially the female) spins a fluffy silken cocoon inside the larval case before pupation. This effectually fills up the entrance, and possibly acts as an effective bar against the entrance of many enemies (Cowl).

* The larva of *A. opacella* in hybernating skin (probably almost full-fed), freshly killed, in spirit; that of *P. villosella* possibly in last skin, killed and kept in spirit since the spring of 1898.

Pupa.—♂. 7mm.-9mm. long, rather robust, of ordinary Macro-Psychid type, *i.e.*, fairly cylindrical, the head, prothorax, and anterior part of mesothorax forming a rather truncate, though sloping, front, up to which the full size of the pupa is maintained; the abdominal segments tapering very slightly, with a slight forward curve, made more evident by the curving forwards of the last three segments so as to bring the anal hooks to a definite ventral aspect. The wing-cases are fixed to abdominal segments 1 and 2, and closely appressed, but not adherent, to the nearly white front of 3. The colour is pale brown, hardly materially darker dorsally. The head, or rather the face-parts, quite ventral in position; the antennæ very large, wide, and marked by strong transverse ridges, extend not quite to end of wings, second legs to same length, third just visible beyond between tips of wings, first legs less than half the length of second, very short indeed, as they start below the face-parts, whilst the second start higher up beside them, and the antennæ form, at their bases, part of the vertex alluded to above as contributing to the truncate anterior end of the pupa. The anterior femora occupy a very small triangle between the anterior legs. The face-parts are well developed; the clypeus, not marked off by sutures, presents a boss above labrum which is large, prominent, and divided into an upper and lower portion. The mandibles are rounded, rather transverse, eminences on either side of this. The line across ends of labrum and mandibles is tolerably straight, but bends upwards, when it passes outwards between cheeks and maxillæ which extend outward in a separate piece that looks very like a maxillary palpus, much as it appears in the Cochlidids. The labium is large, with a transverse basal eminence and two prominences side by side beyond. The maxillæ are as long and nearly as large as the labium, rounded at their extremities and extending outwards, as noted above, below the eyes, so as to touch the antennæ. The dorsal anterior abdominal hooks are present on 6, 7, and 8, but not in front of these, those on 8 resting on rather a high flange. The intersegmental spines are well-developed on 4 and 5 and less so on 3, evanescent on others. The hooks are in one definite row in each series; the intersegmental ones are hooked with the concavity forward, but are not so appressed to the surface as in some ♀ pupæ, being shorter and blunter than they are when so appressed. The dorsum of each segment is transversely wrinkled and carries i and ii, i being a bristle towards the outer anterior portion of the wrinkled area, ii at its posterior margin and near the middle line; these bristles and that (iii) above spiracle are well-developed and of about equal size; above and behind the spiracles is a depression, placing them on an eminence, but they do not themselves project; beneath them is a raised ridge, with depressions below marking with sundry wrinkles, but not very distinctly, the three ridges of the lateral (larval) flange. There are one or two bristles below the spiracles, one lower down and two (or three) above prolegs, and one below them, but these are difficult to detect and be quite positive as to positions. The proleg-scars are well raised above the general surface, and marked by several rings of deep wrinkles. The anal structure presents two great ventral bosses on 10 directed ventrally and ending in a blunt point, or flattening, and outside this a prominent forward curving hook of dark colour. Immediately between these bosses is the well-marked anal furrow, and at its dorsal extremity, still rather between the bosses, is a pair of small blunt points anteriorly, whilst a little inside each boss is a rounded eminence surmounted by a raised ring, defective externally and posteriorly. These look very much as though they represented the claspers of the larva, and if so the anal hooks cannot be the claspers but must represent the corneous plates clothing their bases. On 9, which is not very definitely marked off ventrally from 8, is a median depression with a rounded mammilla on either side. The wings are strongly marked by nervures, and the inner nervure is very prominent, sending two branches to margin of wing (Chapman). ♀. The empty *female* pupal-skin is about 12mm. in length and 3mm. in thickness at the widest part, 6th abdominal segment. It tapers gradually to head, and rapidly to the broad rounded anus without armature. The scars of the prolegs are very distinct and the sexual organs also distinct. The anterior margin of the dorsal area of abdominal segments 6-7 bears a short row of recurved hooks pointing backwards, not particularly strong or prominent. The 2nd-5th abdominal segments bear on the posterior margin of the dorsal area a row of small curved hooks pointing towards the head; these latter rows extend much farther transversely than those on the anterior edge of 6 and 7. There are slight indications of the posterior row of hooks on the 6th abdominal. The spiracles are small, almost level with the surrounding surface. The two subspiracular hairs iv and v are present, at least on one segment, but small and weak. The dorsal hairs are apparently present, but most difficult to clearly distinguish. The skin of the pupa is much wrinkled in places, and granular or finely shagreened in others, giving it a dull appearance. The envelope is semi-transparent and contains numerous empty eggs and many young larvæ moving about (Bacot).

Dehiscence.—♂. The dehiscence of the male pupa of *A. opacella* is not distinguishable from that of *P. villosella* (Chapman).

Habits of Pupa.—The female pupa is thin and pliable, unlike that of the male, and with energetic twists of its body it is enabled to go up and down its gauze-like funnel with astonishing rapidity. The funnel serves for a weather-guage for both male and female; it serves for the female both in the pupal and imaginal states, for the male only in the pupal state. The female pupa moves to the top of the funnel when almost ready for emergence and if mature and the sun is sufficiently brilliant she emerges. The funnel of the male case is considerably longer than that of the female, and it is astonishing how fast the pupa travels up and down the funnel. The pupæ will sometimes thrust their bodies half-way out of the silken tube and return again if the sun be not shining, as they only emerge when the sun shines (Weaver).

Food-plants.—Sallow (Cowl), *Vaccinium* and *Calluna* (Hoffmann), grass, heath, furze (Merrin), grass (Speyer), sallow, willow, especially fond of *Polygonum aviculare* (Bacot).

Habits and Habitat.—The males usually emerge in the morning especially in the sunshine (Speyer), but Zeller notes a ♂ example that emerged in the afternoon of June 6th, from a pupa obtained at Weissenstein. The male flies in the sunshine, and Holland says that a specimen captured by himself near Reading looked unexpectedly pale on the wing; he also notes that "when captured the motion of the wings is continued with such swiftness as to render them invisible." The female never leaves the case, if fertilised, until her eggs are deposited (unless quite by accident). On emergence, she just thrusts her head out at the end of the funnel to await the arrival of the male, retiring into the case at night, or if the weather be cloudy, or if she be disturbed. She appears at the top again when the conditions are suitable and when a male discovers her, goes down the case and raises the lower extremity of her body. The body of the male is somewhat similar to a telescope, lengthening out between every joint or segment. The male introduces his body into the funnel and copulation takes place. Having completed the process of oviposition the female falls through the aperture of the funnel to the ground and dies (Weaver). Near Bournemouth Mrs. Cowl observes the insect as occurring in a country covered with *Calluna vulgaris*. Barrett notes the larva on grasses and the fully grown cases on the trunks of oaks, alders, or other trees in woods and on rocks and boulders on open moors; he reports full-grown cases as found attached to outcropping boulders and rocks on the mountains of the Rannoch district. Cases found in considerable numbers from mid-April to May by Bang-Haas, at Jaegersborg and Rudehegn, spun up at the foot of birch-trunks always on the south side. Speyer notes cases singly in dry sunny places at Arolsen and Wildungen, in some years locally abundant in the former locality. The male cases are generally spun up near the ground, the female cases usually on oak-trunks 1ft.-4ft. from the ground. Schütze notes the cases abundant at Holbendorf, partly on birch-trunks, partly on moss and lichen (*Cladonia rangiferina*) and twigs lying on the ground. Caradja obtained cases in numbers in May, 1893, in Roumania, on grass and trunks in a light birch wood which produced the Bulgarian var. *senex*, Staud. Wocke says that in Silesia it is sparingly distributed in the woods of the plains and the lower mountains, whilst on the Stilfser-Joch it reaches nearly to the tree-limit. Peyerimhoff says that in Alsace, it occurs in the woods on the mountains, but is rare in the plains. In Andalusia, Rambur found the species in arid and sandy woods. Hofmann says that at Erlangen, it occurs with *Ptilocephala angustella* (*atra*) and *P. villosella*. The male cases are, with few exceptions, spun up on the grass at the side of the road-ditches, lie very much on one side, but sometimes upright; the female cases are generally found from one to four feet from the ground on the trunks of the oaks that form the road avenues, often as many as six or eight on a tree-trunk. At Ratisbon *A. opacella* only occurs very rarely on the southern slopes of the chalk.

Time of appearance.—The end of April and May (possibly June in Scotland). Larva near Wellington College station, pupated April 16th, 1895, ♀ emerged April 30th (Hamm); larvæ April 1st-15th, 1857, at Rannoch (Harding); Barrett notes the larva from June to February and March, and for the imago gives "end of March and April and probably May" for Britain. We suspect "March and April" as being altogether too early here, and also for the continent except for Spain, Italy, &c., and then rarely in March, although cases obtained at Locarno in March, 1899, produced imagines early in April (Chapman). By the end of April the larvæ have generally spun down their cases for pupation at Erlangen the imagines first appear in May, sparingly at first and more ♀s than ♂s, then ♂s and ♀s in about equal numbers, whilst later only males appear. The last males emerge in early June (Hofmann); in Andalusia it appears in March (Rambur *teste* Bruand);

April 6th, 1896, many cases at Holbendorf, from which imagines appeared in May (Schütze); imagines on April 14th, 23rd, and May 24th, in Hungary (Fritsch); imagines May 9th, 1886, in the Baltic Provinces (Teich); the larvæ in April on grass in Baden, the cases later spun up on stems (Reutti); a case from a trunk of *Populus tremula*, near Riga, in April, produced a male on May 12th (Nolcken); cases are found on trunks, palings, stones, oaktrees, &c., from the middle of April to May, at Arolsen and Wildungen, the imagines emerging from the beginning to the end of May (Speyer); cases are found in early spring on trees, rocks, and bushes, in the moor region of the Upper Hartz, the larva winters once, the imagines emerge in June (Hoffmann); the imago emerges in May and June at Jaegersborg and Rudehegn (Bang-Haas); middle of April to end of May for spun-up cases, the imagines emerge throughout May at Arolsen (Speyer); common at Bisbinno June 3rd, 1894 (Knecht).

LOCALITIES.—Several parts of the south of England and Highlands of Scotland (Barrett). BERKS: Reading (Barnes), Crowthorne (Brit. Mus. Coll.), Padworth (Holland), Wellington College (Hamm), Wokingham (Barrett). DORSET: Poole Heath (Dale), Bournemouth (Cowl). HANTS: New Forest and district (Bankes), Woolmer Forest (Barrett), nr. Brockenhurst (Newman). PERTHSHIRE: Rannoch dist. local—Black Wood, &c. (Reid). SURREY: Haslemere (Barrett). SUTHERLAND: (Salvage). WESTMORLAND: Witherslack (Murray *teste* Threlfall).

DISTRIBUTION.*—ASIA MINOR: Armenia (Staudinger). AUSTRO-HUNGARY: Pressburg (Rozsay), Styria, Berchtesgaden in Fuchsthal at 2500, near Meran, Salzburg (Speyer), Brünn (Müller), Bohemia—Kuchelbad near Prague (Nickerl), Hansdorf (Fritsch), Innsbruck (Weiler), Chemnitz (Pabst), Lavantthal (Höfner), Nagyág (Czekelius), South Tyrol (Staudinger), Wienerwald (Schleicher). DENMARK: Sjælland, Helsingor, Jernbanen, Jaegersborg, Rudehegn, &c. (Bang-Haas), La Hulpe (Hedemann). Finland: Lajosee (Sintenis), Abo, Karelen, Osterbotten (Lampa), Aland, S. Karelia (Tengström). FRANCE: Cannes, Antibes, &c. (Tutt). GERMANY: Scattered as far north as Arolsen, Berlin, and the Hartz (Heinemann), Berlin, Hartz, Weimar, Lissa, Klarenkraust, Halle, Trier (Speyer), Münster, Freiburg, Erlangen (Hofmann), Karlsruhe (Reutti), Silesia—from the plains to the highest mountains—Parchwitz, Obernigk, Schreiberhau, Seefelder, Altvater (Standfuss), Waldeck—nr. Arolsen, Wildungen—nr. Breslau (Speyer), Erfurt (Keferstein), Saxon Upper Lusatia—Holbendorf, Ober-Eulowitz, Rachlan (Schütze), Dresden (Steinert), Upper Lusatia—Herrnhut (Moeschler), Silesia, the Stilfser-Joch (Wocke), Ratisbon (Schmid), Alsace—Colmar, Strasburg, Saverne (Peyerimhoff), Jena, Riesengebirge (Zell. coll.), on the Winzerberg near Ratisbon (Herrich-Schäffer), Upper Hartz (Hoffmann). ITALY: North, not common (Curò), Lombardy, Brianza (Turati), Piedmont—Macugnaga (Staudinger). ROUMANIA: Grumazesti, Slanic (Caradja). RUSSIA: Transcaucasia—Tiflis (Staudinger), Baltic Provinces—Dorpat, Neu Kasseritz (Sintenis), Wolmar (Lutzau), Riga (Nolcken). SCANDINAVIA: rare, but generally distributed to Alten (Aurivillius), Dovre, Finmark nr. Bossekop (Staudinger), Arctic Region—common at Kuusamo and Uleåborg (Schilde *teste* Petersen). SPAIN: Andalusia (Rambur). SWITZERLAND: up to 6000ft. (Frey), Grisons—Bergell, &c. (Killias), Lugano (Huguenin), Engadine, nr. Bergün, Ober-Albula—Weissenstein, Tuors Pensch (Zeller), Stelvio (Wocke), Locarno (Chapman), Ticino—Bisbinno (Knecht). TURKEY: Constantinople (Staudinger).

Genus: PACHYTHELIA, Westwood.

SYNONYMY.—Genus: *Pachythelia*, Westd., "Proc. Ent. Soc. Lond.," v., pp. xli-xlii (1848); "Proc. Zool. Soc. Lond.," 1854, *note* p. 220; Humph. and West., "Brit. Moths," i., pp. 84, 94 (1851). *Psyche*, Ochs., "Die Schmett.," iii., p. 180 (1810); iv., p. 54 (1816); God., "Hist. Nat.," iv., p. 284 (1822); Cantener, "Lép. du Var," p. 14 (1833); Bdv., "Gen. Ind. Meth.," p. 79 (1840); Dup., "Hist. Nat.," supp. iv., p. 61 (1842); "Cat. Méth.," p. 66 (1844); Evers., "Bull. Mosc.," 3, p. 542 (1843); H.-Sch., "Sys. Bearb.," ii., p. 20 (1845); Bruand, "Mém. Soc. Doubs," ii., livr. 1-2, p. 66 (1845); "Mon. Psych.," p. 51 (1853); Hdrch., "Sys. Verz.," 2nd ed., p. 6 (1846); 3rd ed., p. 24 (1851); Led., "Verh. z.-b. Ges. Wien," ii.,

* BELGIUM.—Heylaerts notes this as a probable Belgian and Netherland species, specimens, supposed to be native, being in Breyer's collection, but without labels.

abh. p. 73 (1852); Ghil., "Elenco," p. 25 (1852); Speyer, "Stett. Ent. Zeit.," p, 323 (1852); "Geog. Verb. Schmett.," i., p. 306 (1858); ii., p. 278 (1862); Frey, "Neu. Beit.," vi., p. 109 (1856); Müll., "Lotos," vi., p. 145 (1856); Sta., "Man.," i., p. 166 (1857); Mann, "Wien. Ent. Monats.," i., p. 147 (1857); Hein., "Schmett. Deutsch.," i., p. 181 (1859); Trim., "Act. Soc. Linn. Bord.," xxii., p. 34 (1859); Hofm., "Berl. Ent. Zeits.," iv., pp. 18-19 (1860); Kef. and Wernebg., "J.-B. Ak. Erfurt," p. 144 (1860); Now., "Enum. Lep. Hal. Or.," p. 30 (1860); Wilde, "Zeits. Nat. Halle," xvi., p. 306 (1860); "Pflanz. Raup. Deutsch.," ii., p. 73 (1861); Staud., "Cat.," 1st ed., p. 26 (1861); 2nd ed., p. 62 (1871); "Hor. Ross.," xiv., p. 348 (1879); "Stett. Ent. Zeit.," xlviii., p. 94 (1887); Nick., "Lotos," xi., p. 154 (1861); Hoff. and Kell., "J.-H. Ver. Vat. Nat. Württ.," xvii., p. 238 (1861); Mill., "Iconog.," ii., pl. 102, figs. 6-12 (1868); iii., p. 465 (1874); "Ann. Soc. Linn. Lyon," xviii., p. 12 (1871); "Cat. Lép. Alp.-Mar.," p. 99 (1875); Wernbg., "Btr.," i., p. 126 (1864); Cooke, "Merrifield's Brighton," p. 213 (1864); Const., "Cat. Lép. Saone-et-Loire," p. 90 (1866); Ramb., "Cat. Lép. And.," ii., p. 295 (1866); Hint., "Zeit. Ferdin.," (3), xiii., p. 251 (1867); Wallgrn., "Skand. Het. Fjär.," ii., pp. 46, 49 (1869); p. 429 (1885); "Ent. Tids.," ii., p. 106 (1881); Heyl., "Tijd. voor Ent.," xiii., p. 148 (1870); Wocke, "Zeits. Ent. Bresl.," N. F. iii., p. 25 (1872); "J.-B. Schles. Ges. Vat. Cult.," liii., p. 163 (1876); Bang-Haas, "Nat. Tids.," (3), ix., p. 407 (1874); Glitz, "J.-B. Ges. Han.," xxiv., p. 36 (1874); Curò, "Bull. Soc. Ent. Ital.," viii., p. 142 (1876); Sint., "Arch. Nat. Liv.," (2), vii., p. 335 (sep. p. 15) (1876); Pet., "C.-B. Ver. Riga," xxii., p. 8 (1877); Weil., "Verz. Schm. Innsbr.," p. 15 (1877); "Lep. Taufers," p. 17 (1880); Parf., "Trans. Dev. Ass.," x., p. 550 (1878); Rozs., "Cat. Lep. Poson," p. 8 (1878); Tur., "Bull. Soc. Ent. It.," xi., p. 165 (1879); Standf., "Zeit. Ent. Bresl.," vii., pp. 31, 42 (1879); Pfütz., "Deutsch. Ent. Zeit.," xxiii., p. 37 (1879); Fiori, "Bull. Soc. Ent. Ital.," xii., p. 213 (1880); Peyer., "Cat. Lép. Als.," 2nd ed., p. 58 (1880); Frey, "Lep. Schweiz," p. 90 (1880); Ersch., "Trudy Soc. Ent. Ross.," xii., p. 203 (1881); Hell., "Ber. Ver. Innsb.," xi., p. 90 (1881); Röss., "J.-B. Ver. Nat. Nass.," xxxiii-xxxiv., p. 67 (1881); Husz, "Magy. Tud. Tars. Evkön.," viii., pp. 251, 283 (1881); Herng., "Stett. Ent. Zeit.," xlii., p. 153 (1881); Lampa, "Ent. Tids.," p. 38 (1885); Rom., "Mém. sur Lép.," ii., p. 6 (1885); Schmid, "C.-B. Ver. Nat. Regensb.," xxxix., p. 83 (1885); Jord., "Schmett. N.-W. Deutsch.," p. 94 (1886); Vang., "Rovart. Lap.," iii., p. 143 (1886); Calb., "Iris," i., p. 151 (1887); Zimm., "Verh. Ver. Nat. Hamb.," vi., p. 21 (1887); Mina-Pal., "Nat. Sic.," vii., p. 225 (1888); Schmidt, "Soc. Ent.," iii., p. 58 (1888); Teich, "Arb. Nat. Ver. Riga," vi., p. 19 (1889); Püng., "Stett. Ent. Zeit.," l., p. 144 (1889); Auriv., "Nord. Fjäril.," p. 59 (1889); Rühl, "Soc. Ent.," v., p. 151 (1891); Dale, "Lep. Dorset.," 2nd ed., p. 9 (1891); Garb., "S.-B. Ak. Wiss. Wien. Math. Nat. Cl.," ci., p. 933 (1892); Czek., "Verh. Sieb. Ver. Nat.," xlii., p. 44 (1892); Reut., "Macrolep. Fin.," p. 26 (1893); Carad., "Iris," vi., p. 200 (1893); viii., p. 86 (1895); Barr., "Ent. Mo. Mag.," xxx., p. 217 (1894); xxxi., pp. 60, 97 (1895); "Brit. Lep.," ii., p. 334 (1895); Meyrick, "Handbook," p. 445 (1895); Tutt, "Brit. Moths," p. 343 (1896); Lutzau, "K.-B. Ver. Riga," xxxix., Bomb. no. 43 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 307 (1898). *Penthophera*, Curt., "Brit. Ent.," v., pl. 213 (1828); Stphs., "Ill.," ii., p. 79 (1828); "Cat.," p. 57 (1829); Wood, "Ind. Meth.," p. 27, pl. vii., fig. 30 (1839). *Sterrhopterix*, Stphs., "List Anim. Br. Mus.," v., 1st ed., p. 55 (1850); 2nd ed., p. 52 (1856). *Oiketicus*, Westd., "Proc. Zool. Soc. Lond.," 1854, p. 220. *Pachytelia*, Heyl., "Ann. Soc. Ent. Belg.," xxv., p. 42 (1881); "C.-R. Ent. Belg.," xxviii., p. xcii (1884); "Rom. Mém. sur Lép.," ii., p. 177 (1885). *Canephora*, Kirby (*nec* Hb.), "Cat. Lep. Het.," p. 508, *in part* (1892).

Westwood was the first author to show that *villosella* should be isolated in a separate genus. He points out (*Proc. Ent. Soc. Lond.*, v., pp. xli-xlii) that the *Penthophera nigricans* of Curtis, could not be generically associated with the type of that genus, *Penthophera morio*, on account of its transformations, the apterous state of the female, the want of palpi, and peculiar neuration of the wings in the male. He asserted that the latter character, as well as the almost obsolete, exarticulate antennæ of the female likewise removed it from *Psyche fusca*, and the genus *Fumea* of Haworth. Mr. Westwood accordingly proposed for it the generic name of *Pachythelia*, considering it most nearly allied to *Oiketicus macleayii*, Guilding. The genus was subsequently diagnosed by Westwood as follows:

Pachythelia, West. (*Penthophera* pars, Curtis, but not of Germar).—This curious genus is well characterised by its semi-transparent hairy wings of an uniform blackish colour, the deeply bipectinated antennæ of the males, the want of a spiral tongue, the small porrected palpi, terminated by an acutely ovate joint, and the robust thorax. The females are entirely wingless, with a large fleshy body, and with very minute rudimental antennæ and legs. The arrangement of the veins of the wings agrees with *Hypogymna* rather than with *Spilosoma*, but differs from both these groups in having the precostal vein and its branches in the forewings pushed considerably into the disc of the wings, so as greatly to diminish the ordinary size of the discoidal cell, as we have also seen in *Psyche*, to which the genus is related very closely (and next to which it should be arranged in the system), especially in the transformation of the species, the caterpillars residing in movable cases (Humphrey and Westwood, *Brit. Moths*, i., pp. 84, 94).

The genus *Pachythelia* having been created in 1848 by Westwood for *nigricans* this species becomes the type. Westwood afterwards strangely enough uses (*Proc. Zool. Soc. Lond.*, 1854, p. 220) *Pachythelia* as a subgenus of *Oiketicus*. Heylaerts has adopted the genus (which he writes *Pachytelia*) for *villosella* and *unicolor* (*graminella*), but the latter is not congeneric with the former, and is also the type of *Canephora*, Hb., *Tent.*, p. 2. One suspects that some of the species placed by Heylaerts in *Amicta*, are closely allied to *P. villosella*. Thus Chapman notes *lutea* as essentially congeneric with this species and he further considers that *cana*, Hampsn., is also closely allied to it. Should *cana* be congeneric with *P. villosella*, it would prove interesting, since *cana* is an Indian species.

The principal characters of the genus may be diagnosed as follows:

Ovum.—Oval, exceedingly delicate, surface irregularly reticulated, very shiny. Eggs laid in an agglomerated mass in pupal skin.

Case.—A strong silken tube, soft in texture, covered with pieces of grass, heather, stick, &c., fastened by one end, sticking out from central tube at about 30°, the free ends pointing back to the posterior end of case; the silken anterior end (whence larval head is protruded) hood-like, the opposite end with an uncovered silk prolongation.

Larva.—Head small, rounded, partly retractile, hairy; thoracic segments covered with corneous plates (with paler, mediodorsal, subdorsal, and lateral lines), spiracle in pro-mesothoracic incision; abdominal segments increase to 4th, then decrease to 10th, anal segment chitinous, segments 1-7 divided into two subsegments; broad longitudinal lateral flange; prolegs with oval of hooks incomplete on inner edge, centrally depressed; spiracles large, placed anteriorly; tubercles with single setæ, i outer and ii inner, i, ii, and iii with large chitinous basal plates, extra plates (without setæ) on abdominal segments 1-2, the thoracic setæ in transverse line; iv and v close together, v the weaker; vii carries 2 setæ.

Pupa.—♂. Stout, short; abdominal segments free, 3 (dorsally), 4, 5, 6, 7; ventro-anal hooks strong and sharp, wings to end of 2nd abdominal, firmly soldered; no dorsal headpiece; prothorax frontal, narrow, mesothorax large, metathorax narrow widened laterally; anterior dorsal spines on 3-8, posterior intersegmental spines well developed; the antennæ nearly to end of forewings, strongly developed; 3rd pair of legs to wing apices, 2nd pair to tips of antennæ, the 1st pair short of antennæ; tubercular setæ as in larva; elements of larval lateral flange distinct; proleg scars conspicuous; two hairs at base of labrum; jaws prominent; labium slightly bilobed at margin; maxillæ outside and as long as labium, broadly triangular, with a palpal elongation. ♀. Somewhat cylindrical; head bent forwards; anal extremity bluntly rounded; spiracles large; proleg scars pronounced; anterior dorsal spines obsolete, posterior intersegmental hooks well developed from segments 2-5; the setæ on i and iii small, ii large, iv, v, vi, vii (double) also with setæ; on abdominal segments 8-9 some of the setæ with recurved tips; wings and legs represented by definite folds.

Imago.—♂. Robust, forewings somewhat elongate; hindwings ample, with notch at end of nervure 2; hair-scales basally and on inner margin; other parts with scales rounded or pointed at free end, with few striæ; fringes with notched scales; antennæ 32 joints (*villosella*), two pectinations on joints 3-32; clavola scaled dorsally, pectinations unscaled; anterior tibial spur ·88; no posterior tibial spurs. ♀. Vermiform. Head with eyespots, antennal, labral and labial prominences; thoracic segments with dark dorsal plates; legs represented by an oval plate and central mammilla; 1st and 2nd abdominal segments with dorsal plates; spiracles distinct; abdominal segments 1-7 with dark ventral nervous ganglia; 9th abdominal segment with a double ventral lappet; 10th abdominal forms a small tapering ovipositor.

Pachythelia villosella, Ochs.

Synonymy.—Species: *Villosella*, Ochs., "Die Schmett.," iii., p. 180 (1810); iv., p. 54 (1816); Godt., "Hist. Nat.," iv., p. 287, pl. 29, figs. 1-2 (1822); Cant., "Lép. du Var," p. 14 (1833); Bdv., "Gen. Ind. Meth.," p. 80 (1840); Dup., "Cat.," p. 66 (1844); H.-Sch., "Sys. Bearb.," ii., p. 20 (1845); Brd., "Mém. Soc. Doubs," ii., livr. 1-2, p. 66 (1845); "Mon. des Psych.," p. 51, pl. i., fig. 28 (1853); Hdrch., "Syst. Verz.," 2nd ed., p. 6 (1846), 3rd ed., p. 24 (1851); Spey., "Stett. Ent. Zeit.," 1852, p. 323; "Geog. Verb. Schmett.," i., p. 306 (1858); ii., p. 278 (1862); Led., "Verh. z.-b. Ges. Wien," ii., *abh.* p. 73 (1852); Ghil., "Elenco," p. 25 (1852); Frr.. "Neu. Beit.," vi., p. 109, pl. 663, figs. 1 *a-d* (1856); Sta., "Man.," i., p. 166 (1857); Mann, "Wien. Ent. Monats.," i., p. 147 (1857); Hein., "Schmett. Deutsch.," i., p. 181 (1859); Trim., "Actes Soc. Linn. Bord.," xxii., p. 34 (1859); Hofm., "Berl. Ent. Zeits.," iv., pp. 18-19 (1860); Kef. and Wernbg., "J.-B. Ak. Erfurt," p. 144 (1860); Now., "Enum. Lep. Hal. Or.," p. 30 (1860); Wilde, "Zeits. Nat. Halle," xvi., p. 306 (1860); "Pflanz. Raup. Deutsch.," ii., p. 73 (1861); Staud., "Cat.," 1st ed., p. 26 (1861), 2nd ed., p. 62 (1871); "Hor. Ent. Soc. Ross.," xiv., p. 348 (1879); "Stett. Ent. Zeit.," xlviii., p. 94 (1887); Nick., "Lotos," xi., p. 154 (1861); Hoff. and Kell., "J.-H. Ver. Vat. Nat. Württ.," xviii., p. 288 (1861); Wrnbg., "Btr.," i., p. 126 (1864); Cooke, "Merrifield's Brighton," p. 213 (1864); Const., "Cat. Lép. Saone-et-Loire," p. 90 (1866); Ramb., "Cat. Lép. And.," ii., p. 295 (1866); Hint., "Zeit. Ferdinand.," (3), xiii., p. 251 (1867); Wlgrn., "Skand. Het.," ii., pp. 46, 49 (1869); p. 429 (1885); "Ent. Tids.," ii., p. 106 (1881); Heyl., "Tijd. v. Ent.," xiii., p. 148 (1870); "Ann. Soc. Ent. Belg.," xxv., p. 70 (1881); "C. Rend. Soc. Ent. Belg.," xxviii., p. xcii (1884); "Rom. Mém. Lép.," ii., p. 177 (1885); Wocke, "Zeit. Ent. Bresl.," N. F. iii., p. 25 (1872); "J.-B. Schles. Ges. Vat. Cult.," liii., p. 163 (1876); Bang-Haas, "Nat. Tids.," (3), ix., p. 407 (1874); Glitz, "J.-B. Ges. Han.," xxiv., p. 36 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 99 (1875); Merr., "Lep. Cal.," 2nd ed., pp. 54, 67, 100 (1875); Curò, "Bull. Soc. Ent. It.," viii., p. 142 (1876); Sint., "Arch. Nat. Livl.," (2), vii., p. 335 (sep. p. 15) (1876); Pet., "C.-B. Ver. Riga," xxii., p. 8 (1877); Weil., "Verz. Schmett. Innsb.," p. 15 (1877); "Lep. Taufers," p. 17 (1880); Parfitt, "Trans. Dev. Assoc.," x., p. 550 (1878); Rozs., "Cat. Lep. Poson," p. 8 (1878); Tur., "Bull Soc. Ent. It.," xi., p. 165 (1879); Standf., "Zeit. Ent. Bresl.," vii., pp. 31, 42 (1879); Pfütz., "Deutsch. Ent. Zeit.," xxiii., p. 37 (1879); Fior., "Bull. Soc. Ent. It.," xii., p. 213 (1880); Peyer., "Cat. Lép. Als.," 2nd ed., p. 58 (1880); Frey, "Lep. Schweiz," p. 90 (1880); Ersch., "Trudy Soc. Ent. Ross.," xii., p. 203 (1881); Hell., "Ber. Ver. Innsb.," xi., p. 90 (1881); Röss., "J.-B. Ver. Nat. Nass.," xxxiii-xxxiv., p. 67 (1881); Husz, "Magy. Tud. Tars. Evkön," viii., pp. 251, 283 (1881); Hering, "Stett. Ent. Zeit.," xlii., p. 153 (1881); Lampa, "Ent. Tids.," p. 38 (1885); Rom., "Mém. sur Lép.," ii., p. 6 (1885); Schmid, "C.-B. Ver. Nat. Regensb.," xxxix., p. 83 (sep. p. 34) (1885); Jord., "Schmett. N.-W. Deutsch.," p. 94 (1886); Vángel, "Rovart. Lap.," iii., p. 143 (1886); Calb., "Iris," i., p. 151 (1887); Zimm., "Verh. Ver. Nat. Hamb.," vi., p. 21 (1887); Mina-Pal., "Nat. Sic.," vii., p. 225 (1888); Schmidt, "Soc. Ent.," iii., p. 58 (1888); Teich, "Arb. Nat. Ver. Riga," vi., p. 19 (1889); Auriv., "Nord. Fjär.," p. 59 (1889); Weir, "Ent. Mo. Mag.," xxvi., p. 249 (1890); "Proc. Sth. Lond. Ent. Soc.," p. 43 (1890); p. 128 (1891); pp. 85, 110 (1893); Dale, "Lep. of Dorset.," 2nd ed., p. 9 (1891); Garb., "S.-B. Ak. Wiss. Wien," ci., p. 933 (1892); Reuter, "Macrolep. Finl.," p. 26 (1893); Carad., "Iris," vi., p. 200 (1893); viii., p. 86 (1895); Barr., "Ent. Mo. Mag.," xxx., p. 217 (1894); xxxi., pp. 60, 97 (1895); "Brit. Lep.," ii., p. 334 (1895); Meyr., "Handbook, &c.," p. 444 (1895); Lutz., "K.-B. Ver. Riga," xxxix., Bomb. no. 43 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 308 (1898). *Hieracii* [? Fab., "Sys. Ent.," p. 568 (1775)]; Wernbg., "Beit.," i., p. 502 (1864); Kirby, "Cat. Lep. Het.," i., p. 508 (1892). ? *Viciella*, Hb., "Eur. Schmett.," fig. 2 (*teste* Staud., *Cat.*, p. 62) (1796). [? *Vestita*, Bkh., "Besch. Schmett.," iii., p. 274 (*teste* Werneburg, *Btr.*, i., p. 372, with ref. to *Naturf.*, vii., p. 171, pl. iii., figs. 1-2) = *unicolor*, *teste* Staud., *Cat.*, p. 62 (1790).] ? *Alburnea*, Esp., "Die Schmett.," iii., supp., p. 100 (= *viciella* S.V., *teste* Staud., *Cat.*, p. 62) (1807). *Cinerella*, Dup., "Hist. Nat.," supp. iv., p. 61, pl. lvi., fig. 1 (1842); Bruand, "Mon. Psych.," p. 53, pl. i., figs. 30 *a-b* (1853); Mill., "Iconog.," ii., pl. 102, figs. 6-12 (1868); iii., p. 465 (1869); "Ann. Soc. Linn. Lyon," xviii., p. 12, pl. 102, figs. 5-12 (1871). *Hirtella*, Ev., "Fauna Volg.-Ural.," p. 140 (1844), &c., *vide*, *post*. p. 400. *Vilosella*, Müll., "Lotos," vi., p. 145 (1856); Püng., "Stett. Ent. Zeit.," l., p. 144 (1889); Rühl, "Soc. Ent.," v., p. 151 (1891); Czek., "Verh. Sieb. Ver. Nat.," xlii., p. 44 (1892). *Nigricans*, Curt., "Brit. Ent.," v., pl. 213 (1828), etc., *vide*, *post*. p. 399. *Nigricantella*, Brd., "Mon. Psych.," p. 52, pl. i., fig. 29 (1853). *Magniferella*, Brd., "Mon. Psych.," p. 54, pl. i., fig. 32 *b-e* (1853); Kirby, "Cat. Lep. Het.," p. 509 (1892). *Grandiella*, Bdv., "Gen. Ind.," p. 79 (1840). *Casanella*, Brd., "Mon. des Psych., p. 53 (1853). [Werneburg raises (*Beiträge*, i., p. 502) what appears to be a purely academic discussion as to whether *Bombyx hieracii*, Fab. = *Psyche villosella*. Space would be wasted to repeat the arguments, and we only mention it because Kirby has adopted (*Cat.*, p. 508) Werneburg's conclusions. Rambur asserts that the insect Boyer de Fonscolombe designated *febretta* is *villosella*, and says that he had examples sent by Duponchel that proved this. Duponchel's *cinerella* also was *villosella*].

Original description.—*Psyche villosella*. *Psyche* alis corporeque hirsuto fuscescentibus. Diese Art ist wesentlich von der vorhergehenden verschieden und wahrscheinlich öfters damit verwechselt worden; eine befriedigende Abbildung davon kann ich nicht anführen, denn selbst die Hübner'sche bleibt zweifelhaft und die Beschreibung ist so unvollkommen, dass sie zur Aufklärung nichts beytragen kann. Soviel ist gewiss, dass Hübner's *viciella* nicht die des *Wien. Verz.* ist, sondern dessen *siciella*: die von den Verfassern gelieferte Abbildung und die wohl erhaltenen Exemplare in der Schiffermiller'schen Sammlung geben den offenbaren Beweis. *Psyche villosella* ist grösser als *viciella*, die Vorderflügel sind länger gestreckt als die hinteren und am Aussenwinkel spitzer, die Fühler schwarzbraun, der Kopf, Rücken und Hinterleib mit dunkelbraunen langen Haaren dicht besetzt, letzterer unten weissgrau. Die Flügel sind fein beschuppt, der Aussenrand derselben gegen den Innenwinkel etwas eingebogen; die Grundfarbe ist graubraun, der Vorderrand und die Franzen sind schwärzlichbraun und die Hinterflügel führen gegen den Innenrand einen schwarzbraunen Schatten. Der Sack, in dem die mir unbekannte Raupe lebt, wurde mir von H. Abbate Mazzola mitgetheilt und ist mit unordentlich querliegenden Grasstengeln bekleidet. Merkwürdig ist daran, dass die leere männliche Puppenhülse in der Mitte desselben zur Hälfte heraussteht; ein Beweis, dass der Schmetterling auf diese Art ausgekrochen ist. Er ist in der Gegend von Wien einheimisch (Ochsenheimer, *Die Schmett. von Europa*, iii., pp. 180-181).

Imago.—Anterior wings 27mm.-28mm. in expanse; when fresh of a blackish tint (fades to pale brownish), the scaling fairly dense, the nervures and discoidal lunule darker owing to accumulation of scales; fringes also dense. Posterior wings ample, concolorous with forewings, fringes like those of forewings. Antennæ 31-32 joints, scaled dorsally, pectinations unscaled.

Sexual dimorphism.—♂. Exp. 27mm.-28mm. The *male* as usually seen in collections is of a pale brownish or dove-colour, but when fresh is much darker answering to its synonym *nigricans*; the nervures darker, especially at end of cell, owing to closer placing of scales; the scaling looks dense, but the spacing between the scales is two or three times the width of the scales; the fringes are also dense. The forewing looks broader than that of *A. opacella*, but is really of exactly the same form. The hindwing has the costa rather more prominent and rounded towards the base, and apart from the somewhat pointed and produced apex is of nearly circular form; it is, therefore, very full and ample; it presents very distinctly the Oiketicid notch at end of nervure 2; this also exists in *A. opacella*, but is so slight as to require looking for. The branch nervure from $1b$ to inner margin does not always reach it, and $1a$ is indistinct except where it joins $1b$. The notch of hindwing is faintly reproduced in forewing at end of nervure 2. Both fore- and hindwings have hair-scales basally and at inner margin, but the general covering of the wings consists of scales rather than hair-scales. These, on the general wing-surface, are narrow ($\frac{1}{10}$-$\frac{1}{12}$ of length), narrowing gradually to each end, and rounded or pointed at free end (not square or notched) and have five or six striæ. In the fringes, however, the scales are twice as long and four or five times as broad, with ends showing one or two notches and 25 or more striæ, and various intermediate forms; along the inner margin of the forewing there are longer (and pointed) scales much like those on the wing-area, but two or three times as long, some longer with only two or three striæ, passing into hair-scales and without hiatus into hairs, though in places hairs and scales are mixed without intermediate forms. These apparent hairs are, therefore, not really hairs but hair-scales. The forewing has a definite spine-area (haftfeld) at the base of inner margin, the spines are very minute. The antennæ have 31 or 32 joints—the 1st very large and urn-shaped, the 2nd large, thick, narrowing outwards, the 3rd very short, half its length, the 4th-7th gradually lengthen up to the 8th which with the the 9th is about equal in length to its width; they then commence to narrow, so that the 24th or 25th is about half the width and twice the length of the 8th or 9th. The whole length is about 5·3mm. The flagellar joints, 3-31, each carry two pectinations; in a mounted specimen, joint 3, short as it is, appears to be a fixed joint and has four plumules, the basal inner one very slender and no longer than the thickness of an antennal joint; on 4 the length is about ·6mm., on 7 nearly the full length is reached, *viz.*, 1·2mm. on inner row and 1·5mm. on outer, thence they become shorter until they are about ·3mm. on the 27th joint and are reduced to nothing in the last. The antennal joints are clothed dorsally with scales about half the size of those on wings and slightly broader, they are scattered over the surface, without being in definite rows, 20-30 in a joint about the middle of the antenna. The thickness of the pectinations is fairly uniform, about $\frac{1}{3}$ of that of the antennal shaft at the middle of the antenna; they arise, apparently from the middle of the joint, but really from its base, their outer margin sweeping straight down to the proximal end of the joint, but they are so inclined forwards that their other side is beyond the middle of the joint. The thickness of plumule is about ·04mm.-·05mm., and the length of the sense-hairs is about ·11mm.-·15mm., these are black in colour, whilst the solid portions are very dark brown. They are disposed along the under forward surface of the pectinations, in two or three not very defined rows, they number perhaps 100 to 150 on a pectination. The outer surface of the plumules is perfectly smooth, not only free from hairs or scales, but of any trace of points whence they may have been accidentally removed. (In *C. unicolor* this surface carries a few scales.) The under surface of the antennal joints carries sense-hairs also. The basal joints carry two rows of about ten hairs each near their basal margin; medially they form a patch on the basal half of the joint between the pectinations of about 25 hairs, irregularly placed. The face is covered with hairs, though the long wool that covers the mouth-parts is largely that of the 1st coxæ. The mouth-parts are represented by a transverse oval depression, rising a little in the centre. The femora and bases of the tibiæ have very long hair-scales, whilst the rest of the limbs carry hairs that are rather spines, or bristles in appearance, but are really scales. These hairs are striated and are very scale-like, except at ends of tarsal joints and along anterior ridges of tibiæ where they are more bristle-like. The 1st tibial spur is very long, ·88, its extremity bent outwards and extending slightly beyond tibia; there is no trace of spurs on other legs. The tarsi measure 1st = 2·0mm., 2nd = 2·0mm., 3rd = 1·3mm. ♀. The *female* measures when at rest about 22mm. in length and about 6mm. in width (at 7th abdominal). The head ventral, shiny, dirty-white frontally, brownish at side, antennæ dark-tipped, and rather conspicuous, as also are the sunken eye-patches which are black. The rudimentary mouth-parts are readily homologised, and the feet form a series of well-developed mammillæ, with terminal (? fleshy) hair-like prolongations, that are not used, however, for progression. The colour is whitish, inclining to yellow on the dorsum, with corneous plates on the thoracic and first two abdominal segments. The prothorax forms a sort of hood over the head, brown in colour, shiny, corneous, with a conspicuous spiracle, rather dark edged, the meso- and metathorax also dark brown dorsally, and covered with thin corneous plates, the venter of the thoracic segments tinged with pinkish. Ventrally in the 1st and 2nd abdominal segments is a collection of tubules (urinary) which are very conspicuous. A remarkable series of tracheal vessels can be observed as a longitudinal band extending down each side of the body (visible as a pale grey line to the naked eye), centralising around the spiracles whence branches are given out, of which the two most important go off at right angles to the main trunk, one centrally up the dorsum of each segment, the other in the opposite direction, ventrally. These, being nearer the surface than the conspicuous ventral nerve ganglia, often shut off part of the latter. The nerve-cord is traceable medio-ventrally from the 2nd thoracic to the 7th abdominal segment, the conspicuous ganglia, in each segment, dark reddish-brown marginally, paler centrally, each segmental mass evidently double, as seen from the median line dividing it longitudinally; that on the 7th abdominal is much elongated, and evidently forms the centre for the nerves supplied to the segments posterior to it. The anal segment carries a slender fleshy mass (? ovipositor) standing out behind in line with the dorsum, whilst the preceding segment carries two fleshy flaps (one on either side) the function of which is quite unknown. The venter of these segments (9-10) tends to flesh colour. The spiracles are small but distinct, surrounded by a flesh-coloured rim (of cartilaginous appearance), and are slightly raised above the level of the segments on which they are situated. When vermicular movement is taking place there is a distinct swelling along the spiracular line, which appears to be as much due to inflation by air as to muscular contraction. The abdominal segments 4-7 are the largest, the posterior segments thinning off very rapidly. [Described June 13th, 1899, from a living ♀ received from Mrs. Cowl.] The ♀ has brown dorsal plates on the pro-, meso-, and metathorax, spreading quite down to the lateral line, a smaller dorsal one on the 1st abdominal. The head presents the following details—two eye-patches of pigment with neither compound facets (imaginal) nor single ocelli (larval); antennæ two-jointed, not unlike larval antennæ; a large number of fine bristles on head; two maxillary prominences not quite so prominent as legs. The legs are transverse plates, with a chitinous tubercle, which has a small central mammilla. No hairs in general on the segments, a few, however, on the 8th and 9th abdominals, and very numerous but very minute ones on ovipositor (Butterfield). At first sight the ♀ of *P. villosella* (and of other Psychids) is very chaotic and puzzling, but a little examination shows the head with its eye-spots (sunk), antennæ, labral and labial prominences. The three thoracic segments each larger than the preceding, with dorsal black plates each smaller (proportionally) than the preceding one, each with transverse ridges ventrally carrying the legs, each leg being an oval plate with a central mammilla and point, the posterior being the larger. The prothoracic spiracle at, or just below, the margin of plate, well-marked. The 1st abdominal segment shows a dorsal plate, dark, but smaller than that of the last thoracic, and carries a large spiracle; it is rather narrow ventrally, as is also, in a considerable degree, the next one, which also has dorsally a chitinous plate (but a small spiracle), and is almost without colour. The abdominal segments 3-7 are more uniform in width, large, white, or colourless, and each carries a spiracle. Each of these seven abdominal segments has (as also the thoracic) a double brown ganglion, very conspicuous, ventrally, that of the 7th segment, apparently, from its size and outline, including that of the 8th segment also. The 8th abdominal segment is very conical, tapering rapidly, anally narrower than the others, and narrower ventrally, and has no spiracle or ganglion. The 9th abdominal segment is a narrow and altogether small segment, carrying, ventrally, a curious double lappet, the precise nature and function of which sexually are not clearly evident. The 10th segment forms a small tapering (?) ovipositor (Chapman, June 17th, 1899). The ♀ of *P. villosella* is longer (8-9 lines long) and, in comparison, more slender than those of *Ptilocephala angustella* (*atra*) and *Psyche viciella*. The head is bent inwards, yellow-brown, with short white antennal stumps and black eyespots. The three thoracic plates are brown, and on the back of the 4th segment is also a small brown corneous spot of irregular form. The colour of the body and the three pairs of legs is yellowish-white. The corneous plates of the last three segments are of a light brown colour (Hofmann).

Variation.—The species (owing to the coloration of the male) cannot be a variable one, yet differences of size and tint appear sufficiently defined to have developed several local races. This has led Standfuss to assert that the moth varies much, and he states that the Silesian examples differ considerably from the south German ones, the fore- and hindwings being narrower, the colour grey-black instead of the decided brown of the south German examples, whilst sometimes the nervures six and seven are stalked instead of seven and eight, but transitions between the two forms occur. The following appear to be the various forms described, some possibly not really forming local races apart from the type.

a. var. *nigricans*, Curt., "Brit. Ent.," v., pl. 213 (1828); Stphs., "Ill. Brit. Ent.," ii., p. 79 (1828); "Cat.," p. 57 (1829); "List An. Brit. Mus.," v., p. 55 (1850);

2nd ed., p. 52 (1856); Wood, "Ind. Ent.," p. 27, pl. vii., fig. 30 (1839); Humph. and Westwd., "Brit. Moths," i., p. 94, pl. xix., fig. 3 (1851); Westwd., "Proc. Zool. Soc. Lond.," 1854, p. 220, *nec* pl. xxxiv., fig. 1 (♀, from Scotland = *A. opacella*); Sta., "Man.," i., p. 166 (1857); Kirby, "Cat. Lep. Het.," p. 509 (1892); Tutt, "Brit. Moths," p. 343 (1896). *Nigricantella*, Brd., "Mon. Psy.," p. 52, pl. i., fig. 29 (1853).—*Penthophera nigricans*. Male, semi-transparent, hairy, brownish-black with a yellowish tint; cilia and nervures darker, the former very short; superior wings rather long and narrow. Thorax and abdomen woolly, the latter beneath at the apex and the tarsi silvery. Beaten from a birch tree on the outside of West Parley coppice, Dorsetshire, by J. C. Dale, June 18th, 1824 (Curtis).

This (our British form) was reared, in 1848, by Stevens, from cocoons found on heath and gorse in the neighbourhood of Ringwood and Lyndhurst; he has observed that the males invariably emerge from the pupa between the hours of 5 and 7 p.m. and that one evening great numbers of males were attracted by a ♀ just emerged from the pupa, in one of his breeding-cages, in a garden at a considerable distance from the heath where the insect was found. He further notes that these cases were obtained in the third and last week of May, the imagines appearing a few days after; he observed that two males had not been out of the pupa more than ten minutes before they paired with the ♀s but did not remain in copulation more than a quarter of an hour, only the head and wings of the ♂s were observable at the time. Bruand considers *nigricans*, Curt. (which he renames *nigricantella*) a slightly larger race of *P. villosella* (the male measuring 27mm.) than the continental form, in which the colour is exactly the same, as also the shape of the wings and the antennæ; the neuration, too, is identical, except that the nervule that closes the discoidal cell of the hindwing on its outer edge is straighter or even turned to the outer margin in *nigricans*, whilst it is inclined towards the base of the wing in *villosella*. He looks upon the case formed of pieces of ling as very remarkable, but fortuitous, and states that Doubleday informed him that the larva feeds also on sallow. [We may note here that Westwood states (*Proc. Zool. Soc. Lond.*, 1854, p. 220) that his ♀ (pl. xxxiv., fig. 1) was drawn from a living insect, specimens having been sent by Weaver from Scotland in the middle of the month of June. As *P. villosella* does not occur in Scotland and *A. opacella* was the Psychid that Weaver obtained there, there can be no doubt that Westwood's description and figure apply to the latter species.]

β. var. *hirtella*, Ev., "Bull. Mosc.," (3), p. 542 (1843); Kirby, "Cat. Lep. Het.," p. 509 (1892). *Casanella*, Brd., "Mon. Psy.," p. 53, pl. i., fig. 31 (1853). *Villosella*, Heyl., "Rom. Mém.," ii., p. 177 (1885).—*Psyche*. Corpus hirtum, e ferrugineo cano-fuscum; alæ nigricantes subpellucidæ, lunula media obscuriore obsoleta.—Magnitudine *P. graminellae*, corpore autem crassiore; antennæ maris eodem modo pectinatæ, quo esse vidimus in *graminella*—fuscæ. Alæ fusco-nigricantes, subdiaphanæ, fere eodem colore, quo *Liparis detrita*, sed paulo magis diaphanæ. Habitat in promontoriis Uralensibus. Larva saccata repit frequentissime mense Junio in quercuum et betularum truncis; ejus sacculus e foliolis minutis pendentibus constructus est. In arboris trunco hærens larva metamorphosin subit; imago apparet Julio [Eversmann, *Bull. Mosc.*, p. 542 (1843)].

This would appear to be without doubt *casanella**, Brd. Heylaerts

* Bruand's description of *casanella* reads as follows: *Casanella* = ? var. *cinerellae*. Mas: nervis, *cinerellae* maximè affinis; colore autem necnon alarum formâ ad *villosellam* accedit. Femina larvaque ignotæ. M. Boisduval possède un seul exemplaire mâle de cette Psychide qu'il a reçue de Casan, ainsi que son nom l'indique. Elle a la même forme d'ailes que *villosella* et elle est de la même couleur; de sorte que sa figure ne serait qu'une répétition de celle-ci. Mais en revanche le système nervulaire se rapproche de celui de *cinerella*, sans cependant

states that Oberthür had sent him the originals of *casanella* for examination, and that he found them to be large *P. villosella*, with no difference in the neuration as Bruand says.

γ. var. *cinerella*, Dup., "Hist. Nat.," supp. iv., pp. 61-62, pl. lvi., fig. 1 (1844); Brd., "Mon. des Psych.," p. 53 (1853); Mill., "Icon.," pl. 102, figs. 6-12 (1868).—Elle est de la taille de la *graminella*. Ses quatre ailes sont demi-opaques, d'un gris cendré en-dessus et légerèment jaunâtre en-dessous, avec la frange un peu plus foncée et les nervures bien marquées, surtout celle qui ferme la cellule discoïdale. La tête et le corps sont de la couleur des ailes. Le corselet et l'abdomen sont très-velus, et les poilsont un reflet d'un gris blond. Les antennes sont grises et les pattes d'un brun rougeâtre. Cette espèce, que nous n'avons pu reconnaître dans aucun auteur, nous a été donnée comme ayant été prise dans la forêt de Fontainebleau; M. Boisduval en possède plusieurs individus trouvés par lui dans cette localité. Elle paraît en juillet (Duponchel).

The figure of *cinerella* is undoubtedly our *villosella*, browner than our British examples (at least when fresh), and of about normal size. Bruand notes (*Mon. des Psychides*, p. 53) this as near *P. villosella*, but with the wings a little narrower; the colour brownish-ashy; the antennæ somewhat shorter. He adds that Millière has sent him many specimens of this Psychid, which he considered to be *febrettella*, an error into which Pierret also fell. The insect, like *nigricantella*, he considers to be only a local variety of *P. villosella*, although the four examples that he had under observation presented very striking differences, *e.g.*, "*cinerella* has slightly narrower forewings and rather shorter antennæ, the colour less brown and rather inclined to ashy; the neuration of the superior wings differs, so that the first superior nervure is bifurcate and the second simple in *cinerella*, whilst in *villosella* the first is simple and the second bifurcate." All one can say is that Bruand's figure of *cinerella* (pl. i., fig. 30*a*) is distinctly that of *P. villosella*, but one is able to speak with much less certainty of his *P. villosella* (pl. i., fig. 28), which looks a somewhat more slender insect than the species he names it. Bruand adds that Millière had collected *cinerella* in the neighbourhood of Lyons, the cases covered with short dry stems, splinters, and with *débris* of plants and flowers. Edwards bred *P. villosella* from cases found in the Forest of Fontainebleau in June, 1897.

Comparison of P. villosella with its allies.—Chapman notes two species as being closely allied to *P. villosella*, *viz.*, *lutea* and *cana*. These were described as follows:

Lutea, Staud., "Hor. Soc. Ent. Ross.," vii., p. 113 (1871).—*Psyche febretta*, Boyer. ? var. In this difficult genus I will not venture to erect a new species on a single male caught by Krüper on the Veluchi. It differs essentially from the true southern French *febretta*, in being yellow-grey (still paler than *viciella*) not black-grey. The very hairy body and head (which in *febretta* are whitish-grey) are yellow-grey; but as the specimen has in common with *febretta* a very pointed abdomen, and antennæ gradually thinning to a point, I should refer it to this species rather

être totalement identique. Chez elle la première nervule supérieure est bifurquée, comme chez *cinerella*, mais la bifurcation commence presque à la naissance de la nervule: en outre la première et la seconde nervules inférieures ont une origine commune, tandis que chez *cinerella* elles l'ont distincte (voir à la planche iii). Ces légères différences constitutent-elles une simple variété, intermédiaire de *villosella* et *cinerella*? ou bien est-ce là une espèce distincte? On ne peut guère trancher la question, d'après un individu unique dont on ne connaît ni la femelle, ni la chenille et son fourreau. Mais je pencherais pour le dernier parti, si cette disposition des nervures était constatée sur plusieurs exemplaires. J'ai figuré, sous le no. 31 de la planche iii., les nervures de *casanella*, comparées avec celles de *villosella*, *nigricantella* et *cinerella* (nos. 28, 29 et 30).

than *viciella*, which, however, it much more nearly approaches in tint, but the forehead which is black in *viciella* is almost whitish, and so lighter than the thorax in the Grecian species. The antennæ are not quite so pointed as in *febretta*, though much more so than *viciella*. Should it prove a new species I propose to name it *lutea* (Staudinger).

Cana, Hamps., "Moths of India," i., p. 623 (1892).—♂. Head white; thorax and abdomen pale ochreous-brown, wings greyish-fuscous. Larval case rather smooth, covered with comminuted vegetable scales and fibres. Pundaloya, Ceylon. 24mm.

Chapman says *cana* has a very smooth unclothed case. It is a smaller darker insect with wider wings, and distinct from *P. villosella*, but very close thereto.

Egglaying.—The eggs are laid by the female in the empty pupa-skin which remains in the bottom of the puparium. They are packed so tightly together, and are so absolutely fluid to touch that one cannot at first resist the belief that the female pupa is really being killed to get at the eggs. To obtain an egg or two for description one has to rupture the pupa-skin, and in so doing one breaks many of the eggs, and the mass appears semifluid. As a matter of fact we opened two egg-masses before we could convince ourselves that we were not dealing with the pupa, although the dehisced pupal skin (at the anterior end) showed us that this could not be so. Chapman observes that there are some fibres (? silk) distributed through the egg-mass. After the ♀ has finished ovipositing she drops from the case and dies, but the plentiful supply of silk that fills up the long tube and apparently formed part of the silken cocoon spun by the larva for pupation within the case, effectually closes up the orifice and offers considerable protection to the eggs.

Ovum.—The egg is oval in outline, exactly 1mm. in length, ·75mm. in width, pearly-white in colour (but with a creamy tint in the mass), surface shiny, shell exceedingly delicate (so delicate that the eggs break when separated), covered with an exceedingly fine irregular surface reticulation. [Described June 13th, 1899, from an egg-mass sent by Mrs. Cowl.]

Case.—The newly-hatched larva makes its case by biting off a tiny bit of lichen, which it cements into a ring, and fastens to a branch of heather, it then creeps into it till about halfway through, and afterwards adds to it with sand and its own silk until a case is formed; after a time the larvæ ornament their cases with bits of hair taken off the heather, and do not get much beyond this stage before their first winter (Cowl). In the hybernating stage (October 8th, 1899) the case is about 9·5mm. long and 3·2mm. wide, but sometimes such comparatively large pieces of leaf are attached at an obtuse angle, that the case appears almost as broad as long; in the middle of January (1900) the cases appear to be just as when the larvæ commenced hybernation the preceding October, being still about 9·5mm. long, covered with scraps of leaf, and very rough and ragged (Bacot). The cases made by male larvæ are generally more elaborate than those made by female larvæ, the former often of twigs of *Calluna*, the latter of short lengths of grass and twigs (Fowler). The full-grown cases vary immensely in size and material, yet there is a general similarity among them all that makes it almost impossible to mistake one, and the more or less regularly-placed, rounded leaves that are intermixed with the twigs in the case of *C. unicolor* are quite wanting in *P. villosella*. The following is a description made from a fairly typical, completed case (really one of many) collected at Bournemouth by Mrs. and Master Eric Cowl (to whose energy our knowledge of the life-history of this species is very largely due): As nearly as possible 1·5in. in length and ·3in. wide. The posterior (unattached) end formed of a silken tube ·3in. in length (elongated to ·6in. when spun down for pupation). This being of soft texture naturally falls in and closes this end of the case, but the larva backs itself readily out of it to get rid of its excrement. The central tube is cylindrical, formed of white silk, and this is covered with small pieces of grass, pine-needles, heather, stick, &c., of varying length (average from ·25in.-·75in.), but all attached by the basal end only, the other end free and pointing towards the posterior end of the case. The pieces are intermixed with dead flowers of *Calluna*, still arranged, however, as the sticks, and in the same regular manner. The free open end, from which the larval head is protruded, is much more developed dorsally, and forms a sort of hood that fits close down to the surface on which the larva is crawling, when the latter is disturbed and withdraws itself within the case. The cases with the heather blossoms are much more bulky, especially towards the anterior end, and as we have already noticed there is no trace of the regular intermixture of leaves that characterises the case of *C. unicolor*. When full-fed the larva fixes down the anterior (mouth) of the case with silk, turns round in it so that the head is towards the old posterior end of the case and pupates in this position. [Described June 2nd, 1899.] Two strange-looking cases (also sent by Mrs. Cowl and collected at Bournemouth), which Chapman referred to this species (about half-grown), were very peculiar, one was formed entirely of very fine, light straws, sticking out at about 70° from the longitudinal axis of the case, and hence very bristling in appearance, the other was formed entirely of heather flowers, and as may be supposed was very unlike normal cases of this species. Other cases made entirely of small pieces of bracken frond, are exceedingly beautiful. Nickerl says that the cases are constructed of different materials according to the locality. In his own district in Bohemia, he says they are covered longitudinally with short thick plant-stalks, whilst those found in the Upper Engadine were mostly clothed with leaves of *Vaccinium vitis-idaea* and hence they had a quite different appearance. Staudinger notes that the cases he found at Constantinople were quite typical of the species but smaller. Chapman observes that in Constant's collection are some cases made of *Vaccinium*, others of leaves, some of grass, whilst others from the New Forest are made of pine-needles. Mrs. Cowl says that she observed cases in which pieces of charred stem had been woven into the covering, these were found near where a fire had occurred the preceding autumn. Hofmann says that the cases are variable, especially those of the males, some of which are made of thick grass or plant stems, others of round pieces of dead oak and beech leaves; the female cases are nearly always composed of plant stalks placed lengthwise. Weir noted (August 14th, 1890) cases of *P. villosella* (containing living larvæ) some made entirely of rush, some with fragments of grass and heath, and one (the original case having been taken away) with scraps of coloured paper.

Habits of Larva.—Ova laid June 13th, female left case June 14th, eggs hatched July 22nd, 1898, larvæ began to hybernate in October, when not half an inch long; in May following they had grown little, but slowly developed and added new pieces to their cases, so that by October, 1899, they appeared to be almost (or quite) full-grown; these have hybernated again and will no doubt spin up in May, possibly without much further feeding (Cowl). Weir says that the larvæ hatch in about 10 or 12 days, and that they have been observed to lengthen their cases by additions to either the proximate or distant end. Fowler states that the young larvæ, as soon as hatched, make cases of the woolly lining of the puparium, feed up quickly, and by the autumn are half-grown and may be picked up in this condition throughout the winter (hybernating very low down on ling); in March they commence to feed again—on *Calluna* preferably—drop to the ground at once if disturbed and do not commence to crawl for some little time, then a larva protrudes its head, takes hold of a twig, draws itself along by a series of sharp jerks until it has reached a safe place on the plant again. Its ability to close its case when disturbed is remarkable. The female larvæ climb high upon furze-bushes, or pine-trunks to spin up for pupation, the male larvæ almost invariably pupate on the stems of *Calluna*. Bacot notes that, in confinement, for the purpose of hybernation the larvæ appear to prefer an elevated situation, many being attached to the gauze covering of the tub in which they are confined, others on the sides of the tub, others on twigs; altogether there are some 80-100, all, however, firmly spun up. McRae says that the larvæ take two years to reach their full growth and that they then select *Calluna*, furze, or the trunks of pine-trees on which to pupate. Barrett observes that, "in confinement, larvæ are sometimes obstinate as regards food, existing sometimes for months without any, at other times releasing the case after spinning it down tightly as though for pupation and then feeding on for months so as to pass over another year." We suspect that neither of these habits has anything to do with the food supply. All larvæ that pass a second winter,* do so practically full-grown, and spun down from October to March; they also spin their cases down temporarily for some days at each exuviation; large larvæ that have gone over their second winter are certainly easily reared if fully exposed to the sun and supplied with fresh food. On June 3rd, 1899, we noticed that full-grown larvæ cling very tightly to any object by means of their true legs and allow themselves to be drawn partly out of the cases before loosening their hold. Having protruded the anterior part of the body to the 2nd or 3rd abdominal segment a larva draws the rest of its body after it, in a more or less Geometrid fashion, in short jerks, the case being pulled along after it suddenly, the larva stretches out again and so on as before, the weight of the case keeps it almost horizontal on the surface of the ground, or, if the larva be climbing, the case hangs almost vertically. The head is quite retractile within the prothorax and the other thoracic segments more or less retractile within each other. The slightest disturbance of the case, or even of the object on which it is resting, is sufficient to make

* As bearing on the statement that the larvæ take two years to come to maturity, Rössler states that although Wocke gives the beginning of June for the appearance of the imago, Von Reichenau found the larvæ at Mayence, still unpupated, on pine-trunks with those of *Canephora unicolor*, in July. Hofmann states that he has proved the species to pass two years in the larval stage by breeding from eggs.

the larva draw itself entirely within its case and to remain quite still for a considerable period. Hofmann notes that when full-fed, the male larvæ spin up on grasses, &c., at the foot of tree-trunks, the female larvæ usually from 2ft.-4ft. up the trunks.

Larva.—The *young larva* of *P. villosella* (in its first hybernating stage, October 8th, 1899) is about 6·5mm. in length, 1·5mm. in width, and under the microscope shows traces of the pale markings on face and thorax that characterise the adult larva, and also the dark anal plates. To the naked eye, however, the abdomen is reddish-brown and the head and thorax black, the body is flatter and wider relatively than that of *A. opacella*, and the lateral flanges are more prominent than in that species. The central depression of the prolegs do not appear to be corneous, and the spiracles are much less noticeable than in *A. opacella* (Bacot). The *fullgrown larva* has the head black, with several whitish marks on face, and many hairs; the pro-, meso- and metathorax black, corneous, with whitish mediodorsal line, and much wider whitish-yellow subdorsal lines extending to the 3rd abdominal segment. The abdomen dirty blackish-grey in colour, the 1st, 2nd, and 3rd abdominal segments rather darker than the following; the subdorsal lines of the thoracic segments exist on 1st-3rd abdominal segments as creamy-white spots; a triple lateral flange, dirty white in colour, extends the whole length of the abdomen, weakened after the 6th abdominal; the upper ridge most developed, but all broken by the strongly-marked, abdominal, segmental incisions, the upper ridge (of flange) continued on thoracic segments, but black (thus taking on the colour of the chitinous covering of the thoracic segments). The abdominal spiracles dark and conspicuous on whitish ground colour, situated almost in groove between 1st and 2nd lateral ridges rather anterior to the middle of the segment. The true legs black, corneous, the joints pale, and a single strong terminal hook; several hairs at joints. The prolegs strong, the crochets forming a somewhat elongated oval (the inner edge without hooks) from 26 to 30 in number (in one case 24 on one side and 30 on the other); the anal prolegs somewhat close together, each with 28 short and very strong hooks. The ventral area dirty yellowish-white like the lateral flanges and, therefore, much paler than the dorsal area. On the abdominal segments are dorsally, on either side, two black marks, which are deeper portions of the groove marking the subsegments; on 7th abdominal a distinct black spot occurs before the inner of these, but is really part of it, if one may judge by the preceding segments. On the 4th, 5th, and 6th abdominal segments the trapezoidal tubercles are reversed (*i.e.*, i farther from mediodorsal line than ii), these are small pale plates, with very minute bristles, ii being just posterior and slightly outside the inner black mark noted, the exterior, i, is a good way in front of the outer of the black marks; on the forward segments these become gradually larger, and on the 1st abdominal they form large lunular marks; on the 1st and 2nd abdominals also they are supplemented by a similar plate at posterior margin of segment, and behind i, but this is without a hair. The triple lateral flange has the three ridges (and a smaller subsidiary one) separated from each other by shallow grooves, but above and below are deeper ones; the upper of these ridges is the larger and carries above it a large oval plate, with a hair, iii, towards its anterior end; below this, and rather on the prominence of this boss than in the groove beneath, is the spiracle; the next two ridges are nearly parallel but tend to unite in front, the upper of these carries a small corneous point with one hair (iv) except on the 4th abdominal, where a second minute hair, v, is in front of it, the other segments have only a point representing this second (v) hair; the lower of the two carries a corneous point towards the anterior extremity of the segment, and on segments 3 and 4 this carries a hair (vi); there is another hair, vii, at the base of the proleg. On the 8th abdominal the trapezoidal tubercles are on a large plate. [Described June 3rd, 1899, from a larva sent by Mrs. Cowl.] Bacot describes the larva as follows: Head small, rounded, partly retractile within prothorax, black, mottled with whitish; surface roughened with scattered hairs. The thoracic segments of normal shape, the skin chitinous, nearly as corneous as head, black, with dull yellowish mediodorsal, subdorsal, and lateral longitudinal bands; no subsegments apparent. The abdominal segments larger, softer, gradually increasing in bulk to the 4th abdominal then tapering to the 10th; colour dull yellowish-white, except the anal segment which is chitinous and brown; segments 1-7 divided into two almost equal subsegments; a broad raised lateral longitudinal ridge on either side, the skin much wrinkled above and below. The true legs are large, strong, and powerful; the prolegs very short with an incomplete oval of hooks; centrally (within the hooks) the foot is depressed, the bottom of depression yellow in colour. The spiracles large, placed towards anterior edge of abdominal segments 1-7, but towards the posterior edge of 8; the thoracic spiracle is in the pro-mesothoracic incision. The surface of the skin rather granular, covered with minute chitinous plates or buttons; all the tubercles single-haired, the hairs or setæ slender, pointed and simple; on the abdominal segments the dorsal and subdorsal tubercles have large chitinous plates surrounding the bases of tubercles; this character is not noticeable on tubercles below spiracles, the plates (when present) being small. These plates larger on abdominal segments 1-3 and get gradually smaller to 7. On the 1st and 2nd abdominal segments are additional plates, independent of the tubercles, and bearing no hairs. On the prothorax are six tubercular setæ on either side of median line, arranged transversely along anterior edge of segment, a row of four setæ behind these and a single one on either side farther back vertically above spiracle, those below spiracle are difficult to make out. On the mesothorax, i and ii are in a transverse line near anterior edge of segment, the inner smaller than outer; a small iii (supraspiracular), iv and v subspiracular, close to each other, v larger (also a supplementary one in a straight line in front of these), vi appears also to be present; on the metathorax the arrangement is the same, but iii is lower down and larger. On the abdominal segments 1-7, i and ii are trapezoidal, but ii nearer mediodorsal line than i, the latter is rather stronger than the former; iii is supraspiracular (in vertical line with spiracle and i), iv and v close together, below, but rather posterior to the spiracles, v (anterior) much weaker than iv (posterior), both really weak and without chitinous bases, and situated on lateral ridge; below iv and v is vi a larger tubercle and seta rather anterior to spiracle; vii is double at base of prolegs. The number and arrangement holds good for segments 8, 9, and 10, but owing to the altered shape of the segments the relative position is very different. Bacot notes also an extra dorsal tubercle bearing a minute hair, very far forward on the abdominal segments close to anterior margin, in the same position as the extra tubercle of *Zeuzera pyrina* (on which, however, no seta was traced); this tubercle is very small and obscure, dorsal and anterior to i and ii, lying in line with i longitudinally, and is called by Bacot tubercle oi; i, he says, is much smaller than ii, is on the 1st subsegment, whilst the larger ii is on the 2nd subsegment. Bacot further notes that the chitinous plates at base of dorsal tubercles are often asymmetrical. In an example examined he found that on the 2nd abdominal segment the plate at base of ii, on the left hand side, was smaller than that on the right, and the actual tubercle and hair missing; on the 3rd abdominal, plate ii on the right hand side was smaller than on the left, and the hair and tubercle were wanting here also; while on the 4th abdominal, though tubercle and hair ii on right hand side were present, the plate was smaller than that on the left hand side. He further notes that the extra dorsal (or subdorsal) plates that were observed in *Standfussia zermattensis* (*Ent. Rec.*, xi., pp. 180-1) are present only on the 1st and 2nd abdominal segments, and in the specimens examined are without a hair, so that it is possible these are corneous plates, specially developed to protect these occasionally exposed segments; they are on the 2nd subsegment and are placed between ii and the lateral ridge.

Puparium.—When full-fed the larva spins down the anterior end of its case, and, turning round in it, adds to the other end a long silken tube. It then appears to spin inside the lower part of the case a certain amount of loose fluffy silk (much more so in the ♀ than in the ♂), and therein changes to a pupa. On emergence the ♂ pupa-case projects considerably from the end of the tube, but the ♀ pupa-case remains at the bottom of the puparium, the female herself wriggling up the tube and opening the end for the insertion of the abdomen of the male. Barrett states that the pupa state lasts about a month, but in some instances over a year (This last statement seems quite incredible, and certainly wants confirmation).

Pupa.—♂. The *male* pupa is brown in colour, the appendages rather paler and more transparent, the abdominal incisions rather darker than the ground colour. *Ventrally:* The mouth black, the eye-spots black; the face-parts well-developed; the apices of the forewings, not quite meeting each other, extend over the posterior edge of the 2nd abdominal segment; the antennæ very strongly developed, two-ridged, segmented, and not reaching to the apices of the forewings; the scars of the prolegs on abdominal segments 4-6 very conspicuous, and formed of a series of concentric ovals; two sharp-pointed hooks, much curved ventrally, each with a terminal point, occupying a corresponding position to, and evidently analogous with, the larval anal prolegs; the anus between the bases of these points, so that hooks are anterior to anus; the third pair of legs terminates at apices of forewings, the second pair terminates with the antennæ, the first pair falls short of the antennæ. *Dorsally:* The prothorax frontal, narrow; the mesothorax shiny, exceedingly well-developed, with a groove at base of forewing which stretches away ventrally; the dorsum medially ridged; the metathorax also narrow, much widened laterally, and continued laterally into the hind margin of the hindwing; not shiny like the mesothorax. The 1st and 2nd abdominal segments narrow; movable incisions between 2-3, 3-4, 4-5, 5-6, 6-7, 7-8, folded in, and of dark colour, and with a sharp row of points on the posterior edge of each segment (*i.e.*, on intersegmental membrane); segments 8-10 fall sharply to anus; a distinct trace of lateral flange of larva observable especially on the meso- and metathorax and 1st abdominal segment, where a distinct groove is observable; another transverse ridge of hooks on the anterior edge of abdominal segments 3-8 (weak on 3), this ridge separated by the intersegmental membrane from the posterior ridge on preceding segment. The posterior hooks of one segment form a sort of forceps with the anterior of next. *Laterally:* The antennal base protrudes beyond the prothorax, the prothoracic spiracle deeply embedded in the pro-mesothoracic incision; the wings conspicuous, especially the outer margin of the hindwing; the abdominal spiracles dark, oval in outline, each in a depression, that on the 2nd abdominal on the edge of the wing and more dorsal than the others; the depression evidently analogous with that between the lateral ridges of larva. *General notes:* The tubercles appear to be identical with those of larva, i outer, ii inner, iii supraspiracular, with a depressed area posterior to it, iv (strong) and v (weak) very close and subspiracular, vi single, and vii double just dorsal to proleg scar. The amount of pupal movement is almost incredible. It wriggles its abdominal segments, the terminal ones moving round and round, and rolls rapidly about when on smooth paper or moves along on its back by a quick upward and downward movement of the abdominal segments. Cutting the end of the silken tube projecting from the free end of the case and shaking it, soon persuaded the pupa to wriggle out with a rapid backward movement. [Described June 9th, 1899, from pupa sent by Mrs. Cowl.] Bacot noted May, 1898, that the row of fine slender curved spines on the posterior dorsal area of the movable abdominal segments pointed forwards, whilst on the anterior edge of each succeeding segment, was a group or irregular row of much stronger but shorter spines, pointing backwards, and that these two sets were brought into close proximity. Chapman writes: The male pupa is very stout and short, compared with many species, *e.g.*, *Canephora unicolor*, and more so if compared with *Standfussia zermattensis*, or a Fumeid pupa. Length 13mm., width 4mm.; free segments 3 (dorsally), 4, 5, 6, and 7; anal hooks very strong and sharp. It has several features of approach to a pupa-obtecta that are absent in the lower Psychids—(1) The wings seem firmly soldered to the body throughout, but only extend to end of 2nd abdominal (or with a slight free margin over 3rd). (2) There is no dorsal headpiece. (3) On dehiscence the head, legs, antennæ, &c., separate as one entire piece. There is at base of wings, especially the hindwings, the appearance of an articulation, more obvious than in most pupæ, and even than in most Psychids, where it is very common, especially in female pupæ of Fumeids, Epichnopterygids, &c. Dorsal hooks are found on the anterior of abdominal segments 3-8 (very weak on 3), the intersegmental hooks are present immediately above all anterior hooks. Depressions marking the three elements of lateral flange in larva very distinct; prolegs marked by large oval depressions with raised ring in centre (the proleg proper). Two hairs are very obvious at base of labrum; jaws prominent; cheeks about as wide as labrum; the labium forms a lappet about as long as wide, narrower at base and at margin slightly bilobed; maxillæ outside this and fully as long, rounded, but broadly triangular, with a very definite palpal prolongation, that, in one specimen, is continuous with the palpus on one side and has a joint between on the other, showing that the deep differing proximal joints are not absolutely obsolete; antennæ very broad, as also base of first legs, first femur long and broad; all these parts adhere to pupa-case on dehiscence by the third legs which are attached to 2nd and 3rd abdominal segments by their tips, the latter hardly visible between the apices of the wings. In one specimen, the second legs are well seen, in another, the antennæ cover all but a very narrow margin that needs looking for. The tubercles as in the larva (Chapman). ♀. The *female pupa* is about 18mm. in length, when fully stretched and about 4mm. in diameter, fairly cylindrical, rather narrowed in front and with the head bent forwards, the anal extremity more bluntly rounded. The colour is a rather light brown, without any darker areas except slightly where the chitin of each segment is medially and dorsally a little denser. The spiracles are well marked, and the larval prolegs leave very pronounced oval or nearly circular scars. Dorsally there are some roughnesses or wrinkles on abdominal segments 3, 4, 5 and 6, not very marked and less apparent on the other segments, but beyond this there is no trace of the anterior dorsal row of hooks. The intersegmental hooks, however, are well-developed, they occur on the divisions 2-3, 3-4, 4-5, and 5-6, being especially very large and strong on the latter incision, where they are definitely in one straight level row; on the anterior incisions they are less regular and might even be regarded as showing indication of a second row. When the segments are stretched they point directly forwards and though really minute, look under a lens terrible and formidable implements. As there are no hooks for forward progression these cannot be functional for regression and must subserve the purpose of a cremaster, in retaining the pupa-case in its place, on the partial emergence of the imago, when pairing, &c. The anterior trapezoidal (i) and supraspiracular (iii) hairs are small but very distinct, the posterior trapezoidal hair (ii) is comparatively large and less than half the distance from the middle line of the dorsum that i is, but measured antero-posteriorly, i is about the middle of the segment, ii halfway from this to posterior border; at some distance below and behind the spiracles are two small hairs (iv, v), and a solitary one, rather larger, further down and immediately in line (transverse) of spiracle; two others are just above and close to scar of proleg, the posterior being the upper, if there be a third, it cannot be detected; there is also one on either side beneath the prolegs. On 8 and 9 one or two of these hairs have distinctly recurved tips. The thoracic and 1st abdominal segments are narrower than the others behind, and the 1st abdominal spiracle is rather small, the wings and legs are represented by certain folds and wrinkles, without definite structure, but which, by their position, are recognisable as representing these parts. The face and leg region is delicate and pale; the venter is also paler than the dorsum, which is often deep brown, but could hardly in any case be described as black.

DEHISCENCE.—♂. The head and face-parts separate in one piece, with the legs, &c., but are held in place by the internal dissepiments, so that they remain close to their natural position; the antennæ may slightly separate from the first legs; the thorax splits dorsally to not quite the posterior margin of mesothorax (This seems to be the general method of dehiscence in all the ♂ Macro-Psychids). ♀. The anterior margin of thorax, or more strictly the dorsal head-piece, separates from the head, the thorax splits down dorsally quite into the 1st abdominal segment, the leg-area is stretched out so that comparatively colourless pupal tissue is displayed between the leg-papillæ and between these and the wings; whether this thinner membrane between the legs and wings splits or not, it seems irregular, and it is very usual for it to split on one side and remain intact on the other (Chapman).

Habits of pupa.—The cases containing the pupæ are kept in a window with a southern aspect. Before the sun comes round they are quite immovable, but as the sun reaches them they wriggle up and down the silken tube that protrudes beyond the sticks of which the cases are made, until the yellow-brown pupæ appear to be almost bursting out at the end. At the slightest touch they hurriedly wriggle back, and they also do so as soon as the sun is obscured (Cowl).

Food-plants.—Sallow, willow, birch, whitethorn, *Polygonum aviculare* (Bacot), *Myrica gale*, *Calluna* (Burrows), *Sarothamnus* (Reutti), Alpine strawberry, sloe, bramble, heath (Weir), *Erica*, *Genista* sp., *Spartium*, *Vaccinium myrtillus*, *V. vitis-idaea*, *Vicia* sp., &c. (Hofmann), grasses, heath, furze (Merrin), *Prunus spinosa* (Bruand).

Parasites.—Upon opening cases that I had kept all the winter I found many larvæ attacked by ichneumons; the larvæ must have been the hosts of the parasites throughout the winter (Weir).

Habits and Habitat.—The male imagines, at least in confinement, appear to emerge in the early evening from 5 p.m. to 6 p.m., although, occasionally, examples will appear until 8 p.m., and we have once observed a morning emergence (a female). The species, however, appears to be essentially an early evening or day-flier, assembling readily to the females, that do not (except by chance or when not fertilised)* leave the case until the eggs are laid, when they drop out and perish. Copulation takes place in the case, the female coming up to the entrance of the extended silken tube from which she repeatedly pushes out the head and anterior segments of the body, and thus makes a means of entrance for the extensile abdomen of the male, which is forced into the tube, for the purpose of copulation, the wings being pressed upwards during actual pairing by the upper edge of the tube.† As soon as copulation has finished, the female wriggles back into the pupa-skin and deposits her eggs therein, finishing in a comparatively short time. She then usually falls from the case and dies. Cowl notes that he believes that, just before doing so "she spins the wool plug that fills up the emergence-end of the tube and that this serves as a protection for the eggs." If she remain unfertilised, she will, in time, wriggle out of the case, without laying her eggs, fall to the ground, and by means of powerful vermiform movements, cover a considerable distance, and will live some days in this exposed condition. The female is thus very active (within limits) and muscular considering that she appears to be chiefly formed as an

* Barrett's statement that the "♀ leaves the case" (*Brit. Lep.*, ii., p. 334), and McRae's that "the female on emergence falls to the ground" are quite incorrect as to the normal habit, except within the limits suggested above.

† Stevens and others have stated that the ♀ turns round in the case so that the male can pair with her, this is not so, she wriggles to the top of the tube and keeps her head at the open end of the case.

egg-bag. The vermiform movements pass from tail to head, and reversely, and this happens more or less continuously, so that it is sometimes difficult to determine which is a segmental incision and which a wrinkle caused by movement. Tubules (containing urates) are also very visible subcutaneously, and these sometimes get caught up and render the wrinkles more pronounced. With regard to the emergence of the male, Mrs. Cowl notes that it takes less than a quarter of an hour from the time that the pupa moves to the end of its case, for the male to have its wings fully developed, the body being at first pale and grublike but the segments quickly become compressed and so covered with the longish black fur. Fowler states that the males fly rapidly and then look inconspicuous, with an appearance something like that of a small bee, and he has seen them assembling freely at midday to a newly emerged female. Cowl, however, observes that in June last (1899) a ♀ was at the opening of her tube one evening as if awaiting a ♂, and that on putting one in the glass in which she was, they copulated at once, and remained *in cop.* for an hour; he did not afterwards appear able to pair with another the same evening, although in the morning he was apparently strong and fit. McRae notes the males as emerging about 6 p.m., and states that they soon mature and quickly damage themselves; he has three times observed them flying in the early afternoon sunshine, and compares the flight with that of *Anarta myrtilli*. Stevens says that when at Lyndhurst in 1848, he kept the cases, from which imagines were emerging, in a bandbox covered with fine gauze, in the garden, and that, although he was living quite a mile from the heath where the cases were found, he observed in the afternoon a number of males flying around the box, no doubt attracted by a freshly emerged ♀. The insect appears to be confined (in Britain) to the extensive tracts of heathland in east Dorset and Hants, where one finds the cases not uncommonly spun-up on the heather-stems, &c. (Bankes); it occurs upon all the heaths in the New Forest district but is more abundant at Wimborne and St. Leonards, rarer in the New Forest proper (Fowler); on heaths all over south Hants, sparingly, and in certain spots abundantly (McRae); cases found somewhat freely in the neighbourhood of Bournemouth among the heather, several found on May 23rd, 1899, at once spun-up for pupation (Cowl); the cases are in some seasons very abundant on heather stems around Bloxworth (Cambridge); likes dry heathy ground in sunny sheltered places, but also occasionally inhabits moist swampy places (Barrett). Fowler says that to obtain the cases he searches during the months of March and April the trunks of fir trees; the cases are generally to be found from 1ft.-2ft. from the ground. This appears to be the favourite position taken up for pupation, although cases are also to be obtained from the ends of twigs of *Ulex europaeus*. In Germany, both on the northern tableland and in south Germany, it is rare; it occurs at Ratisbon, but is extremely local on hillsides and in grassy coppices (Hofmann). Petersen says that at Lechts cases were first found on boggy ground on birch and fir-trunks, that from about 40 cases collected only a single ♂ emerged (June 24th), but that by placing freshly emerged ♀s in the localities whence the cases had come the males were attracted so fast that he was quite unable to prevent their copulating, and thus many ♀s were rendered unavailable for further attraction. Millière notes it as one of the most abundant Psychids on the Mediterranean littoral, the larva everywhere in spring, even in the gardens around Cannes, fixed to walls, rocks, and trees, where it undergoes its transformation to pupa. He notes that he has found it in the higher mountains of the Alpes-Maritimes but that it is rare there. He adds that it "always emerges directly after sunset, flies at night and rests during the day, contrary to all its congeners, which are diurnal." Our experience in Britain does not altogether confirm this statement.

Time of appearance.—The first three weeks in June appear to be the usual time for the emergence of this species, but earlier and very much later specimens are frequently found. To breed the insect, cases should be collected throughout May (in normal seasons) when the larvæ are on the point of pupating or have just done so. The first example recorded in this country was taken in West Parley coppice, June, 1824, by Dale. Stevens obtained larvæ (fullgrown) at Lyndhurst, in May, 1848, males were bred and others captured a few days later. Cases containing pupæ were found in June, 1898, at Bournemouth, and others in July, 1898, containing eggs. In 1899, several larvæ (which at once spun-up) were collected on May 23rd and following days and emerged as follows: June 8th, one ♂ and one ♀, June 9th, one ♀, June 10th, two ♂s and two ♀s (all between 5 p.m.-6 p.m.), June 11th, one ♂ (about 8 p.m.), June 13th, one ♂ and one ♀, June 14th, two ♀s, June 15th, one ♂ (all from 5 p.m.-7 p.m.), June 15th, one ♀ in the early morning; the males (and ? females) appear to emerge in the evening between 5 p.m.-8 p.m. (Cowl); June 8th, 1899, one ♂, June 11th, one ♀, June 13th, one ♂ and one ♀, on June 9th, one of the cases sent by Mrs. Cowl still contained an apparently full-fed larva (Tutt); Bankes notes ♀ bred June 25th, 1882, cases found May 4th, ♂ bred May 13th, ♀ bred May 18th, 1893, case found May 29th, ♂ bred June 6th, 1896, ♀ bred June 21st, 1894, all from the Isle of Purbeck; ♂ bred June 30th, 1895, from Wareham. Burrows notes the cases in large numbers in the New Forest, August 21st, 1879, the larvæ feeding on *Myrica gale* and heather. Fowler notes 30 cases from May 28th-June 10th, 1889, at Wimborne, all on furze, four or five ♂s bred; cases end of March and throughout April, 1890, at Verwood, bred 4 ♂s in May; cases June 4th-10th, 1893, at St. Leonards, females, but no males, bred; March 9th, 1894, six cases at Verwood, May 30th, several cases of both sexes spun-up, from June 8th, two males and several females were bred, whilst male imagines were noted flying on the heaths at Verwood, on June 18th; June 5th, 1895, many cases spun-up, one ♂ and several females were bred from June 7th; June 2nd, 1896, seven cases, all produced females later; June 4th-10th, 1897, many cases, bred males on June 11th and 14th, also several females; June 3rd-12th, 1898, eight cases, two males bred on June 5th, and on June 16th, obtained four cases, one of which had a ♂ pupa-skin sticking out; May 30th, 1899, two cases with crawling larvæ, June 1st, three cases with larvæ and one spun-up, June 5th, five spun-up, June 6th, two males bred, June 8th, two males netted, whilst others were seen flying over the heath. Garbowski notes the capture of an imago, June 24th, 1870, and a ♂ pupa taken May 28th, 1891, at Rzesna, in Galicia, whilst Czekelius captured imagines on July 5th, at Hermannstadt. Wocke notes it as appearing in the beginning of June in Silesia, and Hofmann spun-up larvæ at end of April and beginning of May in Hanover, the imagines appearing from the beginning of June to the end of July. Sahlberg gives imagines as occurring from July 4th-13th, 1874, at Ruovesi in Finland, and Edwards bred a male on June 23rd, 1897, from a pupa obtained in the forest at Fontainebleau, whilst Gauckler found spun-up cases at Wildpark, near Carlsruhe, on May 14th, 1896.

Localities.—Devon: very rare (Parfitt). Dorset: Isle of Purbeck, Wareham (Bankes), Knighton Heath, Poole Heath, Parley Heath, West Parley coppice (Dale), West Hurne (Barrett), Bloxworth (Cambridge). Hants: Bournemouth (Cowl), Ringwood, Lyndhurst (Stevens), Studland (Dale), Wimborne, Verwood, St. Leonards, New Forest (where it is scarcer than on the outlying heaths) (Fowler). ? Sussex: Brighton dist. (Cooke).

Distribution.—Asia Minor: Beyrout, Cyprus (Speyer), Brussa (Mann), Kis. Aolé (Lederer), Pontus—Amasia (Staudinger). Turkestan: Saisan (Staudinger). Austro-Hungary: Fiume, Carinthia, Spalato (Mann), Trafoi (Wocke), Pressburg (Rozsay), Vienna, Wippach in Carniola, Buda, Dalmatia (Speyer), Galicia—Rzesna, Brody (Garbowski), Lemberg (Nowicki), Brünn (Müller), Bohemia—Königsaal (Schneider), Tyrol—Taufers, Innsbruck (Weiler), Hermannstadt (Czekelius), Epiries (Husz), Kocsocz (Vángel), Dalmatia (Oberthür), Bohemia (Nickerl). Belgium: Antwerp nr. Hoogstraeten, Minderhout, &c. (Heylaerts). Corsica: Ajaccio (Speyer). Denmark: Vroue, S. of Skive (Bang-Haas). Finland: Ruovesi—Pekkala (Sahlberg). France: Dept. Doubs—Maison-Rouge, nr. St. Vit, &c., Lyons (Bruand), Haute-Garonne —St. Béat, Ardiège, Luchon (Caradja), Dept. Var (Cantener), Gironde (Trimoulet), Saone-et-Loire (Constant), Cannes, Alpes-Maritimes (Millière), Fontainebleau (Edwards), Montpellier (Boisduval). Germany: rare on northern tableland and in south Germany (Hofmann), quite rare in Silesia—Obernigk, Parchwitz (Standfuss), Pomerania, Hamburg (Heinemann), Niendorf (Zimmermann), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Nassau, near Mayence (Rössler), Silesia—Riemberg (Wocke), Marbach (Hoffmann), Ratisbon (Schmid), Alsace—Colmar, &c. (Peyerimhoff), Osterode (Jordan), Hanover (Glitz), Kaiserstuhl, near Oberschaffhausen, Hintergarten, Kniebis, Karlsruhe, Würtemberg, Nassau (Reutti), Munich (Hartmann), Augsburg, Lauban, near Freiburg, Erlangen, Breslau (Speyer). Greece (Staudinger). Italy: not common (Curò), Sicily (Mina-Palumbo), Palermo (Mann), Lombardy—Brianza (Turati), ? Modena (Fiori). Netherlands: Gelderland—Arnhem, N. Brabant—Breda sometimes common (Heylaerts). Roumania: Grumazesti, Slanic, Kloster Neamtz (Caradja). Russia: Baltic Provinces—Dorpat, Neu-Kasseritz (Sintenis), Wolmar (Lutzau), Transcaucasia—Ounous, near Ordoubad (Romanoff), St. Petersburg (Erschoff), Esthonia—Lechts (Petersen). Scandinavia: rare Scania (Aurivillius), Ramlösa (Wallengren), ? Vestergötland (Dalman). Spain: Andalusia (Rambur). Switzerland: up to 5500ft. (Frey), Grisons (Killias), Upper Engadine, near Sils (Hnäteck), Upper Engadine (Nickerl), Vispthal (Püngeler), the Uto (Rühl). Turkey: southern parts, Constantinople (Staudinger).

Subfamily: Psychinae.

When the *Psychinae* branched from the ancestral Macro-Psychid stem, it lost the anterior tibial spur, it also simplified nervure 4 within the cell (*i.e.*, it lost the cellula intrusa), and the scaling became particularly hair-like. At the same time nervure 1*a* remained more or less present (or absent) but never anastomosed with 1*b*, whilst the antennæ retained the full scaling on the shaft and pectinations, and even where these scales have since become hair-like, they are readily distinguished from the sense-hairs on the other aspects of the antennæ. The *Psychinae* are particularly well-developed in the Palæarctic area, and hence a student of the European Psychids usually attaches undue importance to this subfamily, which forms in reality only a comparatively small branch from the main stem, given off, as shown above, before the antennal scaling specialised by disappearing, and before the anastomosis of 1*a* and 1*b* developed, but which specialised at once by losing the anterior tibial spurs, as many Acanthopsychids did later.

We have already noted (*ante*, p. 373) that Chapman proposes to divide this subfamily into two tribes, the *Psychidi* and the *Oreopsychidi* (rect. *Phalacropterygidi*), the former to contain *Psyche*, Schrank (*Megalophanes*, Heyl., *Gymna*, Rbr., *Stenophanes*, Heyl.), the latter to consist of *Oreopsyche*, Speyer (*Hyalina*, Rbr., *Scioptera*, Rbr.), as used by Heylaerts in the *Ann. Soc. Ent. Belg.*, xxv., pp. 70-71. These correspond respectively with our divisions *Empedopsychinae* and *Oreopsychinae* (*ante*, pp. 274-275), the former readily to be distinguished from the latter by the reduction in the number of the nervures of the hindwings, &c. Most of these genera (and subgenera) as used by Heylaerts appear to be heterogeneous and heterotypical, so that his *Oreopsyche* and *Psyche* become respectively synonymous with *Oreopsychidi* and *Psychidi* as defined by Chapman.

Heylaerts' diagnosis of *Oreopsyche* (= *Oreopsychidi*) reads as follows:

Antennes bipectinées jusqu 'au sommet, à barbules très longues formant panache. Les ailes antérieures n'ont que neuf à dix nervures marginales et les postérieures n'en ont que cinq. Les tibias antérieurs n'ont pas une épine tibiale..	*Oreopsyche*, Speyer.
α. Les ailes sont plus ou moins transparentes	*Hyalina*, Rbr.
β. Les ailes sont opaques	*Scioptera*, Rbr.

Speyer notes (*Stett. Ent. Zeit.*, 1865, p. 250) that his *Oreopsyche* corresponds with Herrich-Schäffer's division v (*Sys. Bearb.*, ii., p. 21), and is by him essentially characterised in the diagnosis: "Alae posteriores cellula media bipartita, costis 5, anterioribus 9-10." In addition, however, to this simplicity in the neuration, it is also characterised by the unusually long antennal pectinations, which, in the middle of the shaft, are half as long as the whole antenna, thin, threadlike, and but little shortened towards the apex. The body is clothed with long hairs, and the especially long hairs of the head form a frontal tuft directed forwards and downwards. The wings are entirely devoid of scales, clothed with fine appressed hairs, the wing-membrane either as clear as glass (*muscella*, *angustella*, &c.), or more or less dark-coloured—smoky-grey to deep-black—(*plumistrella*, *tenella*, &c.). The fringes are relatively long (compared with other Psychids), longest round the inner angle, and consist of fine hairs not very closely placed. The bifurcation of the dorsal nervure of the forewings (characteristic of the genus *Psyche*, H.-Sch.) occurs not far from its commencement, at one-third of the length, or still earlier. *Oreopsyche*, then, is characterised by the following:

(1) The lesser number of nervules arising out of the median cell.
(2) Seven or eight on forewings, with four (or exceptionally five) on the hindwings.
(3) By the simply divided median cell of the hindwings.
(4) By the length of the antennal pectinations.

But within the group there are considerable differences in respect of habitus, build of body in relation to wings, and in the form of the wings. On these grounds the group is divided into three sections:

(1) Body robust; forewings triangular; hindwings much shorter, rounded; seven separate nervules from median cell of forewing—*albida*, Esp.

(2) Body robust; abdomen very shaggy; forewings elongate with very rounded angles; eight nervures from median cell (in *muscella* that from front of cell sometimes imperfect), all separate or six and seven from one point or stalk—*tabanella*, Brd., *angustella*, H.-S. (*atra*, Esp.), *muscella*, W. V., *plumifera*, O., *mediterranea*, Led., *hirsutella*, W.V. (*schiffermilleri*, Staud.). The more slender body of *schiffermilleri* makes it a transitional form to the following group.

(3) Body slender; forewings with eight nervures from median cell, six and seven on a common stalk—*plumistrella*, Hb., *tenella*, Spey.

Speyer noted the second of these groups as typical *Oreopsyche*, *i.e.*, the group containing *angustella*, H.-S. (*atra*, Esp.).

The following year (1866) Rambur divided (*Lép. Andalousie*, p. 307) this same (*atra*) group (to which as a whole he applied the name *Ptilocephala*, citing *atra*, Esp., as the type) into three sections:

(1) *Atra.*, Esp., *sicheliella*, Brd., *hirsutella*, S.V., *muscella*, Hb., *plumifera*, Ochs., *mediterranea* (Led., *massilialella*, Brd.).
(2) *Tabanella*, Brd., *kahri*, Led.
(3) *Albida*, Esp., *plumosella*, Rbr., *malvinella*, Mill.

This third group Rambur names (*Ibid*, p. 310) *Hyalina*, whilst *plumistrella* is given as the type of *Scioptera*.

In 1879 Standfuss divided (*Zeits. Ent. Bresl.*, n.s., vol. vii., p. 41) the Oreopsychids into four sections (retaining Speyer's name *Oreopsyche*), as follows:

(1) *Tenella*, Spr.
(2) *Plumistrella*, Hb.
(3) *Schiffermilleri*, Staud., *pyrenaella*, H.-S. (*tabanivicinella*, Brd.), *vesubiella*, Mill., *atra*, Esp., *muscella*, Hb., *fulminella*, Mill., *mediterranea*, Led., *gondebautella*, Mill. (*sicheliella*, Brd.), *plumifera*, Ochs. (*siculella*, Brd.), *kahri*, Led.
(4) *Silphella*, Mill., *leschenaulti*, Staud., *malvinella*, Mill., *albida*, Esp.

All these groups except the *tenella* group have already been placed in different genera. Standfuss diagnoses this as:

Antennæ ½ longitudinis alarum attingentes; plumulis longis. Alae pellucidæ vel opacæ, pro corpore maximæ, pilis obtectæ et circumdatæ. Corpus gracillimum, corpore affinium rarius lanuginosum—*tenella*, Spr.

It appears quite clear that *tenella* and *zermattensis* are further removed from *Scioptera plumistrella* than is the latter from *Leptopterix schiffermilleri*, and as these groups have all been adequately diagnosed by Standfuss we would call the *tenella* section *Standfussia*, and cite *tenella* as the type.

Before discussing the synonymy of the above divisions, we may state the suspicion that the tribe *Oreopsychidi* should be called the *Phalacropterygidi*, since this appears to be the oldest group name for the tribe. Hübner about 1825 (*vide*, *ante* p. 265) suggested *Phalacropterices* as a group name, consisting of the genus *Phalacropterix*, with *vitrella* (*albida*), *fucella* (*apiformis*), and *muscella*. This genus he diagnosed as: "Wings almost naked and transparent as far as the margin." It is pretty clear then that Hübner intended this name for the transparent-winged group (*Oreopsychidi*), and although one may call *apiformis* moderately transparent, the description applies much more strongly to *albida* and *muscella*, which are almost scaleless over the greater part of the wings, and it must be considered as particularly referring thereto. There can be no doubt that *Phalacropterix* is heterotypical, for *apiformis* is an Empedopsychid, and Rambur, in 1866, proposed (*Cat. And.*, p. 301) for this species and *graslinella* the name of *Arctus*, whilst, as we have already stated, he further erected (ibid, p. 310) the genus *Hyalina* for *albida*, its var. *plumosella*, and *malvinella*, so that this leaves *muscella* (an Oreopsychid) the residuary type of *Phalacropterix*, Hb.

One other synonymic difficulty remains. Hübner's genus *Leptopterix* was erected (*vide*, *ante*, p. 265) for *viciella* and *schiffermilleri*, Staud. (=*hirsutella*, S.V. *nec* Hb.); but these are heterotypical and we shall show a little later that *viciella* is the type of *Psyche*, Schrk., so that *schiffermilleri* becomes the residuary type of *Leptopterix*. This species Heylaerts groups with *plumistrella*, Hb., and *tenella*, Spr., in the genus

Scioptera, Rbr., of which *plumistrella* is undoubtedly the type (being the only species named by Rambur). If, therefore, *schiffermilleri* and *plumistrella* were really congeneric, it is clear that *Scioptera*, Rbr., would fall before *Leptopterix*, Hb., but Speyer, Rambur and Standfuss are agreed that these belong to different groups, hence *schiffermilleri* is properly referred to *Leptopterix* and *plumistrella* to *Scioptera*, Rbr.

The work of the authors already considered evidently gives us the following generic titles, for application to the Oreopsychid species:

Phalacropterix, Hb. (*cir.* 1825), with *muscella*, Hb., as type.
Oreopsyche, Speyer (1865), with *tabanella*, Brd., as type.
Ptilocephala, Rbr. (1866), with *angustella*, H.-S. (*atra*, Esp.), as type.
Hyalina, Rbr. (1866), with *albida*, Esp., as type.
Scioptera, Rbr. (1866), with *plumistrella*, Hb., as type.
Leptopterix, Hb. (*cir.* 1825), with *schiffermilleri*, Staud. (*hirsutella*, W.V.), as type.
Standfussia, n. gen., with *tenella*, Hb., as type.

As we have said, Speyer notifies his section 2 as being typical of *Oreopsyche*. This Rambur subdivides, calling the first part typical *Ptilocephala* and citing *atra*, Esp. (=*angustella*, H.-Sch.), as the type, leaving the second part (*tabanella* and *kahri*) unnamed. We suspect, therefore, that *tabanella* remains the type of *Oreopsyche*, Speyer. We do not propose to enter further into the matter here, now that we have shown what genera are available for the tribe. The grouping appears to fall roughly, according to these authors, as follows:

Hyalina—*vesubiella*, *albida* and its var. *lorquiniella*, *millieriella*, *malvinella* and its var. *abencerragella*, *leschenaulti* and its var. *nigricans*, *silphella*.
Phalacropterix—*muscella*.
Oreopsyche—*pyrenaella* (=*tabanella*), *kahri*.
Ptilocephala—*angustella*, H.-Sch. (*atra*, Esp.) *siculella*, *sicheliella*, *fulminella*, *mediterranea*, *gondebautella*, *atra*, Linn. (=*plumifera*, Ochs.).
Leptopterix—*schiffermilleri*.
Scioptera—*plumistrella*.
Standfussia—*tenella*, *zermattensis*.

Wallengren in 1869 grouped the Oreopsychids (*i.e.*, Phalacropterygids) into one genus, which he terms *Carchesiopsyche* and defines as "costa subcostalis alarum posticarum omnino nulla." The species included are, *plumifera*, *muscella*, *angustella*, *plumistrella*, and *schiffermilleri* (*hirsutella*, W. V.), all of which are provided with earlier generic names.

The Oreopsychids resemble the *Psychidi* in having no anterior tibial spine and in the possession of well-scaled antennal pectinations. The latter are very long in the Oreopsychids and the neuration is somewhat more specialised, and like most of the tribal divisions of the Psychids—some of the genera consist of species with wide, delicate wings, others containing more robust species with shorter, stouter wings, but often almost unclothed. Speyer says that the Oreopsychids are essentially confined to the mountains—several (*Leptopterix schiffermilleri*, *Ptilocephala angustella* (*atra*), *Scioptera plumistrella*, and *Standfussia tenella*) dwell on the high alps up to the limits of perpetual snow, the males flying in the morning sunshine. Their home is predominantly in southern Europe, but *Phalacropterix muscella* reaches Livonia (*teste* Lienig) and *Ptilocephala plumifera* (which has proved to be the *atra* of Linné) has been taken at Wolfhagen in Gelderland by Snellen.

According to Heylaerts the Empedopsychids or *Psychidi* consist of three very distinct groups, which he refers to *Megalophanes*, Heyl., *Gymna*, Rbr., and *Stenophanes*, Heyl. These he terms subgenera (making them sections of the genus *Psyche*, Schrank), and defines them as follows:

Antennes bipectinées jusqu 'au sommet, à barbules plus ou moins longues. Les tibias antérieurs n'ont pas une épine tibiale	*Psyche*, Schrank.
(α) Les ailes antérieures très larges et à angles très arrondis. Les barbules des antennes assez longues	*Megalophanes*, Heyl.
(β) Les ailes antérieures larges, mais pourtant plus allongées. Les barbules des antennes très courtes	*Gymna*, Rbr.
(γ) Lee ailes antérieures allongées, mais assez étroites. Les barbules des antennes plus ou moins épaissies à leur sommet	*Stenophanes*, Heyl.

The first of these subdivisions, *Megalophanes*, Heyl., includes among other species, *viciella*, S.V., the species that has since been determined by Kirby as the type of Schrank's *Psyche*, a heterotypical genus containing—*graminum*, *viciae* (=*viciella*), *carpini*, *agrostidis* (=*atra*, *teste* Heylaerts), *lichenum*, *quercûs* (*xylophthorum*, Pallas), and *pruni*—of which Schrank did not know the two last-named in nature. In 1809, Latreille restricted (*Gen. Crust.*, iv., p. 219) the genus *Psyche* to *hieracii* (=*unicolor*), *viciella*, and *muscella* (by name, although he adds "etc."), but Hübner had already in 1806 (*Tent.*, p. 2) fixed *unicolor* as the type of *Canephora*, so that the type of *Psyche* was restricted to *viciella* or *muscella*. Of these *muscella* is Oreopsychid, and, moreover, is not included in the genus by Schrank, besides being as we have already shown (*ante*, p. 415) the type of *Phalacropterix*, so that this left *viciella* the residuary type of *Psyche*. Unless, therefore, *Megalophanes*, Heyl., be heterotypical, this genus falls as a synonym of *Psyche*, Schrank, whilst *Gymna*, Rbr., falls as a synonym of *Sterrhopterix*, Hb., for there can be no doubt whatever that *Sterrhopterix* is the proper generic title for *hirsutella*, Hb. At the same time, as we have already stated (*ante*, p. 415), Rambur created the genus *Arctus* for *apiformis* and *graslinella*, two of the typical species of Heylaerts' *Stenophanes*. This being so, the latter genus falls before *Arctus*, Rbr. Hence it would appear that, if Heylaerts' divisions (*suprà*) of the *Psychidi* be sound, the proper generic appellations would be *Psyche*, *Sterrhopterix*, and *Arctus* respectively, *Psyche* replacing *Megalophanes*, *Sterrhopterix* replacing *Gymna*, and *Arctus* replacing *Stenophanes*.

The genus *Psyche* of Wallengren, which he diagnoses as "Alæ diaphanæ pilosulæ," is quite heterotypical, for he includes therein not only *viciella* and *stetinensis*, which belong to *Psyche*, but *Stenophanes graslinella*, *Acanthopsyche opacella*, and *Pachythelia villosella*, whilst *Sterrhopterix hirsutella* (*fusca*) is separated on account of the "costa subcostalis tota libera, nec cum costa mediana per costam transversam connexa," under the name *Trichopsyche*.

Like the *Oreopsychidi*, the *Psychidi* contain species with scaled antennules, bipectinated antennæ, the anterior tibiæ without spurs, and both tribes also contain sections comprised of robust and slenderly built species respectively (*ante*, p. 274). In the *Psychidi* the species of *Stenophanes* are robust with somewhat narrow wings, whilst those of *Psyche* and *Sterrhopterix* are more slenderly built, have wide and ample wings, the former with very long, the latter with very short, antennal pectinations.

We have no Oreopsychids in Britain, and of the true Psychids only one species, *Sterrhopterix hirsutella*, Hb., which is exceedingly local and has of late years been very rarely captured.

Tribe: Psychidi.

Genus: Sterrhopterix, Hübner.

Synonymy.—Genus: *Sterrhopterix*, Hb., "Verz. bek. Schmett.," p. 399 (1825); Kirby, "Cat. Lep. Het.," p. 516 (1892); Meyr., "Handbook," p. 444 (1895). *Tinea*, Hb., "Eur. Schmett.," p. 14 (1796). *Nudaria*, Haw., "Lep. Brit.," pt. 2, p. 157 (1809). *Psyche* (*in part*), Ochs., "Die Schmett.," iii., p. 171 (1810); Zink., "Germ. Mag. Ent.," i., p. 35 (1813); Stephs., "Ill. Brit. Ent.," ii., p. 80 (1829); Meig., "Eur. Schmett.," iii., p. 10 (1832); Bdv., "Gen. Ind. Meth.," p. 79 (1840); Dup., "Hist. Nat.," supp. iv., p. 68 (1842); "Cat. Méth.," p. 65 (1844); Hdrch., "Sys. Verz.," 2nd ed., p. 6 (1846); 3rd ed., p. 24 (1851); Seyff., "J.-H. Ver. Vat. Nat. Württ.," v., p. 97 (1850); Hein., "Stett. Ent. Zeit.," xii., p. 62 (1851); "Schmett. Deutsch.," i., p. 180 (1859); Led., "Verh. z.-b. Ges. Wien," ii., *abh.* p. 73 (1852); Bruand, "Mon. des Psych.," p. 71 (1853); Reutti, "Lep. Bad.," 1st ed., p. 47 (1853); 2nd ed., p. 307 (1898); Wocke, "Cat. Lep. Sil.," p. 2 (1853); "Zeit. Ent. Bresl.," iii., p. 25 (1872); Koch, "Schmett. S.-W. Deutsch.," p. 70 (1856); Freyer, "Neu. Beiträge," vii., p. 92 (1856); Müll., "Lotos," vi., p. 145 (1856); Sta., "Man.," i., p. 166 (1857); Moesch., "Neu. Laus. Mag.," xxxiv., p. 271 (1858); Spey., "Geog. Verb. Schmett.," i., p. 305 (1858); ii., p. 278 (1862); Bert., "Pollichia," 1859, p. 308; Hofm., "Berl. Ent. Zeits.," iv., p. 17 (1860); Stoll., "Ver. N.-H. Ver. Preuss. Rheinl.," xvii., pp. 43, 76 (1860); Kef. and Wrnbg., "J.-B. Ak. Erfurt," i., p. 144 (1860); Now., "Enum. Lep. Hal. Or.," p. 30 (1860); Wilde, "Zeits. Nat. Halle," xv., p. 306 (1860); "Pflanz. Raup. Deutsch.," ii., p. 72 (1861); Staud., "Cat.," 1st ed., p. 27 (1861); 2nd ed., p. 64 (1871); "Rom. Mém.," vi., p. 302 (1892); Kell. and Hoffmn., "J.-H. Ver. Vat. Nat. Württ.," xvii., p. 288 (1861); Nick., "Lotos," xi., p. 154 (1861); Schmidt, "Schr. Ges. Königsbg.," iii., p. 73 (1862); Wernbg., "Beit.," i., pp. 372, 377; ii., p. 130 (1864); Cooke, "Merrifield's Brighton," p. 213 (1864); Const., "Cat. Lép. Saone," p. 90 (1866); Röss., "J.-B. Ver. Nat. Nass.," xix-xx., p. 139 (1866); Snell., "De Vlind.," p. 122 (1867); "Tijd. v. Ent.," p. 89 (1870); Nolck., "Lep. Fn. Est.," p. 120 (1867); Tgstrm., "Not. Sällsk.," x., p. 300 (1869); Stange, "Verz. Halle Schm.," p. 18 (1869); Heyl., "Tijd. v. Ent.," xiii., p. 148 (1870); "Sepp's Ned. Ins.," (2), iii., p. 79 (?1872); Meur., "Schmett. Rudol.," p. 31 (1874); Glitz, "J.-B. Ges. Han.," xxiv., p. 36 (1874); Guén., "Lép. Eure-et-Loir," p. 56 (1875); Fouc., "Mém. Soc. Agric. Nord," (2), xii., p. 519 (1875); Curò, "Bull. Soc. Ent. Ital.," viii., p. 144 (1876); Schn., "Siebke Enum. Ins. Norv.," p. 35 (1876); Sint., "Arch. Nat. Liv.," (2), vii., p. 335 (sep. p. 15) (1876); Zell., "Stett. Ent. Zeit.," 1877, p. 935; Weil., "Schmett. Innsb.," p. 15 (1877); Mill., "Iconog.," p. 206 (1877); Rozsay, "Cat. Lep. Pos.," p. 8 (1878); Sand, "Cat. Lép. Auv.," p. 31 (1879); Tur., "Bull. Soc. Ent. It.," xi., p. 170 (1879); Rehb., "Abh. Nat. Ver. Brem.," vi., p. 467 (1879); Pfütz., "Deutsch. Ent. Zeits.," xxiii., p. 37 (1879); Frey, "Lep. der Schweiz," p. 90 (1880); Schmidt, "Arch. Meckl.," xxxiii., p. 63 (1880); Peyer., "Cat. Lép. Als.," 2nd ed., p. 58 (1880); Fiori, "Bull. Soc. Ent. It.," xii., p. 214 (1880); Röss., "J.-B. Ver. Nat. Nass.," xxxiii-xxxiv., p. 67 (1881); Husz, "Magy. Karp. Evkön.," viii., pp. 251, 283 (1881); Herng., "Stett. Ent. Zeit.," xlii., p. 154 (1881); Hell., "Ber. Ver. Innsb.," xi., p. 90 (1881); Ersch. and Feild, "Trudy Ross.," xii., p. 203 (1881); Kill., "J.-B. Nat. Ges. Graub.," xxxiii-xxxiv., p. 64 (1881); Donck., "Ann. Soc. Ent. Belg.," xxvi., p. 27 (1882); Jourd., "Mém. Soc. Aube," xlvii., p. 45 (1883); Klem., "Sprawoz. Komis. Fizy.," xvii., p. 205 (1883); Hom., "Stett. Ent. Zeit.," xlv., p. 423 (1884); Krieg., "Mitt. Geog. Ges. Thür.," iii., p. 120 (1885); Schmid., "C.-B. Nat. Ver. Regensbg.," xxxix., p. 83 (1885); Lampa, "Ent. Tids.," v., p. 38 (1885); Jord., "Schmett. Göttingens," p. 43 (1885); "Schmett. N.-W. Deutsch.," p. 94 (1886); Zimm., "Verh. Ver. Nat. Hamb.," vi., p. 21 (1887); Rühl, "Soc. Ent.," ii., p. 53 (1887); v., p. 153 (1891); Pet., "Btr. Kennt. Reuss. Reich.," (3), iv., p. 85 (1888); Auriv., "Nord. Fjär.," p. 59 (1887); Teich, "Arb. Nat. Ver. Riga," vi., p. 20 (1889); Pabst, "Iris," iii., p. 120 (1890); Wack., "Stett. Ent. Zeit.," li., p. 221 (1890); Ries., "Stett. Ent. Zeit.," lii., p. 360 (1891); Brown, "Act. Soc. Linn. Bord.," xlv., p. 55 (1892); Teich, "Arb. Nat. Ver. Riga," vi., p. 7 (1893); Hoffmn., "Stett. Ent. Zeit.," liv., p. 125 (1893); Werch., "Spraw. Komis. Fizy.," xxviii., p. 203 (1893); Paux, "Rev. Biol. Nord," v., p. 321 (1893); Klem., "Verh. z.-b. Ges. Wien," xliv., p. 177 (1894); Carad., "Iris," viii., p. 87 (1895); Lutz., "K.-B. Ver. Riga," xxxix., Bomb. no. 47 (1896); Schütze, "Iris," ix., p. 334 (1896); Bonj. "Bull. Soc. Ouest France," vii., p. 192

(1897). *Fumea*, Sel.-Long., "Enum. Lép. Belg.," p. 9 (1844). *Sterrhoptryx*, Humph. and West., "Brit. Moths," i., p. 83 (1851). *Trichopsyche*, Wallgrn., "Skand. Het.," p. 51 (1863); Garb., "S.-B. Akad. Wiss. Wien," ci., p. 933 (1892). *Gymna*, Ramb., "Cat. Lép. And.," p. 304 *note* (1866); Heyl., "Ann. Soc. Ent. Belg.," xxv., p. 70 (1881); "Comp. Ren. Soc. Ent. Belg.," 1884, p. 8 (1884); "Rom. Mém.," ii., p. 193 (1885). *Empedopsyche*, Standf., "Zeit. Ent. Bresl.," (2), vii., p. 38 (1879). *Epichnopteryx*, Paul and Plötz, "M. T. N.-W. Ver. Neu. Pomm.," iv., p. 68 (1873); Barr., "Ent. Mo. Mag.," xxx., p. 249 (1894); "Brit. Lep.," ii., p. 344 (1895); Robs., "Lep. North. and Durham," p. 76 (1899).

Hübner's diagnosis of the genus (*Verz. bek. Schmett.*, p. 399) reads as follows:

Die Flügel ziemlich ansehnlich und beschüppelt; der Wanst schlang, am Bauche behaart.—3844. *Sterrhopterix vestitella*, Fab. =*graminella*, Hb. 3845. *S. calvella*, Ochs. =*hirsutella*, Hb., fig. 3 (2 by error)."

Since *graminella*, Hb., is the type of *Canephora*, Hb., *Tent.*, p. 2 (the insect standing there as *Canephora graminella*), it leaves *hirsutella*, Hb. = *calvella*, Ochs., as the type of *Sterrhopterix*. We have already shown (*ante*, p. 417) that *Gymna*, Rbr., and *Trichopsyche*, Wallgrn., are synonymous with *Sterrhopterix*, Hb. Two species only are, as a rule, referred to this genus—*hirsutella*, Hb., and *standfussi*, H.-Sch. The genus may be diagnosed as follows:

Ovum.—Oval, surface smooth.

Case.—Roughly cylindrical, composed of loose white silk, covered irregularly with pieces of plant *débris*, the anterior portion with small pieces of vegetable matter, the posterior end unclothed; the cast skin often attached to posterior end.

Larva.—Head flattened; depressed medially on crown; surface rough; antennæ two-jointed; retractile. Prothorax with large pale corneous shield; prothoracic spiracle at middle of segment; mesothoracic and metathoracic (divided medially) shields rather smaller; lateral shield separate from dorsal; intersegmental membranes form large and loose folds of skin; dorsal setæ on front edge of segments; abdominal segments with well-marked incisions; small dorsal plate on 1st abdominal; dorsal setæ on corneous plates, i outside, ii nearer medio-dorsal line; setæ strong; spiracles with well-developed rim, not raised; the lateral flange well marked; prolegs inconspicuous, with incomplete oval of hooks.

Pupa.—♂. Short, stout; wings broad, to middle of 4th abdominal segment, third pair of legs just beyond but not soldered; abdominal segments 3—7 free; proleg scars distinct; anus bluntly rounded; two large ventro-anal hooks; spiracles large, placed towards anterior edge of segments; anterior dorsal spines pronounced on segments 4-8; posterior intersegmental spines on 3-(?)7 well marked; tubercular setæ as in larva; antennæ very broad with distinct pectinations; eye and cheek parts very dark; labrum square; mandibles long and narrow; labium large, square; maxillæ broader than long; first femora with basal division marking off ? coxa. ♀. Head, thoracic segments and last three abdominal segments brown, intermediate segments black; labium, labrum and legs mere chitinous surface irregularities; wings marked by waved lateral lines; proleg scars very marked; spiracles polished; traces of lateral flange.

Imago.—♂. Forewings ample, sparsely covered with irregularly placed hair-scales (longer and broader with two or three striæ near fringes); no "haftfeld"; hindwings regularly rounded, with no marginal notch at nervure 2; antennæ with 19 joints, bipectinated from third to tip, clavola and pectinations covered dorsally with hair-scales; ventrally they have sense hairs (small compared with *Acanthopsyche*); pectinations notched for origin of hairs and scales; legs with long hairs on femur, otherwise sparsely clothed with fine bristles; no anterior or posterior tibial spurs. ♀. Head much retracted; eyespots black; thorax corneous, with ill-marked segmental incisions; antennæ two-jointed.

Neuration.—Forewing with 1*a* very ill-developed, not traceable forwards to 1*b*.

Sterrhopterix hirsutella, Hübner.

Synonymy.—Species: *Hirsutella*, Hb., "Eur. Schmett.," fig. 3, p. 14 (1796); Staud., "Cat.," 2nd ed., p. 64 (1871); "Rom. Mém.," vi., p. 302 (1892); Wocke, "Zeit. Ent. Bresl.," iii., p. 25 (1872); Heyl., "Sepp's Ned. Ins.," (2), iii., p. 74 (? 1872); "Ann. Soc. Ent. Belg.," xxv., p. 171 (1881); "Comp. Ren. Soc. Ent.

Belg.," xxviii., p. xcii (1884); "Rom. Mém.," ii., p. 193 (1885); Meur., "Schmett. Rudol.," p. 31 (1874); Glitz, "J.-B. Ges. Han.," xxiv., p. 36 (1874); Foucart, "Mém. Soc. Agric. Nord," (2), xii., p. 519 (1875) (sep. p. 23) (1876); Curò, "Bull. Soc. Ent. Ital.," viii., p. 144 (1876); Schneid., "Siebke Enum. Ins. Norv.," p. 35 (1876); Sint., "Arch. Nat. Liv.," (2), vii., p. 335 (sep. p. 15) (1876); Zell., "Stett. Ent. Zeit.," xxxviii., p. 435 (1877); Weil., "Schmett. Insnb.," p. 15 (1877); Rozs., "Cat. Lep. Poson," p. 8 (1878); Sand, "Cat. Lép. Auv.," p. 31 (1879); Stand., "Zeit. Ent. Bresl.," vii., pp. 22, 59 (1879); Tur., "Bull. Soc. Ent. Ital.," xi., p. 170 (1879); Rehb., "Abh. Nat. Ver. Brem.," vi., p. 467 (1879); Pfütz., "Deutsch. Ent. Zeit.," xxiii., p. 37 (1879); Schmidt, "Arch. Mecklenb.," xxxiii., p. 63 (1880); Peyer., "Cat. Lép. Als.," 2nd ed., p. 58 (1880); Rössl., "J.-B. Ver. Nat. Nass.," xxxiii-iv., p. 67 (1881); Husz, "Magy. Karp. Evkön.," viii., pp. 251, 283 (1881); Herng., "Stett. Ent. Zeit.," xlii., p. 154 (1881); Hell., "Ber. Ver. Innsb.," xi., p. 90 (1881); Ersch. and Feild, "Trudy Ross.," xii., p. 203 (1881); Kill., "J.-B. Nat. Ges. Graubünden," xxiii-iv., p. 64 (1881); Donck., "Ann. Soc. Ent. Belg.," xxvi., p. 27 (1882); Jourd., "Mém. Soc. Aube," xlvii., p. 45 (1883); Krieg., "Mitt. Geog. Ges. Thür.," iii., p. 120 (1885); Schmid, "C.-B. Nat. Ver. Regensb.," xxxix., p. 83 (sep. p. 35) (1885); Lampa, "Ent. Tids.," vi., p. 39 (1885); Jord., "Schmett. Göttingens," p. 43 (1885); "Schmett. N.-W. Deutsch.," p. 94 (1886); Zimm., "Verh. Ver. Nat. Hamb.," vi., p. 21 (1887); Rühl, "Soc. Ent.," ii., p. 53 (1887); v., p. 153 (1891); Pet., "Btr. Kennt. Reuss. Reich.," (3), iv., p. 85 (1888); Auriv., "Nord. Fjär.," p. 59 (1889); Teich, "Arb. Nat. Ver. Riga," vi., p. 20 (1889); "Nachtr.," p. 7 (1893); Pabst, "Iris," iii., p. 120 (1890); Wack., "Stett. Ent. Zeit.," li., p. 221 (1890); Ries., "Stett. Ent. Zeit.," lii., p. 360 (1891); Brown, "Act. Soc. Linn. Bord.," xlv., p. 55 (1892); Kirby, "Cat. Lep. Het.," p. 516 (1892); Hoffm., "Stett. Ent. Zeit.," liv., p. 125 (1893); Werch., "Sprawoz. Komis. Fizy.," xxviii., p. 203 (1893); Paux, "Rev. Biol. Nord," v., p. 321 (1893); Klem., "Verh. z.-b. Ges. Wien," xliv., p. 177 (1894); Carad., "Iris," viii., p. 87 (1895); Meyr., "Handbook," pp. 444-445 (1895); Lutz., "K. B. Ver. Riga," xxxix., no. 47 (1896); Schütze, "Iris," ix., p. 334 (1896); Bonj., "Bull. Soc. Ouest Fr.," vii., p. 192 (1897); Reutti, "Lep. Bad.," p. 307 and *footnote* (1898); [*nec hirsutella*, Dup. (? = *atra*, Esp.), *nec hirsutella*, Ochs., H.-Sch., Bruand (=*schiffermilleri*, Staud.)]. *Fusca*, Haw., "Lep. Brit.," ii., p. 157 (1809); Stphs., "Ill. Brit. Ent.," ii., p. 80, pl. xviii., figs. 3-4 (1829); Curt., "Brit. Ent.," expl. pl. 332 (1830); Humph. and West., "Br. Moths," p. 83, pl. xvi., figs. 16-17, *nec* fig. 28 (1851); Sta., "Man.," i., p. 166 (1857); Mitfd., "Zool.," p. 7453 (1861); Staud., "Cat.," 1st ed., p. 27 (1861); Wallgrn., "Skand. Het.," p. 51 (1863); Const., "Cat. Lép. Saone," p. 90 (1866); Rössl., "J.-B. Ver. Nat. Nass.," xix-xx., p. 139 (1866); Snell., "De Vlind.," p. 122 (1867); "Tijd. v. Ent.," xiii., p. 89 (1870); Nolck., "Lep. Fn. Est.," p. 120 (1867); Tgstrm., "Not. Sällsk. F. F. F.," x., p. 300 (sep. p. 10) (1869); Stange, "Verz. Halle Schmett.," p. 18 (1869); Heyl., "Tijd. Ent.," xiii., p. 148 (1870); ? Fiori, "Bull. Soc. Ent. Ital.," xii., p. 214 (1880); Hom., "Stett. Ent. Zeit.," xlv., p. 423 (1884). *Calvella*, Ochs., "Die Schmett.," iii., p. 171 (1810); Zink., "Germ. Mag. Ent.," i., p. 35 (1813); Hb., "Verz.," p. 399, no. 3835 (? 1825); ? Zell., "Isis," 1840, p. 207; Bdv., "Gen. Ind. Meth.," p. 79 (1840); Dup., "Hist. Nat.," supp. iv., p. 68, pl. lvi., fig. 7 (1842); "Cat. Lép.," p. 65 (1844); Sel.-Long., "Enum. Lép. Belg.," p. 9 (1844); Heyd., "Syst. Verz.," 2nd ed., p. 6 (1846); 3rd ed., p. 24 (1851); Seyff., "J.-H. Ver. Vat. Nat. Württ.," v., p. 97 (1850); Hein., "Stett. Ent. Zeit.," xii., p. 62 (1851); Led., "Verh. z.-b. Ges. Wien," ii., *abh.* p. 73 (1852); Brd., "Mon. Psych.," p. 71, pl. ii., figs. 47 *a-e* (1853); Reutti, "Cat. Lep. Bad.," 1st ed., p. 47 (1853); Wocke, "Cat. Lep. Sil.," p. 2 (1853); Koch, "Schmett. S.-W. Deutsch.," p. 70 (1856); Freyer, "Neu. Beit.," vii., p. 92, pl. 653, fig. 2 (1856); H.-Sch., "Neu. Schmett.," p. 7 (1856); figs. 4-5 (1861); Müll., "Lotos," vi., p. 145 (1856); Moesch., "Neu. Laus. Mag.," xxxiv., p. 271 (1858); Spey., "Geog. Verb. Schmett.," i., p. 308 (1858); ii., p. 278 (1862); "Stett. Ent. Zeit.," xxiii., p. 168 (1862); Hein., "Schmett. Deutsch.," i., p. 180 (1859); Bert., "Pollichia," 1859, p. 308 (1859); Hofm., "Berl. Ent. Zeits.," iv., p. 17 (1860); Kef. and Wernbg., "J.-B. Ak. Erfurt," i., p. 144 (1860); Now., "Enum. Lep. Hal. Or.," p. 30 (1860); Wilde, "Zeits. Nat. Halle," xv., p. 306 (1860); "Pflanz. Raup. Deutsch.," ii., p. 72 (1861); Kell. and Hoffm., "J.-H. Ver. Vat. Nat. Württ.," xvii., p. 288 (1861); Nick., "Lotos," xi., p. 154 (1861); Schmidt, "Schr. Ges. Königsb.," iii., p. 73 (1862); Wernbg., "Beiträge," i., pp. 372, 377; ii., p. 130 (1864); Cooke, "Merrifield's Brighton," p. 213 (1864); Hint., "Zeit. Ferdinand.," (3), xiii., p. 232 (1867); Guén., "Lép. Eure-et-Loir," p. 56 (1875); Merr., "Lep. Cal.," 2nd ed., pp. 55, 67, 82, 100, 147 (1875); Frey, "Lep. der Schweiz," p. 90 (1880); Klemen., "Spraw. Komis. Fizy.," xvii., p. 205 (1883);

Garb., "S. B.-Akad. Wiss. Wien, &c.," ci., p. 933 (1892); Barr., "Ent. Mo. Mag.," xxx., p. 249 (1894); "Brit. Lep.," ii., p. 344 (1895); Robs., "Lep. North. and Durham," p. 76 (1899). *Fuscella*, Meig., "Eur. Schmett.," iii., p. 10, pl. 88, fig. 10 (1832).

Original description.—Halbdurchsichtige Schabe. *Tinea hirsutella*. Fig. 3 mas. *Hirsutella*, S.V.—Diese ist etwas kleiner als Vorige (*T. viciella*). Das Männchen hat im Verhältniss gegen jene einen schlangern Leib und grössere, zärtere, einigermassen durchsichtige, blassgefärbte Flügel, und das Weibchen ist merklich kleiner als selbige. Sie wird in hiesiger Gegend mit der *graminella*, doch viel seltner angetroffen (Hübner, *Eur. Schmett.*, &c., p. 14).

Imago.—Anterior wings broad; 18·5mm.-25mm. in expanse; apex rounded, dark grey, and moderately clothed with fine hair-scales when fresh (paler grey, inclining to brownish when faded), semi-transparent, unicolorous, nervures distinct, but scarcely darker, fringes unicolorous. Posterior wings and fringes unicolorous, of the same tint as the forewings.

Neuration.—Bruand notes that in the male of this species the internal nervure of the forewings is still bifurcate, but the bifurcation does not reach the lower margin. This species, therefore, forms a natural passage from the species with the inner nervure bifurcate and those in which it is simple. Standfuss says that it has not been hitherto noticed that, of the long stalked nervures, 8 and 9, of the forewings, very often the one branch and sometimes the other, often on one wing but occasionally on both, is absent. Heylaerts notes that there are, in the forewings of many specimens eleven nervures, in others twelve. The median cell is divided; nervures 4 and 5, 7 and 8 are stalked; 6 is the continuation of the nervure that divides the middle cell. In the hindwings also the middle cell is divided, the transverse nervure runs perpendicularly, afterwards obliquely outwards; nervures 4 and 5 are stalked; 6 runs here below the longitudinal nervure which divides the middle cell, whilst 8 independently starts from the base.

Sexual dimorphism.—♂. The peculiar smoky look of the *male* seems to depend on the coloration of the wing-membrane as well as on the dark hair-scales with which the wing is very sparsely scaled. They are very irregularly placed on the wing, and are perhaps 6-10 of their diameters apart, it being difficult in their irregular placing to say which two hair-scales it is fair to measure between. On the wing-surface they are about ·15mm. long and quite hair-like, towards the fringes they get longer and broader, so that two or even three striæ may be counted on some of them, though even here they are rather hair-scales than scales, if such a distinction is to be drawn. No spined area (haftfeld) apparently exists. A curious structure seen in some Psychids is very well marked here, which one might begin, probably erroneously, by calling an extension of the wing margin, from its inner base along the side of the thorax backwards, quite beyond and behind the origin of the nervures. The portion examined is about ·5mm. long and perhaps ·04mm. wide, and looking very like a long tube, with alternate constrictions or expansions like a camera tube or a Chinese lantern, and connected with the thoracic wall by a delicate membrane; it carries a few scales. In the neuration, 1*a* of the forewing is very ill-developed and cannot be traced forwards to 1*b* with any certainty. The margin of the hindwings is regularly rounded with no trace of notch at nervure 2. The antennæ are about 3mm. long, and consist of 19 joints, the first large and urn-shaped, the second urn-shaped but smaller and more globular, the third very short and with very short pectinations; the latter reach their full length on about segment 7 and diminish from about segment 16; the last segment may or may not carry pectinations, but usually does so; from 3 to 16 the joints gradually increase in length from ·1mm. to about ·25mm., and diminish in width from ·13mm. to ·10mm.; the largest pectinations are about ·45mm.; the pectinations arise from the middle of the segments or the ends if allowance be not made for their sloping origin; the joints and pectinations are clothed dorsally (outward or upward aspect?) with long (·2mm.) hair-scales; ventrally they carry sense-hairs, which are very small as compared with those of, say, *A. opacella*, being about ·03mm. in length; the pectinations are curiously notched for the origins of hairs and scales, and are deeply wrinkled transversely (as in *Proutia*, but more markedly). How far the wrinkling is normal or the result of drying is not easily decided. The haired under-surface of the joints is very pale, smooth, and transparent, contrasting with the wrinkled pectinations. The number of hairs is not easy to count, perhaps 100 hairs to a pectination and 30 to an antennal joint. The scales are not in definite transverse rows. The general aspect of the antennal structure suggests a distinct step to that in *Apterona*. The legs have some long hairs on femur, the remaining joints clothed sparsely with very narrow scales, which are almost fine bristles on the prominent ridges and at the ends of the tibia and tarsi; first and third legs without spurs, a very minute one at end of second tibia; first tarsi longest, third tarsi shortest —1st=1·6mm., 2nd=1·3mm., 3rd=·9mm. ♀. Hofmann describes a blown female received from Reutti as follows: Length 3 lines, breadth 1½ lines. The small head is pointed upwards and is very much overlapped by the thorax; the latter is unicolorous, yellow, corneous, and shiny, and without any darker shading and with scarcely any divisions between the segments. The abdomen is swollen, with a rounded end of a yellowish-white colour. Heylaerts notes it as "vermiform; head and thorax very small, abdomen very large and thick and of a brownish-yellow colour. The head, on which mouth-parts are entirely wanting, is roundly flattened off. The eye-patches form two black spots in the ordinary position; the antennæ consist of two segments, the basal thicker than the upper segment."

Variation.—This species is not, apparently, subject to any variation except in size. Our British race (*fusca*) appears to us to be practically identical with the continental specimens examined.

a. var. *fusca*, Haw., "Lep. Brit.," 2, p. 157 (1809); Stephs., "Ill. Brit. Ent.," ii., p. 80 (1829); Curt., "Brit. Ent.," no. 332 *note* (1830).—*Nudaria* (The brown muslin) alis pallide fuscis, antennis pectinatis. Habitat prope Londinum, at rarissime, cum penultimo (*munda*). Exp. alarum 9 lin. Tota fusca. Antennæ valde pectinatæ, radiis distantibus plumosis. Alæ angustiores quam in præcedentibus (*rotunda* et *munda*), anticæ fere ut in *Hepialis*, at nudæ et lucibus certis quasi plicatæ, omnino dilute fuscescentes, concolores, immaculatæ. Pupa utrinque obtusa, castanea, segmentis magnis turgidis (Haworth).

Curtis says that the insect has been caught at Hornsey Wood and Highgate on hazel, sallow, and oak leaves, at the end of June and beginning of July, the perfect insect appearing at the latter period; also taken at Winchmore Hill in June. Stephens quoting Ingpen, notes that this insect was first observed in Britain in the summer of

1820, when two males were reared from larvæ obtained in Hornsey Wood. On June 22nd, and July 4th, 1827, the insect was found in great abundance on the leaves of hazel and sallow, and on the leaves and trunks of young oaks, in the same locality; from these, however, only three males were bred, nearly all the larvæ being infested with ichneumons. In June, 1828, many larvæ and pupæ were obtained, some of the former, only half the size of others; from the largest four ♂ s and two ♀ s were bred in July, the larvæ in smaller cases being alive on November 24th; it seems certain, therefore, from this, that some larvæ at least take two years to come to maturity, an opinion strengthened by larvæ being taken on July 17th, 1827, under three-fourths of a line in length (including the case), which hybernated during the winter, after being fed on sallow, and which commenced to feed again in the spring of 1828. These larvæ devoured the cuticle and formed their cases of the downy part of the sallow leaves when young, remaining fixed to the upper part of the inverted glass in which they were placed (having made the sides easy of ascent by covering them with a fine silken web); in March they began to stir when they were supplied with the buds of whitethorn and afterwards with sallow. They gradually increased the size of their cases, and added to them fine sawdust and pieces of leaves, and after a few weeks they again became immovably fixed, and from each of them Chalcideous parasites were produced. The females never leave their cases and from previous ignorance of that fact I am not confident whether any of the larvæ taken in June 1827, produced any of that sex (Ingpen). Bruand asserts that the English examples are larger than the French. Some of the former which he received from Doubleday expanded 23mm.-25mm., whilst the French males measured only 19mm.-21mm.

Comparison of S. hirsutella with S. standfussi.—The only species that appears to be really closely related to *S. hirsutella* is *S. standfussi*, which Herrich-Schäffer describes as follows:

S. standfussi, H.-Sch.—*Psyche standfussi*, [Wocke, "Cat. Lep. Sil.," p. 2, n. cat. (1853)]; H.-Sch., "Sys. Bearb.," vi., p. 175 (1856); Speyer, "Geog. Verb. Schmett.," i., pp. 305, 459 (1858); Wilde, "Pflanz. Raup. Deutsch.," ii., p. 72 (1861); Auriv., "Nord. Fjär.," p. 59 (1889). *Standfussii*, Hein., "Schmett. Deutsch.," i., p. 181 (1859); Staud., "Cat.," 1st ed., p. 27 (1861); 2nd ed., p. 64 (1871); Wocke, "Zeit. Ent. Bresl.," p. 25 (1872); Standf., "Zeit. Ent. Bresl.," vii., pp. 24, 38 (1879); Wallgrn., "Skand. Het.," ii., p. 429 (1885); Pet., "Btr. Reuss. Reiches, (3), iv., p. 85 (1888); Cafl., "J.-B. Graubünden," xxxviii., p. 27 (1895).—*Psyche standfusii* (*sic*), Wocke. A male from the lake district of the Riesengebirge in the middle of July. The case like that of *calvella*. The moth differs from the latter by its larger size and more shining nervures; the hindwings want nervure 6, 4 and 5 do not rise from a common stalk, but close together; the forewings have the branches as in pl. xvi., fig. 4 (= *villosella*), but there is one branch more on one side, so that after 4 and 5 there are two separate branches before 8 and 9 (Herrich-Schäffer, *Sys. Bearb.*, vi., p. 175).

Standfuss says: "Herrich-Schäffer states that the case is like that of *S. hirsutella*, but apart from the length of the case of *S. standfussi* compared with that of *S. hirsutella* being as 7 : 5 and the area about 2½ times as great, it further differs (especially in those of the males), by the more regular arrangement of the covering material (placed vertically to axis), being almost as accurately arranged as in *Arctus graslinella*. The materials chosen are mainly grass-culms, short stems, ground lichens, or bark. The male larva does not, like that of *S. hirsutella*, undergo its transformations some feet high on tree-trunks, but close to the ground on *Calluna vulgaris*, *Vaccinium uliginosum* or *V. myrtillus*, its favourite food-plants. The females also, differently from those of *S. hirsutella*, mostly spin up high on tree-trunks. The male case has the white silken emergence-tube, and the cast larval skin on it; that of the female lacks both. The male pupa is fully twice as large as that of *S. hirsutella* and clearer brown, otherwise not different. The ♀ imago lives entirely in the case. The wings of the male are covered with fine hairs only. Herrich-Schäffer's remarks as to the neuration appear to be only partially correct, *viz.*, 'the neuration of the hindwings is like that of *S. hirsutella*, but nervure 6 is wanting, and 4 and 5 do not arise from a common stalk but only close to each other.' As a matter of fact 6 is as conspicuous as the others, and 4 and 5, although exceptionally unstalked, are usually found with a short common stalk. The hindwings are, therefore, essentially like those of *S. hirsutella*, but the transverse median nervule of the upper subdivision of the discoidal cell is just as regularly present in *S. standfussi* as it is absent in *S. hirsutella*. Herrich-Schäffer is further incorrect in his description of the neuration of the forewing, *S. standfussi* having twelve nervures as in *Psyche viciella* (not eleven as in *Pachythelia villosella*). *S. standfussi*, therefore, also has one more nervure in the forewing than has *S. hirsutella*, since it possesses instead of the one nervure 10 of the latter species, two nervures (between the subcostal and the stalked 8 and 9) running parallel from the front margin of the cell to the anterior margin of the wing. Heinemann's description is unsatisfactory, but male imagines and cases from the Upper Hartz show that *S. standfussi* occurs in Heinemann's district. Speyer first considered it distinct from, and afterwards referred it to, *S. hirsutella*; but one may point out the difference of 7mm. by which *S. standfussi* exceeds the latter, as well as the fact that the latter (although the larger) is a mountain form, and that specimens of Psychid species (*tenella*, *plumella*, &c.) are usually smaller at higher elevations. *S. standfussi* is essentially a mountain species, the lowest point from which it has been recorded being the so-called "Seefelder" near Reinerz (2317ft.). The species appears scattered on all the heights of the Glatz mountains (Gebirgskessel), on the Altvater (4621ft.) and on the ridges of the Riesengebirge (3000ft.-4000ft.)." Hoffmann notes the larva of *S. standfussi* on *Calluna* and both species of *Vaccinium* in the Upper Hartz, and states that it hybernates twice before reaching maturity. The case, he says, "is nearly one-third larger than that of *S. hirsutella*, Hb., otherwise very similar, about 2cm. long, and ⅔cm. broad, the ♂ case with an open tube ⅔cm. long, parchment-like, white, the larval skin hanging from it as soon as the case contains the intermediate larval form, or the pupa. The case is somewhat pear-shaped in form (especially that of the ♀) which is generally more regularly constructed than that of the ♂, the materials with which it is covered consisting of pieces of grass-culms, heath stems, and generally placed at right angles to the longitudinal axis. The ♂ larva also adds pieces of lichen and wood, which give the case an extraordinary appearance." Aurivillius says that it is rare in Scandinavia, Helsingland, and Arctic Norway. Petersen says Schöyen received from Sandberg, from Sydvaranger, a ♂ which Heylaerts determined as this species, and subsequently Sandberg found others. It is said to fly at night.

Ovum.—Heylaerts notes the eggs as yellowish-white with no trace of pattern discernible. They are laid within the empty pupa-skin.

CASE.—♂. From 15mm.-20mm. long (probably somewhat damaged and hence less than true length), somewhat broader at the anterior and narrower at the posterior end, and as the anterior end is much more thickly clothed with irregularly laid on pieces of lichen, wood, and other vegetable *débris*, it looks somewhat conical in shape. The case is made of loose white silk, the pieces of material attached are often fastened crosswise, and the posterior end has an almost unclothed tubular portion that is rather conspicuous. Heylaerts describes the case as 22mm.-28mm. long, 4mm.-8mm. wide, lined internally with silk, the anterior end covered with small pieces of leaf, in the centre with larger pieces of grass-culm or seed husks; the posterior end unclothed; the hinder end forms two valves, which are opened by the larva to get rid of its cast skin, excrement, &c. The male case is longer and thinner, the female case shorter but broader. Wood also notes the male case as being much more slender than that of the female, whilst Hofmann says the former has a rougher appearance, and has a white silken tube at the anal end, on the outside of which, as in *Ptilocephala atra* (*angustella*), the cast skin is hung. The female cases are smoother, and the posterior white silken tube is absent. Bruand observes that the cases vary considerably, being sometimes covered with little straws placed perpendicularly to the axis and forming a structure something like a pincushion, like that of *tabanella*, but less regular; at other times it is clothed with twigs, little splinters of wood, pieces of cork, &c. In almost all cases, one sees at the lower extremity three small whitish streaks placed triangularly and extending up the case for almost a quarter of its length; these white stripes are only the silk of the sac or real case, which is naked at these places. The different cases might easily mislead one into supposing that they belonged to different species, but there appears to be no difference in the imagines. The straw cases are generally found on sloe and nutbushes; those made of splinters are found on willow, aspen and oak. Barrett notes the case as rather broad in the middle, narrowing rapidly at both ends, covered with dry morsels of leaf, capsules of sallow or plantain, morsels of dried stalks or any other vegetable material, which is placed crosswise or in any direction rather than lengthwise. Standfuss says that the case is clothed with the most diverse materials, with the fallen brown scales of leaf buds, small pieces of bark, of fine stems, small flowers, all placed so irregularly that one cannot say whether they are attached lengthwise or vertically. The male case has a rather long unclothed white silken tube, on which, two or three weeks before emergence, the larval skin may be found hanging; the ♀ case lacks this tube.

HABITS OF LARVA.—Heylaerts notes that eggs laid by females in his possession hatched July 17th, 1870, that the young larvæ were at first gregarious, but separated later, moulted first on July 29th, then grew rather rapidly, moulted again on August 21st, again on September 17th, and then on October 7th; they commenced to hybernate on October 16th, began to feed again the following April, and pupated during May, emerging in June and July, all males. Standfuss states that in Silesia the species matures in one year, but Mitford, whose eggs came from North London in August, did not breed imagines until the next June twelvemonths, and Wood observes that in Haugh Wood, the small yearling cases are sometimes common on the leaves of oak, buckthorn, &c., but mature cases are always scarce, especially male ones. Bruand collected larvæ on sallow in October in the Dept. du Doubs; in the spring they ate the catkins until the leaves appeared, pupation took place at the end of May, and the imagines emerged a month later. He further notes that when the larva is startled by a noise, it crouches closely to the leaf or branch on which it is placed (contrary to the larvæ of *Canephora unicolor* and *Bijugis bombycella* which, under similar circumstances, fall immediately to the ground). Wood observes that the male and female larvæ take up different positions for pupation. The cases of the latter stand upright in the forks of the twigs, and are so firmly fixed as to allow of no play, whereas the male cases are attached somewhat loosely to the trunks and with the tail end downwards after the manner of *Taleporia tubulosa*, at least, this was the position of the only two male cases he ever found and from which he bred the moths. Standfuss observes that the male larva prefers to pupate on lichen-covered tree-trunks at a height of from 1ft.-5ft. from the ground, the female, on the other hand, generally on the leaves, or twigs of lower or higher bushes. Hofmann also notes that male larvæ spin their cases about 2ft.-4ft. from the ground on oak-trunks, whilst female cases are spun-up on the twigs of young oak trees, and Reutti has observed the female larvæ to spin up on the leaves, whereas the male cases are to be found lower down on the trunk.

Larva.—The *newly hatched larva* is dirty-yellow in colour, the thoracic segments, with horny legs, are covered with a thick coating of chitin, the abdominal segments and prolegs are soft; the true legs alone are used for walking, the prolegs for holding to the case. The *fullgrown larva* is short and thick, the head, rather large and broad, is glossy greyish-white, with brown stripes and spots; the mouth-parts yellowish-brown; the thoracic segments fleshy-white, with brownish stripes, corneous; the true legs white, with dark brown rings, and yellowish claws; the abdominal segments yellow-brown and rather weak; anal claspers somewhat lighter; stigmata whitish and very distinct. The male larva longer and thinner than the female (Heylaerts). The *fullgrown larva* is somewhat cylindrical, but attenuated anteriorly when stretched, the segments gradually increasing in width from the prothorax to the 4th abdominal, after which they decrease slowly to anal segment. *Head:* Considerably flattened, depressed medially at crown; black, with several paler markings which consist of two large pale patches one on each cheek, a short transverse line frontally between them, two vertical lines frontally one each side of the middle line; strongly and coarsely reticulated; the antennæ two-jointed; one large seta on the upper part of each cheek and three others just above base of antenna; the ocelli exceedingly inconspicuous; the head partly retractile into a loose fold of pale-coloured skin, between it and prothorax. *Thorax:* The prothorax covered with a pale yellowish corneous plate, rather coarsely reticulated, continuous dorsally and laterally to the spiracular flange, the mesothoracic plate is rather less complete, a small section separated to form a lateral plate just above spiracular flange, the metathoracic still smaller, similarly arranged, but divided into two by a very distinct suture medially; these segments also with a second lateral plate below flange forming basal leg-plate. The irregular dark markings on these form roughly longitudinal dorsal lines, with one subdorsal, and one spiracular on either side; the four dorsal setæ are placed in a straight line on the anterior edge of mesothorax and metathorax; the thoracic segments separated by very wide and well-developed, dirty grey, intersegmental membranes. The true legs are strong, corneous, coarsely reticulated, dark outside, pale beneath, several coarse hairs just above the joints, each bears a strong, brown, terminal claw. *Abdomen:* The abdominal segments dirty greyish, very uniform in tint, the intersegmental membranes well-developed. The 1st abdominal segment has a narrow, median, transverse, corneous, dorsal plate (a mere remnant of those on thoracic segments), and the tuberclar setæ are also provided with other small corneous plates on this, as throughout the abdominal segments. The setæ (i outside, and ii nearer mediodorsal line) are well-developed, the prolegs carry an oval (broken on inner side) of hooks, and are not well-developed; the spiracles have a strongly developed oval rim (Described from blown larva sent by Staudinger). Bacot notes that "the median transverse plate on abdominal segment 1 is in line with and between tubercles i, whilst in front of this again is a small circular scar or corneous spot on either side of the median line. The median plate is long, narrow, and doubtless formed of two independent plates united on median line; no hair-bases are traceable on these plates. On the 2nd abdominal this median plate is smaller, distinctly divided in the median line, thus forming two separate plates; whilst on the 3rd abdominal they are still smaller and show a wider gap. Tubercle oi is present, exceedingly minute, bears no hair, is placed quite on anterior margin of abdominal segments 1-3, and in line in front of i." Bruand writes: "The body of a clear horn-colour with some streaks, or rather black spots, arranged as in *M. crassiorella* but in a more irregular manner, the subdorsal only is moderately indicated, the other streaks are formed by the union of many small spots. The head is black-brown, with some lines and spots of an intense yellow, or very pale brown, disposed on each cheek as follows: First a line slightly recurved, starting from the edge of the prothorax and continuing almost for a third of the head, parallel to the median line (*i.e.*, to the line of intersection between the two cheeks) to which it is quite close; below this line is another, in the form of a V, of which the point is directed towards the prothorax; then, near the mandibles, two spots, almost triangular, of which the lower is larger than the upper. The true legs are brown, ringed with pale; and under a lens one distinguishes some very fine hairs on the body of the larva, as also on the head and at the base of the true legs; of these, the dorsal are longer than the others." Bruand also notes a larva found on oak which differed from those from sallow and aspen, the larva being "much darker, so that the black-brown was predominant, the streaks (very narrow otherwise) were pale, and the head, equally dark, scarcely offered any trace of the lines and spots just described; the true legs were black, the claws reddish. The larva was ichneumoned."

PUPA.—♂. The living *male pupa* is red-brown in colour, darkening to black before emergence. Surface shiny. Short, stout and stumpy; wing-cases extend to about the middle of the 4th abdominal segment; the third pair of legs slightly beyond this but not attached; abdominal segments 3 (dorsally), 4, 5, 6, and 7, free; scars in position of larval prolegs, fairly distinct; anus very bluntly rounded, the cremaster bearing two very large, powerful, curved spines on ventral aspect, these are stout conical processes each ending in a sharp, stout, curved claw. Spiracles, large, placed on anterior edge of segment, not noticeably raised. Dorsal area has a more roughened, and wrinkled appearance and the surface duller, than the appendages. On dorsal area of abdominal segments 4-8, almost centrally (but appearing somewhat anteriorly owing to compression of segments), is a group or broad ridge of chitinous spines, pointing backwards, more pronounced and prominent on the 7th and 8th, weaker and smaller on the 4th, abdominals. On the posterior edge of the dorsum of the 4th abdominal segment is a weaker row of spines pointing forwards, a less developed row on the 3rd abdominal segment, and similar rows on the segments following 4, but hidden (when the pupa is at rest) by the folds of the intersegmental skin. Hairs or setæ, representing the larval tubercles i and ii, are present, i rather weaker than ii and farther from central line; a hair representing iii is also present, whilst iv and v are close together as subspiraculars, and the tubercle and hair (? vi) present in most Psychid larvæ, as well as hairs representing the basal tubercles (vii) of the larva, are also present. All the subspiracular hairs are weak, but there is not a noticeable difference between those of iv and v, as is the case in the larvæ of some other species. The wings are broad and large compared with the size of the pupa as a whole, and more conspicuous, probably, owing to the shortness of the abdominal segments. The antennæ are very broad, show pectinations distinctly, but do not nearly reach to end of wing-cases; inside these are the first two pairs of legs, the tips only of the third pair just showing beyond them (Bacot). The noticeable feature of the head-parts is the very dark coloration of the eye- and cheek-parts, the front of the vertex, and, to a slight extent, the jaws and sides of the labrum. The labrum is square, with small but somewhat long and narrow mandibles, extending downwards and outwards from its lower angles; below this the labium is rather large and square; on either side of this the maxillæ broader than long, so that the triangle each makes has a sharp outer angle. The first femora are below these and between; the first legs have very markedly the basal division tending to mark off the coxæ (?), a basal part at any rate that only comes into view in pupæ like this, with very short labia and maxillæ (Chapman). Heylaerts states that the male pupa is dark brown, with gibbous thoracic parts frontally, an indication of the pectinated antennæ, and somewhat longitudinally-striped wing-cases; the segments are not provided with hooks. This last remark is quite unaccountable, as *S. hirsutella* has the usual anterior and posterior (intersegmental) rows of spines as well as the ventro-anal hooks. ♀. The *female* pupa has the head and thoracic segments, and half of the 1st abdominal segment of the usual pupal brown colour, the 8th, 9th, and 10th abdominal segments also, the intermediate portion black; certain chitinous waves look like the labrum, labium, &c., but these and the leg-covers are very indefinite, and reduced to mere chitinous irregularities of surface; the wings are marked by similar but more distinct waved lines laterally; the scars of the prolegs are very marked, being great hollows with raised margins; the spiracles are polished points, and in some lights glisten, in contrast to the dull general surface; there are also various grooves in the lateral region marking remains of flange [The peculiar coloration of pupa here noticed also occurs in *Psyche viciella*, &c.] (Chapman). The female pupa black with orange head and anal area; at the anterior end one distinguishes a small thoracic area entirely without wing-sheaths. It is irregularly oval in form, narrow anteriorly, broader posteriorly (Heylaerts). Hofmann says that the swollen female pupa is black-brown, the head and anus yellow-brown, whilst Bruand calls the pupa "bicolorous."

DEHISCENCE.—♂. In the male pupa of *S. hirsutella* the face, head and legs, adhere in one piece, and separate from the rest of the pupa, except that the inner shreds retain it near its place; the pro- and mesothorax split dorsally. There seems to be no opening of incisions anterior to abdominal segment 2. ♀. In the female pupa the head-parts separate dorsally from prothorax, and the thoracic segments split in the median line. But after the ♀ has left the case it closes together and looks very like a full pupa, so far as any openings go. (The same arrangement seems to be the rule in the *Psychidi—Psyche stetinensis*, *viciella*, &c.) (Chapman).

FOOD-PLANTS.—Almost polyphagous. Bramble in spring and autumn, various trees particularly buckthorn, oak, and mountain-ash in summer (Mitford), oak, buckthorn (Wood), oak, birch, beech, elm, &c. (Heylaerts), hawthorn, hornbeam, hazel (Knaggs), sloe, nut, sallow, aspen (Bruand), *Sorbus*, *Quercus*, leaves on small shoots growing out of trunk (Hofmann), *Prunus padus*, *Quercus*, and deciduous trees (Reutti), *Lotus uliginosus*, *Rhamnus frangula*, *Viburnum opulus* (in captivity) (Brown), birch, alder, bilberry (Glitz), oak, birch (Schütze), hazel, sallow, oak (Ingpen).

HABITS AND HABITAT.—Larvæ (from Hampstead parents) hatched in August, the moths appearing the following June twelvemonths, taking two years to come to maturity, the female cases generally spun-up on leaves in an upright position those of the males hanging pendent from branches or main stem (Mitford). Paul and Plötz state that the pupal stage lasts 21 days. Standfuss observes that in Silesia the male emerges and is ready for flight in 30 minutes, whilst Schmid and Hofmann both confirm this observation. Mitford says that the imago flies freely at dusk, and Schütze records it as being captured at light at Rachlau. Heylaerts, on the other hand, notes that, about Breda, at the end of June and beginning of July, the males may be found flying rather commonly on sunny days about the ♀ cases which are firmly attached to trees in a pinewood. The period of copulation is very brief, and the female soon begins to lay her eggs in the interior of the case. Blackburn records males as being found flying over the heath at Rannoch. Wood comments on its being excessively local in Hereford, and, so far as he has observed, it appears to be confined to a somewhat restricted area in the heart of Haugh Wood, the yearling cases common on leaves of oak, buckthorn, &c. Werneburg notes the cases as common on oak-trunks in the Steigerwald near Erfurt. Peyerimhoff observes it as common in all the woods of Alsace, and Jäggi on the south side of the Simplon Pass; Hofmann finds the cases in an oak wood at Erlangen, whilst near Ratisbon it occurs in a wood by Etterzhausen, which has a large growth of young deciduous trees, the cases being spun-up in May, on the tall larch trunks, Heylaerts says it is common in the woods of eastern Holland and Belgium, whilst Guénée finds it in the shady parts of woods in the Dept. Eure-et-Loir, the cases in May on *Rhamnus* the imago in June. Paux finds cases on oak-, beech-, and poplar-trunks, in the woods of the Dept. du Nord, in April and May, and Nolcken on old birch-trunks near Kokenhusen and Neuhof, also in May.

Time of appearance.—The cases are spun-up in late April and May, the imagines appearing in June and July (extending even into August). Cases beginning of April until June on pales at Winchmore Hill, larvæ and pupæ at Hornsey Wood and Highgate at end of June and beginning of July, the imagines appearing at the commencement of the latter month (Ingpen); two cases on anemone, April 29th, 1860, at Hampstead, and many more on May 6th (Taylor); cases at Bishop's Wood, May 14th, 1867 (Knaggs); cases, May 14th, 1867, at Hampstead (McLachlan); imagines flying over heaths at Rannoch, in the middle of August, 1867 (Blackburn); case May 13th, at Haugh Wood produced imago June 24th, 1891 (Wood); cases at Horsley, May 25th, 1893 (Turner); larvæ August to May, imagines June and July, at Bordeaux (Brown); larvæ June 1st-7th, at St. Florent (Sand); larvæ in May, imagines in June, in the Dept. Eure-et-Loir (Guénée); larvæ full-grown in May, imagines in June, in Hanover (Glitz); larvæ at end of April and early May, near Erlangen, spun-up at end of May, males emerging in June (Hofmann); imago at light June 17th, 1896, at Rachlau (Schütze); imagines from mid-June to early July in Silesia (Standfuss); end of June and early July, at Hildesheim (Grote); imagines bred June 10th and following days in Galicia (Garbowski); larvæ spun-up in May, imagines emerged end of June and beginning of July, at Breda (Heylaerts); cases in June, 1896, at Oisterwijk (Oudemans); cases in May, 1857, near Kokenhusen and Neuhof, ♀ and ♂ emerged June 16th (Nolcken); Coubeaux captured imagines June 13th, 1886, near Notre-Dame-au-bois. Gauckler found spun-up cases at Wildpark, nr. Carlsruhe, on May 14th, 1896.

Localities.—[? Durham: Darlington (Stainton).] Hereford: Tarrington (Wood). Hertford: (Barrett). Lancashire: (Barrett). Middlesex: Winchmore Hill, Highgate and Hornsey Woods (Ingpen), Bishop's Wood (Knaggs), Hampstead (Mitford). Northampton: (Barrett). Perth: Rannoch dist. (Blackburn). Surrey: Reigate (Barrett), Horsley (Turner). Westmorland: Witherslack (Murray *teste* Threlfall).

Distribution.— Amurland: Chabarofka, Nicolajefsk (Graeser), Ussuri dist. (Staudinger). Austro-Hungary: Innsbruck (Weiler), Tyrol—Schlern (Heller), Epiries (Husz), Chemnitz (Pabst), Galicia—Brody, Neu Sandec (Klemensiewicz), near Meran, Mödling, Transsylvania, Styria, Trafoi, Schneeberg, Vienna (Speyer),* Pressburg (Rozsay), Stanislawow (Werchratski), Brünn (Müller), Bohemia (Schneider), Lemberg (Nowicki). Belgium: Brussels, Liège, Louvain, &c. (Donckier), eastern parts, common in woods (Heylaerts), near Notre-Dame-au-bois (Coubeaux). Finland: Kuusamo (Hoffmann), Tavastia (Tengström). France: Aube (Jourdheuille), Eure-et-Loir, Châteaudun (Guénée), Douai (Foucart), Nohant, St. Florent (Sand), Bordeaux (Brown), Besançon (Bruand), Seine-Inférieure (Bonjour), Autun (Constant), Lyon (Frey coll.), Rennes, Forêt de Sénartser, Paris (Oberthür), Château-du-Loir (de Graslin), Aix-les-Bains (Tutt). Germany: Würtemberg (Seyffler), Frankfort-on-Main (Koch), Rhine Palatinate (Bertram), Zeitz-on-the-Elster (Wilde), Halle (Stange), Sachsenwald (Graeser), Rudolstadt (Meurer), Mecklenburg. Schwerin (Schmidt), Bremen, Delmenhorst, Stenum, Hasbruch, Oberneuland (Rehberg), Saxon Upper Lusatia—Quoos, Lömischau, Rachlau (Schütze), Weimar (Krieghoff), Dantzig (Schmidt), Silesia (Wocke), Upper Lusatia—Lauban, Niesky (Moeschler), Wiesbaden (Rössler), Ratisbon (Schmid), Lüneburg, Berlin, Hartz, Coblentz, Pomerania, Wismar, near Breslau, Glogau, Stolzenfels, Freiburg-im-B., Frankfort-on-Main, Augsburg, Munster, near Lauban

(Speyer),* Hanover (Glitz), Alsace (Peyerimhoff), Steigerwald, near Erfurt (Werneburg), Brunswick (Heinemann), Göttingen, Hanau, Aix, Krefeld, Elberfeld, Nordhausen, Osterode (Jordan), Baden, distributed, Nassau (Reutti), Prater (Zell. coll.), Lissa (Mann), Osswitz near Breslau, Bohrau near Oels, Leubusch near Brieg, Panten near Liegnitz, Parchwitz, Freiburg (Standfuss), Munich (Hartmann), Erlangen, Etterhausen near Ratisbon, Marksteft in Unterfranken (Hofmann), Grubenhagen (Paul and Plötz), Cranz (Riesen), Hildesheim (Grote), Bavarian Palatinate (Bertram), Heeswaldungen (Stollwerck), Wildpark near Carlsruhe (Gauckler). Italy: Val Bregaglia, &c. (Curò), Lombardy—Brianza, Milan (Turati), Modena, Casinalbo (Fiori), Piedmont (Herrich-Schäffer), south side of Simplon (Wackerzapp). Netherlands: Eastern provinces of Holland—Breda, &c., rather common in woods (Heylaerts), Oisterwijk (Oudemans), Empen near Zutphen (Snellen). Roumania: Slanic (Caradja). Russia: St. Petersburg (Erschoff), Baltic Provinces (Sintenis), near Kokenhusen, Neuhof (Nolcken), Wolmar (Lutzau), Livonia (Zell. coll.), Lappea (Petersen), Dorpat, Neu Kasseritz, St. Petersburg, Finland (Sintenis). Scandinavia: Norway and Sweden, rare—Dovre in Norway (Wocke), Arctic Norway (Petersen). Switzerland: Up to 5000ft. (Frey), Grisons (Killias), Prad (Speyer), Simplon (Jäggi), Chasserol (Couleru), Bernese Alps (Rothenbach), Engadine (Zeller-Dolder), Bechburg (Riggenbach-Stehlin), Oftringen (Wullschlegel), Zürich (Frey), Höttingen (Rühl), ? Bergün (Zeller).

Explanation of Plate VI.

We have in various places in our account of the Psychids shown the importance of the antennal structures in their classification (see, *ante*, pp. 273, 299-300, 337, 371, 413). Plate vi (for which we are indebted to Dr. Chapman) exhibits the main characters of the Psychid antennæ. The antennæ shown are:

Fig. 1*a-b*.—Portion of antenna of *Luffia lapidella*. There are two pectinations to each joint arising near its base and rather ventrally than laterally. The pectinations are slightly clubbed and clothed on all aspects with sense-hairs. The scaling is confined to the shaft on its dorsal aspect, four rows of scales not very strictly arranged to each segment or joint.

Fig. 2.—Portion of antenna of *Bacotia sepium*. Agrees with preceding, in arrangement of scales and hairs, the pectinations are more nearly lateral but still nearer the venter than opposite each other; the pectinations are clothed so as to give a special square aspect to the divisions of the antenna.

Fig. 3*a-b*.—Portion of antenna of *Proutia betulina*. Similar distribution of hairs and scales as in the two preceding, the pectinations are longer and have little or no clubbing.

Fig. 4.—Portion of antenna of *Fumea casta*. The antenna is very like the last in general form, but has scales instead of hairs along the whole dorsum of the pectinations, making them look thicker and even somewhat clubbed, due, however, to the scales being rather more abundant apically.

Fig. 5.—Portion of antenna of *Acanthopsyche opacella*. The pectinations are much longer and more flowing than in last. In *Psychinae* such pectinations are scaled (often hair-scales) as in *Fumea*. In *Acanthopsychinae* such scaling has been lost and the dorsum is naked except for an occasional tactile bristle.

Catalogue of the Palæarctic Psychides.†

Psychides. | Naryciidae.

* Standfuss considers that the elevated localities—Trafoi 4000ft., Styrian mts., Altvater and Leiterberg—given by Speyer (*Geog. Verb. Schmett.*, ii., p. 278) are possibly incorrect, and thinks that they may perhaps all be referred to *standfussi*. This he asserts is certainly so in the case of Altvater and Leiterberg, whence he himself has specimens.

† In compiling this list we have been much hampered by the incomplete state of the material in this group in the British Museum collection, and by the fact that some species are erroneously placed, and many of the cases evidently attached to imagines to which they can scarcely belong. We found, for example *Ptilocephala atra*, Linn. (*plumifera*, Ochs.), united in the same series with *Ptilocephala angustella*, H.-Sch. (*atra*, Esp.), the latter species not even having a specimen above the name in the collection. The position we have given some species, especially among the Oreopsychids has been determined by reference to figures and descriptions only.

NARYCIINAE.
NARYCIIDI.
Narycia, Stphs.
monilifera, Geoff.
var. atrella, Stphs.
ab. ochracea, Tutt
astrella, H.-Sch.
DIPLODOMIDAE.
DIPLODOMINAE.
DIPLODOMIDI.
Diplodoma, Zell.
herminata, Geoff.
var. siderella, H.-Sch.
adspersella, Hein.
LYPUSIDAE.
LYPUSINAE.
LYPUSIDI.
Lypusa, Zell.
maurella, Fab.
PENESTOGLOSSIDI.
Penestoglossa, F. v. R.
dardoinella, Mill.
MELASINIDI.
Melasina, Bdv.
ciliaris, Ochs.
lugubris, Hb.
melas, Bdv.
punctata, H.-Sch.
melana, H.-Sch.
SOLENOBIIDAE.
SOLENOBIINAE.
SOLENOBIIDI.
Solenobia, Dup.
inconspicuella, Sta.
? var. triquetrella, Edl.
? var. wockii, Barr.
nickerlii, Hein.
wockii, Hein.
suifunella, Christ.
lichenella, Linn.
cembrella, Linn.
var. pineti, Zell.
ab. alba, Tutt
fumosella, Hein.
triquetrella, Hb.
mannii, Zell.
pallida, Staud.
clathrella, F. von R.
TALEPORIIDAE.
TALEPORIINAE.
TALEPORIIDI.
Bankesia, Tutt
douglasii, Sta.
staintoni, Walsm.
conspurcatella, Zell.
vernella, Const.
montanella, Walsm.
alpestrella, Hein.
defoliella, Const.
Taleporia, Hb.
tubulosa, Retz.
ab. guénéi, Zell.
ab. minor, Tutt
politella, Ochs.
borealis, Wocke
improvisella, Staud.
Sciopteris, Meyr.
technica, Meyr.
pretiosa, Sta. (? genus)
DISSOCTENIDAE.
DISSOCTENINAE.
DISSOCTENIDI.
Dissoctena, Staud.
granigerella, Staud.
LUFFIIDAE.
LUFFIINAE.
LUFFIIDI.
Luffia, Tutt
lapidella, Goeze
var. pectinella, Dup.
ferchaultella, Stephs.
Bacotia, Tutt
sepium, Speyer
FUMEIDAE.
PROUTIINAE.
PROUTIIDI.
Proutia, Tutt
betulina, Zell.
eppingella, Tutt
? salicolella, Brd.
rouasti, Heyl.
FUMEINAE.
FUMEIDI.
Bruandia, Tutt
reticulatella, Brd.
var. obscurella, Chapm.
raiblensis, Mann
comitella, Brd.
norvegica, Schöyen
Masonia, Tutt
saxicolella, Brd.
edwardsella, Tutt
subflavella, Mill.
mitfordella, Chapm.
crassiorella, Brd.
var. (? sp. dist.) affinis, Reutti
hibernicella, Chapm.
Fumea, Haw.
scotica, Chapm.
casta, Pallas
ab. minor, Chapm.
var. (et ab.) intermediella, Brd.
var. bowerella, Chapm.
germanica, Chapm.
EPICHNOPTERYGIDAE.
BIJUGINAE.
BIJUGIDI.
Bijugis, Heyl.
bombycella, Schiff.
var. rotundella, Brd.
var. elongatella, Brd.
proxima, Led.
pectinella, Schiff.
var. perlucidella, Brd.
alpherakii, Heyl.
vestalis, Staud.
EPICHNOPTERYGINAE.
PSYCHIDEIDI.
Psychidea, Rbr.
sapho, Mill.

nocturnella, Alph.
nudella, Ochs.
var. suriens, Reutti
plumella, Ochs.
? nigrolucidella, Brd.
staudingeri, Heyl.
millierei, Heyl.
flavescens, Heyl.
kuldschaënsis, Heyl.
graecella, Mill.

EPICHNOPTERYGIDI.

Whittleia, Tutt
retiella, Newm.
undulella, F. v. R.
Epichnopterix, Hb.
mentonella, Mill.
pulla, Esp.
var. silesiaca, Standf.
var. sieboldii, Reutti
var. heringii, Hein.
var. pullisimilella, Brd.
var. plumistrea, Haw.
var. innitidella, Brd.
var. montana, Heyl.
ardua, Mann
alpina, Heyl.
hofmanni, Heyl.
flavociliella, Mann
tarnierella, Brd.
var. myrmidonella, Brd.

PSYCHEOIDIDAE.

PSYCHEOIDINAE.

PSYCHEOIDIDI.

Stichobasis, Kirb. (Diabasis, Heyl.)
helicinoides, Heyl.

PSYCHIDAE.

APTERONINAE.

APTERONIDI.

Apterona, Mill.
crenulella, Brd.
var. helix, Reutti
helicinella, H.-Sch.
var. gracilis, Speyer

PSYCHINAE.

PSYCHIDI.

Arctus, Rbr.
praecellens, Staud.
graslinella, Bdv.
calberlae, Heyl.
bruandi, Led.
apiformis, Rossi
var. siculella, Brd. (=melasoma, Staud.)
Psyche, Schrk.
detrita, Led.
viciella, Schiff.
stetinensis, Hering
? stigmatella, Zell.
viadrina, Staud.
constancella, Brd. (millieriella, Led.)
turatii, Staud.
? minutella, Geoff. (Fourc.)
Sterrhopterix, Hb.
hirsutella, Hb.
var. fusca, Haw.
standfussi, H.-Sch.

PHALACROPTERYGIDI.

Standfussia, Tutt
tenella, Speyer
zermattensis, Frey
Scioptera, Rbr.
plumistrella, Hb.
Leptopterix, Hb.
schiffermilleri, Staud.
Ptilocephala, Rbr.
atra, Linn. (plumifera, Ochs.).
var. valesiella, Mill.
var. castiliana, Staud.
angustella, H.-Sch. (atra, Esp.)
var. bicolorella, Bdv.
Phalacropterix, Hb.
muscella, Hb.
mediterranea, Led.
fulminella, Mill.
crassicornis, Staud.
sicheliella, Brd.
gondebautella, Mill.
Hyalina,* Rbr.
albida, Brd.
var. millierella, Bdv.
plumosella, Rbr.
lorquiniella, Brd.
malvinella, Mill.
var. abencerragella, Mill.
wockei, Staud.
Oreopsyche, Speyer
vesubiella, Mill.
pyrenaella, H.-Sch.
var. albescens, Heyl.
? tabanivicinella, Brd.
kahri, Led.
leschenaulti, Staud.
var. nigricans, Staud.
silphella, Mill.

ACANTHOPSYCHINAE.

ACANTHOPSYCHIDI.

Oiketicina, Heyl.
inquinata, Led.
staudingeri, Heyl.
Acanthopsyche, Heyl.
opacella, H.-Sch.
var. senex, Staud.
maritimella, Brd.
zelleri, Mann

* Dr. Chapman states that if *Hyalina*, Rbr., be diagnosed by having seven nervures to cell, then its species (judged by those in Constant's collection) are—*albida*, *lorquiniella*, *millierella*, *malvinella*, *mediterranea* and *silphella*. He further adds that in Constant's collection, *leschenaulti* has a case with very wide-spreading straws, whilst *silphella* has a smooth earthy case like *nudella*. In the British Museum collection the case of *leschenaulti* is smooth and earthy like that of *silphella*.

Pachythelia, Westd.
villosella, Ochs.
var. nigricans, Curt.
var. silesiaca, Heyl.
var. hirtella, Ev.
var. cinerella, Dup.
Amicta, Heyl.
oberthueri, Heyl.
jordani, Staud.
uralensis, Frr.
var. demissa, Led.
grummi, Heyl.
ecksteini, Led.
lutea, Staud.
var. armena, Heyl.
var. schahkuhensis, Heyl.
febretta, B. de F.
var. albipunctella, Mill.
var. lambessa, Heyl.
tedaldii, Heyl.
sera, Wisk. (heylaertsii, Mill.)
quadrangularis, Christ.
Canephora, Hb.
unicolor, Hufn.
var. paleiferella, Brd.
var. asiatica, Staud.
OIKETICIDI.
Eumeta, Walk.
pungeleri, Heyl.
japonica, Heyl.
minuscula, Butl.
pryeri, Leech
aurea, Butl.

ADDENDUM.

PROUTIA SALICOLELLA, Bruand.

Whether there be another species on the continent passing under this name, distinct from *P. betulina* (and *P. eppingella*), we do not know, but it is asserted as a fact by Heylaerts, who writes: "*Salicolella*, Brd., does not at all = *betulina*, Zell. I have specimens of *salicolella* that belonged to Bruand (from Millière's collection), and the species is characterised by its case, larva, &c. These have much broader and rounder wings than has *betulina*, Zell., the cell is shorter and wider, &c. The case is not at all like that of *betulina*, Zell., and the larva is of a dark brown colour, with a reddish tint, &c. I have received it only from Lyon and Douai. It is a very rare species, and Bruand's description and figures are very incorrect" (*in litt.*, January 16th, 1900). Heylaerts' remark that it has "much broader and rounder wings" than *betulina* suggests strongly that the insect cannot be referable to our *P. eppingella*. It occurs to us, that if, on the comparison of Bruand's description of *P. salicolella* with the specimens that Heylaerts has standing in his collection as *P. salicolella*, Brd., and which were sent by Bruand to Millière, Heylaerts is not able to make them fit Bruand's description, it is more logical to conclude that Bruand was not describing from specimens similar to those that Heylaerts has, than to dub Bruand's descriptions and figures as "very incorrect." We know enough of Bruand's work to assert that he could describe what he saw. We also know sufficient of it to conclude that he could not always differentiate allied species, and we suspect that, having described *P. salicolella*, he afterwards sent to Millière specimens as *P. salicolella*, which did not correspond therewith, and which Heylaerts now, no doubt justly, determines do not agree with his description and figures of that species. The proper mode of action appears to be, not to tack the specimens to a name and figures with which they do not agree (*teste* Heylaerts), but to name, describe, and publish the life-history of Bruand's, the Lyon and Douai examples, if they all represent one species.

Superfamily VI: LACHNEIDES.

The LACHNEIDES or LASIOCAMPIDES are a most interesting superfamily of the Sphingo-Micropterygid stirps, and appear to form one of the most sharply defined groups of the Lepidoptera-Heterocera, yet it has given considerable trouble to systematists, and Europterid and other species have been included by various authors within its boundaries. The imagines are usually large and densely scaled, they have no frenulum, and the costal area of the hindwing is sometimes remarkably developed. The male antennæ are highly specialised, and have long pectinations; there is considerable sexual diversity exhibited, and the difference in the habits of the sexes is also most marked.

We are indebted to Aurivillius for an excellent revision of the Palæarctic species (*Iris*, vol. vii., pp. 121-192). This author defines the group as follows:

Antennæ maris pectinatæ, feminæ pectinatæ, serratæ aut fere simplices. Alæ retinaculo nullo. Costa quinta alarum omnium ex angulo postico, sexta ex angulo antico cellulæ orientes. Costa dorsalis alarum anticarum unica, basi non furcata. Costæ dorsales alarum posticarum duæ, prima in angulum analem, secunda in marginem egrediens. Costa septima alarum anticarum aut e costa sexta vel octava aut libera e cellula oriens, costæ nona et decima semper ad basin conjunctæ. Cellula discoidalis alarum omnium parva et angusta, medium alæ haud attingens. Tibiæ posticæ bicalcaratæ aut inermes. Lingua nulla aut brevissima. *Larva*: Pedibus thoracibus 6 et abdominalibus 10 semiannulatis (in segmentis 6-9 et 13 sitis) prædita. Caput et corpus plus minus dense pilosa, squamosa vel rarius aculeata. Verrucæ saepissime nullæ aut obsoletæ, rarius magnæ et distinctæ; verrucæ dorsales, si omnes (4) adsunt, etiam in segmentis 2° et 3° in duabus seriebus collocatæ sunt. Pili non solum in verrucis, sed undique in cute inserti. *Pupa*: Cute tenui instructa, in folliculo plus minus denso, sericeo semper inclusa.

The Lachneid egg is of the flat type, the micropylar axis horizontal and usually considerably longer than either of the other axes, of which the vertical is the shorter. It may be either oval (occasionally approaching circular) or roughly quadrangular in outline, slightly depressed on the upper surface, and with the micropyle placed conspicuously at one end of the horizontal axis. It is generally shiny, sometimes somewhat opalescent, apparently smooth, but under a sufficiently high magnifying power is usually seen to be covered with an exceedingly fine polygonal reticulation, a minute dark knob being situated at each of the angular points.

The mode of egg-laying of the Lachneids is very diverse, and our few British species exhibit a striking dissimilarity in this respect. Perhaps the most remarkable methods adopted are those seen in *Malacosoma* (*neustria*, &c.), and *Lachneis* (*lanestris*). These species lay their eggs round and round a twig in the form of a necklace, those of the first in rings, of the latter in spiral form; the eggs of the Malacosomas also are embedded in a stiff liquid glue, whilst those of *Lachneis* are covered with a thick clothing of long silky hairs, mouse-coloured in tint to the naked eye, but seen to be formed of black and white fibres under a microscope. At first sight it would appear that the eggs of these species are upright and not flat eggs, *i.e.*, their micropylar axis appears to be vertical and not horizontal to the surface on which they are laid, but further examination shows that this is not so, that they are in reality laid one upon the other and not upon the twig round which they are placed, being but loosely attached thereto in the Malacosomas, and readily slipping off in mass if the twig contract by drying. Their resemblance in position to upright eggs is only then an extreme development of the condition observable in *Endromis* aud the Saturnias in which the eggs are piled upon each other. The eggs of *Trichiura crataegi* and *Poecilocampa populi* are both laid in linear series side by side on a branch, their long axes parallel, in numbers extending from four or five to a dozen, those of the latter species being often, however, placed singly and irregularly. The eggs of *Eutricha quercifolia* are laid in small groups on twigs (often placed more or less on each other). Those of *Macrothylacia rubi* may be attached to almost anything in the near neighbourhood of their food, and there is a batch in the British Museum coll. placed round and round a twig, almost as in *Malacosoma*, but irregularly, loosely, and without any cementing material, whilst those of *Pachygastria trifolii* and *Cosmotriche potatoria* are slightly attached to stems of grass or other plants. The female *Lasiocampa quercûs* is reported to sprinkle her eggs loosely when on flight, but one may be inclined to doubt whether this statement is always correct. We know, of course, that like the female of *C. potatoria*, she will lay her eggs freely in one's hand whilst being held, but the eggs of the latter are sticky and adhere to each other, whilst, on the other hand, those of *L. quercûs* are not, yet the female of the var. *callunae* is recorded as having been observed attaching her eggs to heather twigs, and we once had eggs that appeared to belong to this species sent to us that were firmly attached to a stone. Bacot observes that he has never known the eggs of the typical form or of the various continental races that he has bred to be attached to anything, the moth dropping her eggs as soon as fertilised, although possibly they have been retained for several days previous to copulation. If kept for any length of time, however, females of this species will lay infertile eggs, but when once pairing has taken place egglaying commences immediately, in from ten to twenty minutes.

The Lachneid larvæ are exceedingly beautiful, often densely hairy, usually with the primary tubercular warts flattened and spread out, and much obscured by the secondary hairs, which, in some genera, form a thick coating spread over the whole skin. In other genera, however, the lateral hairs are those particularly developed, and then in directions that tend to make the larvæ inconspicuous when resting outstretched upon a twig. This is particularly noticeable in the *Eutrichidae*, *Trichiura*, &c. Even the apparently conspicuous larva of *L. quercûs* can scarcely be observed when so extended, in spite of the striking intersegmental and lateral tints which are so conspicuous when it is crawling.

With regard to the structure of the Lachneid larvæ, Dyar states that "the primitive first stage has disappeared; the mature warts are greatly reduced and obscured by secondary hairs; tubercles iv and v appear to have dropped back into line in the first larval stage." We are not quite clear as to this quotation. It is true that the primitive first stage has largely (or wholly) disappeared, and we suspect has been thrust back into the stages passed within the egg before hatching; it is also true that the mature warts are much spread, often (especially i and v) reduced, and obscured in certain genera by secondary hairs, but we are not quite clear as to what is meant by iv and v "appear to have dropped back into line" in the first larval stage. On many grounds the Lachneids must be looked upon as a moderately generalised superfamily, although from a larval point of view they form a highly specialised one, with, however, considerable differences as to the degree of specialisation, *inter se*, and if by "dropping back" Dyar means to suggest a degeneracy from a more specialised form previously reached, we should demur, as we consider the position of these tubercles to be simply an illustration of an otherwise specialised larva retaining a useful ancestral character in the position of the warts, which parts have, however, been specialised in another direction by the development of the lateral hairs arising therefrom, in order to meet new protective needs. These hairs bend downwards to the resting-place, and thus produce a continuity of surface, which is an aid to the perfecting of the resemblance which the larva bears to its surroundings, by minimising the effect of light and shade. It is the lateral hairs (from iv and v) that most largely produce this result. The dorsal secondary hairs of some Lachneid groups develop into the well-known, offensive, urticating hairs. With regard to the ordinary primary hairs of the larvæ of this group, it would appear that those of many species are finely serrated in the first instar, but the character is soon lost, and no larva of the British species seems to have such hairs in the adult stage. One would suspect, however, from the frequency with which they occur in the early stages that the ancestral Lachneid larva had serrated hairs—those of *Poecilocampa populi*, *Trichiura crataegi*, *Malacosoma neustria*, *M. franconica*, *M. castrensis*, *Pachygastria trifolii*, and *Cosmotriche potatoria* have them when young—but the character has been gradually lost, and is now, as we have just noted, only present in the early instars of certain larvæ. The development of secondary hairs is, however, very remarkable. These, in certain specialised larvæ, present very striking developments—scale-like, spear-like, grass-blade-like, &c., in *Eutricha quercifolia*, *Dendrolimus pini*, &c., besides the long, fine, spindle-shaped urticating hairs, in *Macrothylacia rubi*, *Lasiocampa quercûs*, &c.

A most interesting note on the structure of certain scales (or modified hairs) found in the larva of *E. quercifolia* is written by Packard, who says that, in examining the median dorsal tufts on the 2nd and 3rd thoracic segments of this species, he found that they were composed of broad, lanceolate, oval scales, which were opaque and dark steel-purple in colour, with the surface quite regularly striated, though not invariably so; the striæ not appearing to extend to either end. These scales vary in shape and size, some being narrow and with a simple point at the distal end, while the majority are variously notched or toothed. They thus appear to be true scales, like those on the wings of lepidoptera. In the same species, the lateral tufts along the body, each contain a few long hairs with flattened ends, the latter varying in shape from oval to triangular, with the ends often very broad and ragged, and with from one to four very irregular teeth; no striæ are perceptible on these, and the hairs throughout are colourless and transparent. He then adds that, on examining the lateral tufts of *Gastropacha americana*, he found "some very long similar hairs flattened at the end, and of extraordinary form, usually projecting beyond the simple hairs; some ending in regular lanceolate oval shapes, with the point much attenuated, others broader, while some are oval and broad at the end which terminates in a fine attenuated point, with usually three minute teeth at the base. They are similar in shape to those of *Gastropacha quercifolia*. On turning over the beautiful plates of Burmeister's *Atlas of the Lepidoptera of the Argentine Republic*, one finds that the author represents on pl. 22, fig. 9, similar long hairs, much flattened and expanded at the ends, with three, four, or five long slender teeth, in the larva of his *Clisiocampa proxima*, which, however, seems to differ from *Clisiocampa* proper. The hairs are visible to the naked eye, and are much more regular than any I have seen, and are also striated, with beads or clear spots. In *G. americana* the scales forming the dorsal tufts both on the two hinder thoracic segments and on the 8th abdominal are very different from those of the European species; they are dark and opaque but are long, narrow, flattened, very gradually increasing in width to the end, which has a single notch, and from the single notch an impressed line or stria extends along the middle for some distance. These flattened hairs seem common to the family of *Lasiocampidae*, and should be looked for in the European species of this group. In the larva of *Heteropacha rileyana* there are no dorsal scales, but some of those in the lateral tufts have flattened ends, which are very long and slender, lanceolate oval, with the tip much attenuated. I have been unable to discover these singular scales and flattened hairs in *Clisiocampa americana*, or *C. neustria* of Europe, or in any other family of lepidoptera, except in the hairy Noctuina or Noctuo-bombyces, or Bombycoidea, where the hairs with flattened ends probably occur in the more hairy and pencilled species. In the larva of the common American *Acronycta hastulifera*, many of the barbed hairs forming the black pencils are flattened at the end and black, but not striated. These specialised and highly differentiated setæ, so like the scales of adult lepidoptera, appear to be of use in rendering the pencils and tufts more conspicuous and stiff. The shortest and broadest, striated, scale-like setæ occur on the low, broad, stout, dorsal median tubercles of *Gastropacha*, and, perhaps, add a repellent nature to these shiny dark metallic tufts. At all events the occurrence of such scales is an interesting example of the acceleration of development of the setæ in these larval forms, and it is not improbable that in the ancestors of the *Lasiocampidae* they were characters acquired during the later stages of their larval lifetime." Bacot has observed that the larva of *Dendrolimus pini* has also very specialised scales of a somewhat similar character.

We have already (*ante*, vol. i., pp. 120 *et seq.*) given a brief review of the chief general characters presented by the Lachneid larva, and have shown that the tubercles are in great measure specialised, and that there is also much specialisation exhibited in the formation of a thick hairy coat developed from the skin and not from the tubercular hairs, whilst the tubercles proper, or their warts, become atrophied in the older larval stadia. In position, i and ii form ordinary trapezoidal tubercles, i usually very strongly developed compared with ii (in *P. populi*, ii is larger), wart-like, and bearing several hairs, whilst the latter is weak and bears only a few hairs (ii is atrophied in Saturniids); iii also is poorly developed with only one or two hairs; iv and v are both subspiracular, iv large, v ill-developed, and generally coalesced with iv even in the earlier stages, whilst vi is fairly well-developed towards the base of the leg. A number of secondary hairs on the anterior portion of each segment tends greatly to obscure the true tubercular structures. The more generalised Lachneid larvæ—*e.g.*, *Eustaudingeria vandalicia*—have i and ii large and elongate transversely, an Anthrocerid feature; *P. populi* larva has, as we have noted, ii larger than i, a somewhat peculiar feature in this group, whilst in the first instar *Pachygastria trifolii*, *Lasiocampa quercûs*, *Eutricha quercifolia*, &c., have both i and ii large, many-haired warts, iii also a large many-haired wart, and iv + v a large many-haired wart, as in the Anthrocerids. On the other hand, in *Trichiura*, *Lachneis*, and *Malacosoma*, ii is very ill-developed, i being much larger. In the last-named genus iii is a single-haired chitinous-based, generalised tubercle, whilst in *Trichiura*, iii and iv + v form large many-haired warts as in *Pachygastria*, *Lasiocampa*, *Eutricha*, &c. The character of the tubercles in the first instar is well illustrated by the following table drawn up by Bacot :

Poecilocampa.—i smaller than ii, both many-haired warts, iii small (2 or 3 hairs), iv and v close together, many-haired warts (iv larger than v).

Trichiura.—i large many-haired wart, ii small single-haired tubercle, iii many-haired wart, iv + v a combined many-haired wart.

Lachneis.—i larger than ii, i with 3 or 4 large hairs, ii very small with 2 small hairs.

Malacosoma.—i much larger than ii, both chitinous warts, i large and bearing 4 or more large hairs, ii small and bearing only two small ones, iii a single-haired, chitinous-based, generalised tubercle, iv and v represented by a double generalised tubercle bearing 2 hairs.

Pachygastria.—i and ii large many-haired warts, i larger than ii, iii a many-haired wart, iv + v a large many-haired wart; also a supplementary prespiracular many-haired wart (? newly-developed not a primary tubercle).

Lasiocampa.—i and ii large, many-haired flattened warts or cushions, much more specialised and flattened than in *Pachygastria* and *Poecilocampa*, iii large, many-haired, more wart-like than i and ii, iv + v large, many-haired wart; a large supplementary prespiracular on anterior edge of segment.

Cosmotriche.—i large and many-haired wart, ii smaller (but still large) many-haired.

Eutricha.—i and ii large many-haired warts, iii large many-haired wart, iv + v very large; supplementary prespiracular on anterior edge of segment.

Dendrolimus.—i large many-haired wart, ii also large and many-haired (but smaller than i), iii a large and many-haired wart, iv + v large many-haired wart (rather posterior); supplementary prespiracular many-haired wart also present.

For comparison the tubercles of *Bombyx mori* have been worked out, and result as follows :

Bombyx mori.—i large, flat, with 4 setæ, ii minute, a chitinous button giving rise to a single hair, iii small, bearing 2 or 3 hairs, iv is post- and v subspiracular.

Bacot further notes that "compared with the Psychids, Noctuids, &c., we are on the whole correct in saying that the more generalised larvæ of the Lachneids have lost the generalised tubercles and setæ, whilst the more specialised larvæ are in a fair way to lose the many-haired warts that replace the primitive tubercles in the first instar as well. In all the Lachneid larvæ examined, with the exception of *P. populi*, i is larger and more important than ii. The reverse is the case in *P. populi*, and may point to the species having branched from the primitive stock much earlier than the others (a view supported to some extent by the characters of the egg), or, more probably, it may merely be an aberrant development from some unexplained cause. In this connection we may suppose that only a slight tendency to have a weak ii was present in the primitive stock, or we may assume that it was as strongly marked a character as in *Malacosoma*, in which genus degeneration has not even yet gone so far that it might not, under special conditions, increase at the expense of i. The chief reason for holding the view that the large size of ii in *P. populi* may be a special development is, that the lateral tubercles of *P. populi* are not so generalised as in *Malacosoma* in the first instar. It may be here remarked that the general dwindling tendency of ii observable in the Lachneids is also very strongly marked in *Bombyx mori* which is presumably related to the Lachneid as well as to the Saturniid and

Sphingid superfamilies. In this connection one may notice that although the naked Sphingid larvæ show primitive tubercles of a generalised kind in the first stage, and these may lead one to assume the larvæ to be of a more ancestral form than those of the Lachneids, yet the development of the adult Sphinx-like larva of *Endromis versicolora*, from a Lachneid-like larva in its first instar, together with a somewhat parallel development in the larva of *B. mori* suggest that the Sphingids may be a special development of the original Lachneid stirps. With regard to the supplementary prespiracular wart, already noticed as being present on the anterior border of the segments, it is highly improbable that it has any connection with the primary subspiracular tubercle v ; it must be secondary and independently developed. One may here note the prominent development of i on abdominal segment 8, which in some larvæ forms a sort of hump ; it is, one suspects, a good evolutionary character but one does not feel any confidence in dealing with it owing to a similar parallel development in the Notodonts and other more or less unrelated families."

It may be well to note here the great development of the prothoracic lateral tubercles in the early stadia of the Lachneid larvæ. Bacot terms them " ear-tubercles." Packard observes that those of the newly-hatched larvæ of *Artace rubripalpes* project outwards and consist of a large, piliferous, amber-coloured tubercle, three times as large as those behind it on the succeeding segments. Other marked features in some Lachneid larvæ are the extra size and length of the thoracic segments. One may also mention that the arrangement of the dorsal tubercles on the meso- and metathorax appear to be, in the species examined, the same as on the abdominal segments.

We have already referred to the larva of *Eustaudingeria vandalicia*, which Dyar describes as a curious larva, having but little the appearance of those of the modern *Lasiocampidae*, its abundant, rather stiff hairs and conspicuous warts giving it the appearance of an Arctian. He describes the tubercles as " i and ii large, elongate transversely, iii more rounded, iv and v in line below the spiracle, vi moderate, leg-plates pale ; on the thorax three warts above the stigmatal warts, the two upper in line longitudinally, large, equal, elongate transversely, the third wart more rounded, the stigmatal and subventral warts smaller." He adds that " this arrangement is exactly that of the first stage of *Tolype velleda*." The suppression of the larval tubercles in this latter species is discussed by Dyar (*Proc. Bost. Soc. Nat. Hist.*, xxvii., pp. 144-5) ; he observes that the arrangement of the warts in stage 1 is, in this species, as in *Clisiocampa* (*vide*, *Psyche*, vii., pp. 259-260), but the confusing secondary warts on the anterior part of the segments in the latter genus are not present here. On the abdomen v is smaller than iv, and all except i and vi are greatly reduced. These two warts, i and vi*, alone are present in the adult larva. On the thorax there are three warts above the stigmatal wart, the middle one posterior to the others. The two lower are rudimentary, and in the adult larva only three warts persist, corresponding probably to 1 + 1*b*, iv + v, and vi." It appears to us that the above description of the large tubercular warts i, ii, iii of *Eustaudingeria* agrees much more closely with that of the Eutrichids in their first instar than with *Malacosoma*

*Not ii and v as stated in *Ann. New York Acad. Science*, viii., p. 229.

(*Clisiocampa*) or *Tolype*, which have ii and iii greatly reduced (two hairs on ii and one or two only on iii in *Malacosoma*) in the first instar, although, as Dyar says, the arrangement or position is the same. In fact, there appears to be but little difference in the position of the Lachneid larval tubercles, i and ii being trapezoidal, iii supraspiracular, iv and v subspiracular, with a tendency to coalescence, and iv to be pushed back posteriorly.

Bacot says that the larval head forms a fairly good rough guide as to a generalised or specialised first stage—the former being shiny and the latter dull in appearance. Almost all the larvæ examined, except those of *Eutricha quercifolia* and *Dendrolimus pini*, have it shiny in the first instar, whilst nearly all have it dull and often brightly-coloured in the later stages.

The larvæ of the British Lachneids, according to Bacot, divide broadly into two groups (with a possible third group for *Poecilocampa populi*): (1) The Lachneid group—*neustria, castrensis, crataegi, lanestris, rubi, trifolii, quercûs*. (2) The Eutrichid group—*potatoria, ilicifolia, quercifolia*. In the latter group *E. quercifolia* is much more specialised than *C. potatoria*, and appears to be quite as highly developed among the Eutrichids as does *L. quercûs* among the Lachneids. The larvæ of the first group show a great deal of individual specialisation, but the *Malacosoma* larvæ are considered as perhaps nearest the primitive form. The larvæ of *P. trifolii*, *L. quercûs*, and *M. rubi* have the short secondary hairs developed into a loose fur, which easily rubs off, and which, by the mechanical properties due to their small size, delicacy, fineness, and sharpness, produce urtication if they enter the skin. The startling coloration of some of these larvæ—*L. quercûs*, *M. rubi*, &c.—which suddenly display their dark rings when disturbed, probably has a warning significance, and this possibly has also been the case at a previous time with the coloration still exhibited in the early stages of *P. populi*, *M. rubi*, &c., in which the rings or spots of colour exhibited by the young larvæ suggest strongly that this was at one time the adult coloration and had a warning significance, but has now been forced back to the early stages in favour of later and more successful developments. There can be no doubt that the coloration of *L. quercûs*, *E. quercifolia*, &c., are marvellously protective when at rest. Bacot considers that the oblique stripes are the most generalised larval markings, but they are much modified in some species. The subdorsal spots, dorsal coloured patches on the meso- and metathorax, as well as the blue stripes and patches on the subdorsal and lateral areas are also considered generalised characters, because remnants of them can be traced in so many species.

There is a tendency in some of the genera for the larvæ to be gregarious, and the habit is more particularly strong in the early stages and rarely (if ever) maintained in the full-grown larvæ. It is of course less marked in those species which scatter their eggs. The larvæ of *Malacosoma* generally spin large silken webs which are common to a whole brood, and this habit has obtained for them, in America, the popular name of "tent" caterpillars. Still more conspicuous is the large web, formed by *Lachneis lanestris*, which covers a considerable area, and into which the larvæ retire when not feeding or sunning themselves. Others show no tendency to be gregarious, and rest, stretched out at length on the twigs of their respective food-plants, their long subspiracular hairs bent downwards over the edge of the twig, which, added to their mottled coloration, make the larvæ very difficult of detection. Those of *Eutricha quercifolia* are perhaps pre-eminent in this respect. The adaptive protective resemblance of the larva of this species to its resting-place is much increased by the row of fleshy protuberances along the sides of the caterpillar, which enables it to rest on twigs and tree-trunks by day without casting a sharp shadow. Similar lateral developments are seen in the larvæ of *P. populi*, *Catocala*, &c., and there is no doubt that the lateral drooping hairs of *Eutricha quercifolia* and *Poecilocampa populi* help to produce a more perfect protective result. Packard says that the study of a collection of central African Lasiocampid larvæ from the Upper Congo (the group being especially well-developed in the tropics of South America, Africa, and Asia, where they rival in size the colossal *Attaci*) shows that the armature of their spines is the most formidable of any of the Bombyces (*in sensu latiore*), and he further adds that "the most spiny forms appear to be tropical, which tends to prove that originally nearly all our spiny caterpillars appeared in warm regions, whilst the densely hairy forms (*e.g.*, Arctians) predominate in cool, temperate regions." Bacot observes that the Arctiids of the temperate regions tend to have a much more spiny and formidable armature than the Lachneids of the same region.

The differences in the cocoons made by the Lachneid larvæ are very striking. *Lachneis lanestris*, *Pachygastria trifolii*, and *Lasiocampa quercûs*, make the close, hard, dense, egg-shaped cocoons from which the name Eggar has been derived, and which closely resemble the very similar cocoons spun by the Cochlidids. These cocoons are coloured with a fluid which is poured out upon the silk from the alimentary canal, and is supposed to be a chlorophyll product, whilst they are hardened by a deposit of oxalate of lime secreted in the malpighian tubules and poured out from the anus upon the silk when it has been woven. Starvation just previous to spinning by not supplying the larva with the requisite chlorophyll stain results in the formation of a pale-coloured, whitish cocoon. Some of the cocoons of *L. lanestris* are dark-coffee-coloured, and they vary through different grades of intensity to white. Even in nature some of the cocoons of *L. quercûs* are pale brown, others, especially of var. *callunae*, are frequently almost black, and one is forced to the conclusion that the general darker coloration of the cocoon of the latter is due to the different food-plants, especially if, as has been suggested, the colouring matter is a direct derivative of the chlorophyll in the food, the chlorophyll of some plants being notably darker than that of others, although it would appear also that moisture has considerable effect in darkening some cocoons. The soft, somewhat flimsy cocoons of *M. neustria* and *M. castrensis*, with their pale yellow or sulphur-coloured particles of aragonite mixed with the silk are very different from those just described, but like them, they often lose their characteristic colour, and become white. This form of cocoon is not unlike that of *Cosmotriche potatoria*, which is, however, more parchment-like, and this, again, except in colour and texture, is not very dissimilar from that of *E. quercifolia*, whilst it is very similar to that of *G. ilicifolia*. The cocoon of *Macrothylacia rubi* appears to be a very strongly modified form of the *Malacosoma* cocoon, forming a long tubular structure, sometimes three or four inches long, inside which the pupa moves up and down to take advantage of the sun. As a rule, however, the Lachneid pupa has but little freedom of movement within the cocoon, being well attached to the cast larval skin, which in turn is usually fastened to the inside of the cocoon. The cocoons of *P. populi* and *T. crataegi* are very different from those of the other British Lachneid species; they are mixed with pieces of extraneous matter, and as they are usually spun-up in a crack in the bark, or even under the surface of the ground, they bear considerable resemblance to the cocoons of some Notodonts and Noctuids.

It is a not uncommon occurrence for two larvæ of *L. lanestris* to spin a common cocoon and for both to pupate therein. Vaughan, Hewett, Foddy, and others, have recorded such, whilst Russell states that of a large brood, the majority formed single cocoons, others double, while in some instances a general cocoon was formed by three or more of the larvæ. Clark records a cocoon of *P. trifolii* with two exits, containing, however, only one pupa. This is most interesting, because this species does not spin a regular exit to its cocoon, as does *Saturnia pavonia*, in the cocoons of which, the formation of a double exit is not at all unusual. *Malacosoma neustria* also makes double cocoons occasionally.

The pupa is of the ordinary obtect type having the 5th and 6th abdominal segments free in both sexes. It has, however, the dorsal head-piece distinctly developed, and since this is a character specially distinctive of the older forms of pupæ, it suggests strongly that this superfamily is rather low down the evolutionary stem to which it belongs. On dehiscence the head-coverings remain in one piece. Chapman describes the Lachneid pupa as being of stout robust form, rounded at both ends, tapering slightly in the abdominal segments but not to a point or conical extremity, and always terminating in a blunt rounded end, not very reduced in regard to the general size of the pupa. It is usually curved in the abdominal segments, with the convexity forwards, corresponding very often with the form of the cocoon, as exemplified markedly in the pupa of *M. rubi*, but perhaps never quite absent even in such squat pupæ and cocoons as those of *Lachneis lanestris* or *Lasiocampa quercûs*. It is, perhaps, an excess of this character that gives the peculiar form of the terminal segments of the Malacosomas. The pupa has no maxillary palpi, but the labial palpi are almost always represented, often notably. The structures observable between the wings ventrally are—antennæ, first and second pairs of legs, maxillæ and labial palpi. No femora or trochanters are to be seen, and the third pair of legs is usually quite covered by the wings. There is a clothing of scattered hairs, not hairs of the definite tubercles, but stout bristly points that are distributed over the general surface, and in some species thickly stud certain parts of the pupal skin, being very pronounced, and these often, possibly owing to the movement of the pupa in the cocoon, become covered with larval hairs and the powdery material with which the larva loads the cocoon, forming a sort of felt. The pupæ of *Eutricha quercifolia* and *Gastropacha ilicifolia* are good examples of this. In many species, in which the pupa is nearly smooth, it is often much plastered with this cocoon-felt material, and in a species from Sierra Leone, the larval skin is applied to the chrysalis in a similar manner. In a few species there appears to be actually no cutaneous hairs, but in most of these, even in some with a very bright polished surface, some hairs can be found in the infra-spiracular region and on the 9th abdominal segment. The cremaster is very characteristic, it occupies the dorsal half of the 10th abdominal segment, and the end of the pupa being large and rounded, this is usually a considerable area. It is covered with short stiff hairs, almost like a cocoanut mat in some cases, even when there are hooks; where there are hooks, they are these same hairs, very numerous, of equal size, and scattered over a considerable area. In a few species, the cremaster seems to have disappeared in so far as there are no hairs or hooks. There are never any spinous hooks or processes such as we meet with in Sphingids, Noctuids, &c.

The Lachneid pupa has frequently been shown to be not unlike the Notodont, and in some cases the resemblance is somewhat marked. The points of distinction, according to Chapman, are :—

1. *Labial palpi.*—Present in Lachneid, not in Notodont pupa.
2. *Dorsal head-piece.*—Present in Lachneids (usually a very decided quadrangular piece). In Notodonts, this is usually a very narrow strip, slightly broader at one end, often evanescent, especially in the living pupa, in some of these a trace is visible after dehiscence.
3. *Hairs.*—Distributed over general surface in Lachneids. Antenna-basal hairs, and sometimes those of tubercles proper, only present in Notodonts.
4. *Texture.*—In Lachneids the texture is more soft, flimsy, and flexible, and where the surface is smooth, is often transparent. In Notodonts the texture is hard, brittle, and rarely or never transparent.
5. *Cremaster.*—In Lachneids this consists of fine hairs or hooked bristles spread over a considerable surface. In Notodonts it bears a definite spine or spines with hooks as processes of pupa. Where there is no cremaster the surface is much more polished in Notodonts.
6. *Outline.*—In Lachneids the general outline is curved as in Tortricids; in Notodonts it is straight.

In a great majority of cases these characters, or some of them, are sufficiently pronounced to enable a pupa to be referred to its proper family.

The coloration of the imagines is generally brown of some shade. This has probably been developed from a dull buff as exhibited by the undersides of such species as *T. crataegi* and *C. potatoria* ♀. The bright yellow and rich chocolate colorations met with are certainly specialised conditions of this colour. In the markings it will be noticed that there are four transverse lines crossing the forewings: (1) Very short, quite at the base. (2) Two, crossing the centre of the wing, one each side of the discoidal spot. (3) A submarginal wavy line. All the variations in the markings are shown to be modifications of these lines, and we are inclined to look on the fasciated species, as represented by *L. quercûs*, and the unicolorous aberrations of *P. trifolii*, *M. castrensis*, &c., as specialised rather than generalised forms. In the hindwings the short basal line is absent, but the three other transverse lines of the forewing are continued on the hindwing in some of the species. These transverse lines—four on forewing and three on hindwing—are, in some modified form or other, traceable throughout the Saturniids, Endromids, and Sphingids, and also in the Geometrids, Noctuids, Pyralids, &c., and, there can be but little doubt, form one of the most generalised types of marking on lepidopterous insects.

With regard to the structural peculiarities of the imago we may note that in this superfamily, Kellogg states (*Taxonomic value of scales of Lepidoptera*, p. 89) that he has examined scales of the North American genera—*Clisiocampa**, *Artace*, *Tolype*, *Heteropacha*, *Gastropacha**,

* *Clisiocampa* equals *Malacosoma* and *Gastropacha* equals *Eutricha*.

Gloveria, *Thauma*, and (the rare) *Quadrina*. The typical specialised scale is, he says, in this family "especially characterised by its many long acute fingers or teeth. These fingers vary in length compared with the whole length of the scale from tip of pedicel to tip of middle finger from one-third of this length, or even less, as in *Clisiocampa*, to two-thirds or more, as in *Tolype*. The scales of *Clisiocampa* depart most widely from the typical scale of the family in the shortness and small number of fingers. . . . The arrangement of the scales in rows (in *Gloveria*) is fairly apparent, but there is no such regularity or tiered arrangement as is represented by the more specialised Frenatæ." He further notices (*loc. cit.*, pp. 65-66) a particular form of scale specialisation, which he illustrates by reference to *Gloveria*, but which he states is, with certain modifications noted, pretty fairly characteristic of the family *Lasiocampidae*. The scale-hair becomes a little flattened and widened; then it divides at its distal end into two fingers, the cleft not extending very far along the length of the scale; a shortening of the proximal portion of the scale and a widening of that part of the scale between the pedicel and the base of the two fingers is next apparent. Then one of these fingers divides near its base and a third finger is formed, which grows out to be as long as the other two; or both the original fingers send out shoots from their bases, so that there are four fingers. The proximal portion of the scale is shortening all the time, and the space between the pedicel and the bases of the fingers is widening. The number of fingers may increase to seven or eight, and the proximal portion of the scale become so short that the fingers are twice as long as the uncleft portion of the scale. The whole line of specialisation may be well illustrated by scales taken from a single wing of *Gloveria arizonensis*.

Bodine notes that the Lachneids (with the Lacosomids* and Saturniids) are included in Comstock's Frenulum-losers, and writing of the antennæ, states (*Antennae of Lepidoptera*, p. 43) that "the most generalised antenna of this group belongs to the family *Lacosomidae*. It bears a close resemblance to the antennæ of the *Bombycidae* and the *Lasiocampidae*. In all three families the pectinations are long and slender, and arise from the ventral aspect of the segments. They are abundantly supplied with hairs of the third type and have pits along the dorsal aspect, especially near the apex of the pectinations. In the *Lacosomidae* the pectinations are scaled, and there are fewer pits along the dorsal aspect. A study of the antennæ alone would lead to the belief that the *Bombycidae* were more closely related to the *Lacosomidae* than to the other *Saturniina*. In fact, there is such a wide difference between the antennæ of the first (*Bombycidae*) and those of the last two families of the *Saturniina* (*Citheroniidae* and *Saturniidae*) that the first family would not be placed in the same superfamily were the classification based on these organs."

The frenulum is altogether wanting in the Lachneid imago, the much produced humeral angle of the hind-wings serving to keep the pair of wings together, to almost the same extent that the frenulum does.

Among other interesting points relating to the Lachneid imagines is the marked sexual dimorphism (the females much exceeding the males in size), which reaches its greatest extreme in the

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* *Vide, anteà*, vol. i., p. 123.

Pinaridae of Kirby, where, in the genus *Suana* and its allies, we find species in which the difference is most extreme, *e.g.*, the males may be only 1½in. across the wings, whilst the females may have three times that expanse. The African genus *Hilbrides* contains imagines, the wings of which are destitute of scales and hence transparent, whilst their slender form resembles that of a butterfly. The amazing power that some of the virgin females have for "assembling" the males is very remarkable, and dozens of males of *M. rubi*, *L. quercûs*, and *P. trifolii* are often attracted from great distances by such a female. The males of most of the species are strongly attracted by light, and were it not for this mode of capture (and breeding) many of the imagines would be scarcely known, and this is really the case with *L. lanestris* and *M. castrensis*, the imagines of which have rarely been observed wild in Britain, abundant as the larvæ are in many localities.

Bearing on the question of sexual dimorphism one may here note the prevalence of gynandromorphous forms in this superfamily, the difference in the sexes making the examples very conspicuous and remarkable. These specimens vary greatly in the manner and degree of combination of the sexes in the same individual. The most common form possibly is that in which the whole of one side—antenna, thorax, legs, wings, abdomen, and genitalia—is typically male and the other side female. These examples almost always show a laterally bisexual condition of the genital organs, and it would appear that this modification of the latter is always accompanied by the lateral division in which the insect shows the modification of colour, wing-shape, antennæ and leg-structure, indicating different sexes, on the two sides. It has been said that such insects (if they could be divided longitudinally through the head, thorax, and abdomen) would be cut into a male and female half. To us it seems that the modification of the sexual organs is the primary cause of the secondary sexual appearances, and that whenever the organs are modified the secondary sexual characters, as represented by wing-shape, antennæ, colour, &c., follow as a natural response to the stimulus afforded by this modification of the actual sexual organs. The species in which gyandromorphism appears to have been noticed are—*Trichiura crataegi*, *Malacosoma neustria*, *M. castrensis* and var. *veneta*, *M. alpicola*, *Lachneis lanestris*, *Macrothylacia rubi*, *Pachygastria trifolii* var. *medicaginis*, *Lasiocampa quercûs*, *L. fasciatella* var. *excellens*, *Cosmotriche potatoria*, *Dendrolimus pini*, *Eutricha quercifolia* and *E. populifolia*. The known gynandromorphous examples of British species will be dealt with at length later.

The resemblance of the resting imagines of the Lachneids to dead leaves is almost too well known to need repetition. The peculiar mode by means of which the costa of the forewing of *E. quercifolia* is made to resemble the midrib of a brown leaf, the veins being represented by the nervures of the forewing on one side and by those of the protruding "lappet" of the hindwing on the other, and the almost equally perfect resemblance of a *C. potatoria*, hanging from a stout grass or sedge culm, to a yellowish leaf, must be known to all, and Barrett records that near Norwich, some years ago, he saw a batch of eggs of *L. lanestris* on a hawthorn twig, looking particularly velvety and exquisitely arranged, so he picked the spray and had carried it several hundred yards before he discovered that an apparently dry hawthorn leaf drawn closely to the stem just below the eggs, was really the living female moth, still clinging to the place on which she had so carefully arranged them. The posture, the colour, the brown band, even the white spot harmonized in so extraordinary and unexpected a manner with its position and surroundings that even after the creature was discovered he was amazed at the deception.

With one exception, the much-vexed question of the specific identity of *Lasiocampa quercûs* and *L. callunae*, the British species of this superfamily are well-defined, and, as may be expected from the great geographical range of most of these insects, they offer considerable variation, but possibly the variation in the habits of a widely distributed species in its earlier stages is as interesting as the variation in the appearance of the imago, and it is this difference of habit that has led to the suggestion that *L. callunae* is specifically distinct from *L. quercûs*, although it is not generally known that *Trichiura crataegi* and its var. *ariae* offer an almost parallel instance of racial habits being exhibited throughout the whole period of the insects' existence, and we have in those species an excellent illustration of how isolation by diverse habits may aid in the differentiation of species from a common stock, whilst it is evident that the racial peculiarities of *L. quercûs* and *callunae* and *T. crataegi* and *ariae* have gone far towards the necessary point, although they have not yet reached it by becoming thoroughly differentiated. In Scotland, and on the high-lying moors of England, Ireland, and Wales, the imagines of *L. quercûs* emerge in June (or thereabouts), lay their eggs, the larvæ hatch out, and feed up to about the third stadium before hybernation; they subsequently feed up slowly the next summer, pupate in July or August, go over the winter in the pupal stage, and finally emerge in the following June as imagines, having taken two years to complete their metamorphoses; but among these two-year *callunae* there are occasional individuals that emerge from the cocoon in the August of the same year in which the larvæ have pupated, and thus only take one year instead of two for their ecdyses. Throughout France, and reaching well up into England as far as Yorkshire, in the lowlying parts of the country, imagines of *L. quercûs* emerge in July and August, lay their eggs, larvæ from which hybernate comparatively small, but feed up quickly in the spring, pupate in May and June, and emerge in July and August of the same year. These are the normal habits of *L. quercûs*; but among the many that do this an occasional individual remains in cocoon the whole winter, and does not emerge until the next summer, thus taking on the habits of *callunae*. Thus in one brood it is possible to get part with the habits of one form and part with the habits of the other. In the cold season of 1888, almost all larvæ of *L. quercûs* collected in Kent continued to feed throughout the cold summer until August, then pupated, and went over the winter in this stage, adopting the *callunae* habit at once under unfavourable conditions. It appears that in the southern lowlying districts the percentage of individuals that go over is a small one, but gradually increases as we go north (or reach a higher altitude), until, when we reach the Highlands of Scotland (or the hill-moorlands), the individuals have a fixed habit, requiring two years to come to maturity. In the warm parts of France all are *L. quercûs*, and have the *quercûs* habit. In the mountains of France and Piedmont we have found the larvæ at considerable elevations, and here the *callunae* habit again prevails.

The peculiarities cited concerning the life-histories of *L. quercûs* and *callunae* are still more complicated in the case of *T. crataegi* and *ariae*, for the larvæ of both the first-named forms hybernate once as larvæ, the *callunae* form having developed the power to hybernate a second time as a pupa, but the normal *T. crataegi* hybernates as an egg, feeds up rapidly in spring, pupates in June, and emerges in August and September, whilst according to Schneider, *ariae* hybernates first as a quite small larva, is full-fed in July or August, hybernates a second year as pupa, the imago appearing the next June. This is so entirely different from the normal habits of *T. crataegi* (and the hybernating habit of many species is so constant) that one is at first somewhat astonished at an insect that can hybernate as egg, larva, and pupa, and emerge at an earlier period of the year than the typical form of the same species. One can understand at once, that *ariae* is absolutely isolated by its time of appearance, habits, and habitat, from the type, and must sooner or later become a species apart. *P. populi*, that normally hybernates as an egg, is stated by Sharp to have its pupal stage prolonged for several years, whilst *P. trifolii* which is stated by most continental authorities to hybernate as a young larva, hybernates in Britain as an egg, although the larva is fully formed all the winter within the shell, and only awaits the early spring to gnaw its way out. Most of the species can pass a second winter as pupa, but *L. lanestris* is, *par excellence*, superior to all others in this respect.

Lachneis lanestris is on the wing in Britain in February, its habit of going over several years in the pupal stage is very remarkable, and a period of seven years has been recorded before the living pupa gave up its imago, three, four, and five years, form not at all an unusual period, and the imago always emerges true to its own particular time. *Gastropacha ilicifolia* is a very rare species in Britain, found in moorland districts, the imago appearing in late April and May; *Macrothylacia rubi* also appears in May, as does *L. quercûs* var. *callunae* continuing, however, through June; in July, typical *Lasiocampa quercûs*, *Malacosoma castrensis*, *M. neustria*, *Cosmotriche potatoria* and *Eutricha quercifolia* are on the wing, and last well into August. In the latter month, *Pachygastria trifolii*, a very local insect, appears in the New Forest and in various coast localities, whilst *Trichiura crataegi*, appearing in August, lasts well into September; *Poecilocampa populi*, more often appears in November and December, but the coldest January does not prevent the late specimens from emerging, and they may sometimes be found, with the temperature far below freezing point, clinging to the gas-lamps, for, like almost all Lachneids, light has a fatal attraction for this species; it has also been found frozen stiff, and embedded in ice, but has recovered after being brought into a warm room. Most of these species are well distributed and common. We captured all except *G. ilicifolia*, *M. castrensis* (which abounds on the marshes of Essex and Kent bordering the Thames), and *P. trifolii*, the first year we systematically collected insects; still *L. lanestris*, *T. crataegi*, *E. quercifolia*, and *P. populi* are species not to be found without careful search in many districts.

It would appear that the correct name for this superfamily is Lachneides and not Lasiocampides by which it has been recently pretty generally known. Historically the superfamily seems to have been eliminated somewhat as follows: Linné included it in the

"*Bombyx*" group of the *Phalaenae*, and it received the same appellation from Fabricius. Esper and Borkhausen broke up Linné's *Bombyx*, the former including the Lachneids in the section described as "Bombyces elingues alis reversis," whilst the latter placed them in his "Bombyces incubantes." Schrank appears to have been the first author to have separated them under a distinct name; this he did in 1802, calling (*Fauna Boica*, ii., Abth. 2, pp. 153-155) the whole group *Lasiocampa*. He included *dumeti* under this title. His note 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*.

In 1806, Hübner, in the *Tentamen*, founded three genera†—*Lachneis* for *catax*, *Eutricha* for *quercifolia*, *Trichoda* (which, however, was pre-occupied) for *neustria*. This was the first real subdivision of the superfamily into genera, and, since *catax* is congeneric with *lanestris*, it gives us the two oldest genera, applicable to our British species, as *Lachneis* and *Eutricha*. Latreille's action, in 1809, appears to have influenced the synonymy of the group. The reference in which he subdivides *Bombyx* reads (*Genera*, &c., iv., p. 218) as follows:

A. *a*. *Saturnia*—*pavonia*, *tau*.
  b. *Bombyx*, *Lasiocampa*, Schrank.
    * Palpi producti et ad rostelli modum conniventes—*quercifolia*, *populifolia*, *potatoria*, &c.
    ** Palpi ad rostelli modum non producti—*neustria*, *castrensis*, *mori*, *quercûs*, *lanestris*, &c.
  c. *Laria*—*bucephala*, *coryli*, *pudibunda*, *dispar*, *versicolora*, *anachoreta*, &c.

If this has any restrictive influence at all, it would appear that—*mori* being already (since 1798) the type of *Bombyx*, *quercifolia* the type of *Eutricha*, Hb., and *lanestris* the type of *Lachneis*, Hb.—the type of *Lasiocampa* must be either *quercûs*, *populifolia*, *potatoria*, *neustria* or *castrensis*.

In 1810, Ochsenheimer created the genus *Gastropacha*, quoting (*Die Schmett.*, iii., p. 139) *Lasiocampa*, Schrank and Latreille, as a synonym, but it evidently had more than a generic significance to the author, for he subdivided it into seven sections as follows:

A. *Ilicifolia*, *betulifolia*, *populifolia*, *quercifolia*, *pini*, *pruni*.
B. *Potatoria*, *lobulina*.
C. *Trifolii*, *medicaginis*, *quercûs*, *rubi*.
D. *Taraxaci*, *dumeti*.
E. *a*. *Populi*, *crataegi*, *processionea*, *pityocampa*.
  β. *Catax*, *everia*, *lanestris*.
  γ. *Loti*, *franconica*, *castrensis*, *neustria*.

It is clear, therefore, that Ochsenheimer recognised that his *Gastropacha* was really of family rank, and capable of being grouped into several natural sections.

In 1811-12, Germar diagnosed (*Sys. Gloss. Prodromus*, sect. i., pp. 16-17; sect. ii., pp. 46-50) certain of these groups as follows:

Eriogaster.—Palpi duo, brevissimi, hirsutissimi, subglobosi. Lingua nulla. Antennæ filiformes, (maris pectinatæ)—*lanestris*,* *everia*, *catax*, *populi*,* *processionea*,*

† These actually were written to represent families as well as genera, as follows: —Lachneides—*Lachneis catax*. Eutrichæ—*Eutricha quercifolia*. Trichodæ—*Trichoda neustria*. These correspond exactly with stirps x, xi, and xii of the *Verzeichniss*, where they are described.

* Species which Germar had himself studied.

pityocampa. Genus omnino distinctum, quod præsertim abdomine feminarum lanato, masculorum barbato dignoscitur. Auctores Systematis Viennensis et Borkhausen species hoc loco relatas in propriam familiam congesserunt at perperam *Bombyces crataegi*, *ulula*, *neustria*, etc., illis immiscuerunt.

Lasiocampa, Schrank.—Palpi duo compressi, porrecti, hirsutissimi, biarticulati, articulo secundo elongato, obtuso. Lingua nulla. Antennæ filiformes, (maris pectinatæ)—*dumeti*,* *taraxaci*, *rubi*,* *quercûs*,* *medicaginis*,* *trifolii*,* *lobulina*,* *pini** [Genus proprium (*Dendrolimus* olim mihi), ob linguam spiralem abbreviatam constituere possit, attamen ad interim huic generi subjeci], *neustria*,* *castrensis*,* *franconica*, *crataegi*.*

Odonestis.—Palpi duo porrecti, hirti, triarticulati, medio dilatati, apice attenuati, reversi. Lingua brevissima. Antennæ filiformes, (maris pectinatæ)—*pruni*,* ? *potatoria** (potius ad sequens referendæ).

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

It would appear that, Hübner's *Lachneis* having already taken *catax*, *lanestris* and *everia*, the name *Eriogaster* must be applied to *populi*, *processionea* or *pityocampa*, of which the author had seen *populi* and *processionea*. His generic diagnosis "female with woolly abdomen" does not, however, agree with *populi*, which, therefore, cannot form the type of the genus. At the same time, of the five species left by Latreille as possible types of *Lasiocampa*, Germar retains only three —*quercûs*, *neustria* and *castrensis*—thus limiting the possible use of the name to these. The last two were removed by Hübner who placed them in *Malacosoma* leaving *quercûs* the residuary type of *Lasiocampa*.

It is, however, in Hübner's *Verzeichniss*, pp. 184-193, that the first real grouping of the species into classified named sections occurs. Here we find the following groups referring to the species we have now to consider:

Stirps X. *Lachneides*.—The body with very copious hairs, unicolorous; wings rounded, margins entire; abdomen moderately stout.

Fam. A. *Pigiacae*.—Wings thinly scaled, grey or brown, abdomen broad at the anus.

Coitus 1. *Thaumetopoeae*—*Thaumetopoea*** *processionea*,‡ and *T. pityocampa*.

Coitus 3. *Dasysomata*—*Dasysoma*|| *catax*, *D. everia*, *D. lanestris*.

Fam. B. *Vulgares*.—Both pairs of wings of considerable size; abdomen moderately hairy.

Coitus 1. *Pachygastriae*—*Pachygastria*§ *trifolii*, *P. spartii*, *P. quercûs*, *P. medicaginis*.

Coitus 2. *Metanastriae*—*Metanastria hyrtaea*, *M. aconyta*, *M. rubi*.

Coitus 5. *Periphobae*—*Periphoba amalia*, *P. dumeti*.

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* Species which Germar had himself studied.

† *Quercifolia* and *populifolia* are congeneric *teste* Aurivillius, but *quercifolia* is the type of *Eutricha*, Hb., therefore *quercifolia* and *populifolia* are eliminated from *Gastropacha*, Ochs., leaving by Germar's restriction *betulifolia* and *ilicifolia* as possible types. These are congeneric *teste* Aurivillius, and we would name *ilicifolia* the type.

** Evidently synonymous with *Eriogaster*, Germ., of which *processionea* is the only admissible type.

‡ Apparently the residuary type of *Eriogaster*, *populi* not agreeing with the generic diagnosis (*vide suprà*).

|| Therefore distinctly a synonym of *Lachneis*.

§ Heterotypical. *P. trifolii* by the elimination of *quercûs* as the type of *Lasiocampa* became the type of *Pachygastria*.

Coitus 10. *Diaphonae*—*Diaphone elegans* (=*sylviana*, Stoll.), *D. populi*,* *D. crataegi*.*

Stirps XI. *Eutrichae*.—Forewings long, hindwings short, both pairs with almost dentated margin.

Fam. A. *Justae*.—Wings distinctly dentated with waved stripes.

Coitus 1. *Cosmotrichae*.—Forewings with white central markings and oblique dark stripes—*Cosmotriche*‡ *potatoria*, *C. lobulina*, *C. lunigera*.

Coitus 3. *Lasiocampae*.—Wings with almost entire margins; only the forewings marked with dentated bands—*Lasiocampa*|| *capensis*, *L. pini*, *L. bibula*, *L. hirta*.

Coitus 4. *Chrostogastriae*—*Chrostogastria pruni*.

Coitus 5. *Phyllodesmae*.—Both pairs of wings very marked and large-toothed; abdomen very large—*Phyllodesma phidonia*, *P. quercifolia*,† *P. ilicifolia* (= *betulifolia*, Esp., vii., 2-3), *P. tremulifolia* (= *P. ilicifolia*, Esp., Hb., 191-192).

Stirps XII. *Trichodae*.—Wings entire; body moderately long.

Fam. A. *Hebescentes*.—Both pairs of wings of much the same form; only the forewings distinctly marked.

Coitus 6. *Malacosomata*.—The forewings with two almost straight lines; hindwings without markings; both with the fringes somewhat chequered. *Malacosoma*§ *loti*, *M. castrensis*, *M. neustria*, *M. disstria*, *M. franconica*.

Hübner's stirpes x and xi evidently represent broadly the two main families into which our Palæarctic species fall, and will presumably, in conformity with modern spelling, be termed the *Lachneidae*, and *Eutrichidae*. His minor divisions also are usually very fairly natural ones except the family *Pigiacae*, which contains two very divergent coitus in *Thaumetopoea* (Eupterotids) and *Dasysoma* (true Lachneids). We are inclined, however, to consider his *Malacosomata* a constituent branch of stirps x, although the peculiarities exhibited by its mode of egg-laying, the somewhat generalised larval structure, the unusual modification of the pupal anal segments, &c., leave much to be said for Hübner's view.

In 1827, Curtis cited *quercûs* as the type of *Lasiocampa*, which was accurate from the fact that it was the residuary type as soon as Hübner had created *Malacosoma* for *neustria* and *castrensis*, *loti* being inadmissible (see *suprà*) as the type of the latter genus, and Curtis' action makes the matter quite clear. Meigen's genus *Euthrix* erected in 1830 (*Sys. Besch. Eur. Schmett.*, ii., p. 191) for *quercifolia*, *populifolia*, *betulifolia*, *ilicifolia*, *pruni*, *pini* and *potatoria*, need only be mentioned because it is considered by some authorities to have some bearing on the correct name to be applied to the last-named species.

So far was Hübner in advance of his time that we find no authors recognising his excellent work until quite recently, and we observe

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* *Populi* was eliminated by Stephens as the type of *Poecilocampa* and *crataegi* as the type of *Trichiura*, in 1829, leaving *elegans* the residuary type of *Diaphone*.

‡ *Lobulina* and *lunigera* are not permissible types of this genus, not having "oblique dark stripes," and thus disagreeing with the generic diagnosis.

|| This is an impossible usage of *Lasiocampa*, as it does not include either of the permissible types—*quercûs*, *castrensis*, or *neustria*.

† *Quercifolia* is already the type of *Eutricha*, and *ilicifolia* the type of *Gastropacha*, so that it leaves *phidonia* the type of *Phyllodesma*.

§ *Loti* is not congeneric with the other species and does not agree with the generic description. This really leaves *Malacosoma* a monotypical genus, and removes *castrensis* and *neustria* as possible types of *Lasiocampa*. This makes *quercûs* the residuary type of *Lasiocampa* and consequently *trifolii* the residuary type of *Pachygastria*.

that Stephens, in 1829, reverted to the name *Bombycidae*, apparently unaware that Cuvier, in 1798, had designated *mori*, Linn., as the type of *Bombyx*, a determination in which Schrank acquiesced. Boisduval, in 1840, included the superfamily in his *Bombycini*, whilst Duponchel in 1844, retaining the name *Lasiocampidae* for the Eutrichid group, placed the Lachneids (*in sensu strict.*), in his *Bombycidae*, but still included the genera *Cnethocampa* and *Crateronyx* in this section. Herrich-Schäffer, in 1847, included the superfamily in his *Gastropacha*, but later, in 1856, changed the name to *Bombycoidea*, and called the Eupterotids, *Lasiocampina*, whilst in 1848, Boheman, following Boisduval, used *Bombycini*. Rambur, in 1866, again gave the Lachneids superfamily rank, but termed them LASIOCAMPIDES, a name by which they have since been pretty generally known, although Snellen, in 1867, treated them as a single genus under the misapplied term *Bombyx*, and Wallengren (1869) and Guénée (1875) termed them *Bombycoidae* and *Bombycidae* respectively, whilst Ström (1891) called them *Gastropachidae*, and Kirby (1892) separated the large group of which *Andraphisia*, *Suana*, and *Pinara*, are well-known genera, and in which the sexual dimorphism is exceedingly strongly marked, as *Pinaridae*, from the more typical group, for which he retained the name *Lasiocampidae*. But Grote, in 1888, had utilised Hübner's earlier name, and gave them subfamily rank under the name *Lachneinae*, a title which Dyar has maintained (except that he has allowed the group family rank) as *Lachneidae*. The question now arises as to which is the correct superfamily name—LASIOCAMPIDES or LACHNEIDES. As a group name there can be no doubt that Hübner's LACHNEIDES is the oldest (1806) plural form. It is the oldest name, too, under which the group was first really classified (*cir.* 1826), and although it is evidently in its conception synonymous with Schrank's *Lasiocampa* (1802), it must be conceded that if the law of priority is to be applied to superfamily and family names (which must be in plural form) the superfamily must be called LACHNEIDES.

We may here note the persistence with which authors include in this family the Eupterotids. Aurivillius, too, has pointed out in his excellent memoir (*Iris*, vii., pp. 121-192) that in Smith's *List of the Lepidoptera of Boreal North America*, the genera *Pseudohazis*, *Hemileuca*, *Sericana*, &c., which are quite outside the Lachneid limits, are included therein, whilst he asserts that almost half the genera admitted by Kirby in his *Catalogue* (1892) should be excluded.

However widely views may differ as to the main subdivisions of the Lachneids, it is quite evident that Staudinger's grouping of the whole superfamily into 4 genera is unsatisfactory. On this subject Aurivillius speaks very clearly: "The older authors—Germar, Hübner, Curtis, Stephens, Boisduval and Duponchel—erected several very good genera, but, as discovery went on, and all the species could not be fitted into them, Herrich-Schäffer, Heinemann and Snellen, instead of founding new genera, united all into one genus. This, as the family is a natural family, may be called a natural genus, but the differences exhibited by the individuals included within this are so considerable as to warrant generic separation, and if they are to be divided, it is clear that Lederer's few arbitrary divisions (followed by Staudinger) are not satisfactory."

Aurivillius then states that he finds it necessary to divide the

Palæarctic species into 21 genera, all of which are proved to be natural since the early stages confirm the characters derived from the imago. His survey of the genera is set forth in two dichotomous tables, the first one based on the imago, the second on the fullgrown larva. Section A takes off *Chondrostega*, B embraces the remainder. The following are his characters for the second section.

THE IMAGO.

B. Discoidal cell of forewings always completely, of hindwings at least partially, closed. Hindwings with basal cell. Nervure 11 of forewings always running into the costa, and 10 never into the hind-margin. The forehead naked or only with *one* protuberance.

a. Nervure 8 unites shortly after the base, for a short distance with the front median nervure, but is then free and widely separated from 7. The transverse nervures of h.-w. in their anterior part more or less indistinct . 2. MALACOSOMA.

b. 8 of h.-w. unites in a point or anastomoses for a distance with 7, or is united by a transverse nervule with it or with the front median nervure. The transverse nervules of h,-w. complete.

* Nervure 8 is at first united, as far as the commencement of 7 with the front median nervure, and then proceeds either from the same point as 7 or else anastomoses therewith.

a'. Wings with dense mealy scales; nervure 9 of forewings to outer margin .. .. 3. TRICHIURA.

a''. Wings thinly scaled, nervure 9 of f.-w. into the costa, or rarely into the apex .. .. 4. POECILOCAMPA.

** 8 of h.-w. never united with front median nervure, the basal cell accordingly reaches at least to the beginning of nervure 7.

a'. 8 of h.-w. anastomosed with 7 from base .. .. 5. ERIOGASTER (=LACHNEIS).

a'. 8 of h.-w. not anastomosed with 7 until after the commencement thereof, or united by a transverse nervure, or even not connected at all.

b'. Basal cell of h.-w. of moderate size, always narrower and usually shorter than the middle cell. Nervure 8 touches 7 or is connected with it by a very short transverse nervule.

c'. 8 of f.-w. arises before the apex of the cell.

d'. Wing-margin and fringe entire.

e'. Nervures 4 and 5 of h.-w. separate; 3 arising a long way before hinder angle.

f'. Palpi short, densely scaled, eyes hairy.

g'. Basal cell of h.-w. long, extending far beyond the middle of the median cell, without distinct supplementary nervures. F.-w. without, or with only one transverse nervule .. .. 6. LASIOCAMPA.

g''. Basal cell of h.-w. short, scarcely reaching the middle of median cell, with two strong supplementary nervures. F.-w. with two transverse nervules .. 7. MACROTHYLACIA.

f''. Palpi long, thin, bristly-haired, the terminal joint long. Eyes naked. 8 of f.-w. always from the stalk of 9 and 10 .. .. 8. AMURIA.

e''. 4 and 5 of h.-w. stalked, 3 separately out of the hinder angle. Basal cell of h.-w. with two supplementary nervures.

f'. 8 of f.-w. out of the middle cell; 9 to margin near apex 11. CHILENA.

f''. 8 of f.-w. out of the stalk of 9 and 10; 9 into the costa 21. BHIMA.

d''. Wing-margin dentate or distinctly waved. 4 and 5 of h.-w. shortly stalked.

e'. Tarsi with appressed scales. Costa of h.-w. straight.. 17. DENDROLIMUS.

e''. Tarsi at least haired on outer side of base. Costa of h.-w. irregularly arched.. .. .. 16. ODONESTIS.

e''. Nervure 8 of f.-w. arises behind apex of cell, out of stalk of 6 and 7. Wing-margin entire. Nervures 4 and 5 of h.-w. stalked, 3 free, out of hinder angle. 9 of f-w. to outer margin, 10 to apex. Eyes naked.

d'. 4 and 5 of f.-w. with long stalk out of the hinder angle, 3 arising just before the hinder angle.. .. 18. PACHYPASA.

d''. 4 and 5 of f.-w. separate from hinder angle, 3 originating a long way before the hinder angle.

e'. Palpi protruding or descending. Front tibiæ without "Schienenblatt." Outer margin of f.-w. longer than hind margin .. .. 20. TARAGAMA.

e''. Palpi ascending. Front tibiæ with large "Schienenblatt." Outer margin of f.-w. scarcely so long as hind-margin .. .. 19. PARALEBEDA.

b''. The basal cell of h.-w. large and broad, as broad as or broader than the middle cell and often but little shorter, terminated by a long transverse nervule.

c'. The wing-margin and fringes entire.

d'. 6 and 7 of the f.-w. free, out of the front angle. 8 of f.-w. into hind margin, 9 into apex .. .. .. 9. DIPLURA.

d''. 6 and 7 of f.-w. long-stalked; 9 of f.-w. into outer margin, 10 into apex .. .. 10. NADIASA.

c''. Margin of wing and fringes wavy or dentate, 6 and 7 of f.-w. stalked, 8 out of front angle.

d'. 9 of the f.-w. into the apex, 8 of h.-w. connected by transverse nervule with 7, and gives off behind the basal cell no supplementary branch towards costa.

e'. Costa of h.-w. not emarginate. Stalk of 9 and 10 of f.-w. shorter than the free part of nervure.

f'. Costa of h.-w. strongly arched. Palpi very long, with long cylindrical terminal joint.. .. .. .. 12. COSMOTRICHE.

f''. Costa of h.-w. straight, palpi short, with small, knobbed terminal joint .. .. 13. SELENEPHERA.

e''. Costa of h.-w. before the extremity of nervure 8 deeply emarginate. Stalk of 9 and 10 much longer than the free part thereof .. .. 14. EPICNAPTERA (=GASTROPACHA).

d''. 9 of f.-w. into the outer margin, 8 of h.-w. connected by transverse nervule with front median, and sends out behind the extremity of the basal cell a branch towards costa .. .. 15. GASTROPACHA (=EUTRICHA).

THE FULL-GROWN LARVA.

B. Body without (well-developed) warts, or only with 2 dorsal and some very few small lateral ones on each segment.

a. All segments similarly haired (and marked). Sides always without "lateral streaks" [see *infra* at b*].

* All the hairs rather uniformly distributed over the surface of the body, without forming groups or areas of densely crowded hairs.

a'. Body cylindrical.

b'. No warts; head blue-grey; body marked with gaily coloured longitudinal lines .. .. 2. MALACOSOMA.

b''. Segments 4-11 each with two rather large dorsal warts; head black; body without longitudinal lines .. 3. TRICHIURA.

a''. Body somewhat flattened, without dorsal warts; the first three segments with rather large, foot-like lateral protuberance .. .. 4. POECILOCAMPA.

** Some hairs (different in colour and length from the rest) form distinct groups or clothe particular areas.

a'. Each segment on the dorsum with two small groups or tufts of short stiff (red or yellowish-red) hairs .. 5. ERIOGASTER. (=LACHNEIS).

a''. The whole dorsum between the larger hairs clothed with shorter, closely-crowded more or less appressed hairs (felt-hairs), which are arranged in five or six, more or less distinct, transverse lines.

b'. The "felt-hairs" of the dorsum extend also to the sides	6. LASIOCAMPA.
b''. The "felt-hairs" of dorsum are separated from the lateral hairs by a sharp colour-boundary	7. MACROTHYLACIA.
b. Some segments different from others in the hair-clothing or in particular markings ("Prachtflecke," *i.e.*, "show" or "splendour" spots).	
* All segments, or at least segments 6-10 beneath, on the sides, with 2-4 short streaks, which are clothed with appressed silky hairs ("Seidenstriche," *i.e.*, "silk-strokes").	
a'. Body cylindrical without lateral flanges; the dorsum more or less clothed with hair-tufts.	
b'. Segments 6-12 dorsally without hair-tufts.	
c'. Segments 2-5 dorsally with 4-6 short hair-tufts ..	9. DIPLURA.
c''. Only segments 2 and 3 with hair-tufts..	11. CHILENA.
b''. Also segments 6-11 dorsally with hair-tufts; segments 2-11 with a long dorsal tuft.	
c'. At least segments 4-10 each dorsally with two longitudinal rows of 3-5 short hair-tufts	12. COSMOTRICHE.
c''. Segments 3-10 dorsally with four hair-tufts densely placed	13. SELENEPHERA.
a''. Body flattened with distinct leg-like lateral flanges on all segments; dorsum without hair-tufts, but with two "Prachtflecke" on segments 2-3.	
b'. The "Prachtflecke" entirely naked	14. EPICNAPTERA.
b''. The "Prachtflecke" densely clothed with scales ..	15. GASTROPACHA.
** All segments without lateral "strokes," but with leg-like flanges on the sides.	
a'. Dorsum only with one almost naked "Prachtfleck" (on the two segments)	16. ODONESTIS.
a''. Dorsum with two large "Prachtflecke" (on segments 2 and 3) which are densely clothed with bristly hairs.	
b'. Segments 4-11 dorsally with two distinct warts, or replacing the warts two small groups of bristles or scales, or entirely scaled.	
c'. Body almost cylindrical, only a little flattened; the lateral flanges well-developed only on the 1st-3rd segments	17. DENDROLIMUS.
c'', Body broad and much flattened; lateral flanges well-developed	18. PACHYPASA. 20. TARAGAMA.*
b''. Dorsum wholly without warts, fascicles of bristles or scales	19. PARALEBEDA.

Following this, in 1898, Dyar published a paper entitled "Revision of the Lachneidae" (*Canadian Entomologist*, vol. xxx., pp. 2-6). In this a synoptic table of the genera was published which reads as follows:

1.	Secondaries with veins 7 and 8 from intercostal cell, the bar short, or vein 7 from the subcostal vein	2
	Secondaries with very large intercostal cell, vein 7 near 6; the bar long..	23
2.	Primaries ♀ long and narrow, apex produced	3
	Primaries broader	5
	Wings of female absent	30
3.	Primaries with veins 8 to 10 stalked	BHIMA.
	Primaries with vein 8 not stalked	4
4.	Secondaries with veins 4 and 5 stalked	TARAGAMA.
	Secondaries with veins 4 and 5 from the angle of the cell	SUANA.
5.	Costa of secondaries highly excised..	LEBEDA.
	Costa of secondaries slightly or not at all excised.. ..	6
6.	Primaries with veins 6, 7 free or stalked; 6 to 8 stalked; 4, 5 of secondaries as above	7

* A footnote states that Aurivillius knows only one larva in each genus, and that he will not, therefore, venture to indicate the differences.

	Primaries with 6 to 8 stalked; 3 to 5 of secondaries stalked	Syrastrena.
	Primaries with veins 7 and 8 stalked	21
7.	Outer margin of primaries evenly rounded..	8
	Outer margin of primaries crenulate	Dendrolimus.
	Primaries with the outer margin angulated and excised ..	Bhareta.
8.	Palpi long	9
	Palpi short	10
9.	Veins 6 and 7 of primaries from cell	Arguda.
	Veins 6 and 7 stalked	Odonestis.
10.	Cell of both wings closed	11
	Cell of primaries closed, of secondaries open	20
	Cell of both wings open	Trabala.
11.	Very large (80mm. to 110mm.); primaries rather elongated	Pachypasa.
	Smaller, primaries trigonate; veins 4 and 5 of secondaries from the cell	12
12.	Female with large, thick, hairy anal tuft	Eriogaster.
	Female without this tuft	13
13.	Veins 9 and 10 of primaries on a stalk half-way to apex or less	14
	Veins 9 and 10 on a stalk more than half-way to apex of wing	18
14.	Small species, wings short, 7, 8 of secondaries stalked from narrow and very small intercostal cell	17
	Moderate sized, 7, 8 from distinct, elliptical, intercostal cell	15
	Moderate sized; veins 6 to 8 of primaries stalked.. ..	Edwardsimemna.
15.	Sexes similar, wings broad	16
	Sexes dissimilar, wings more elongate	Gloveria.
16.	Intercostal cell of secondaries, half as long as discal cell..	Lasiocampa.
	Intercostal cell of secondaries shorter	Macrothylacia.
17.	Veins 4 and 5 of secondaries from angle of cell	Trichiura.
	Veins 4 and 5 of secondaries stalked	Chilena.
18.	Vein 8 of primaries from cell; 4, 5 of secondaries from cell	Poecilocampa.
	Vein 8 on a stalk; 4, 5 of secondaries from cell; antennæ short	19
	Vein 8 on a stalk; 4, 5 of secondaries stalked	Hypopacha.
19.	Thorax evenly haired	Artace.
	Thorax or base of abdomen with a patch of long spatulate hairs	Tolype.
20.	Outer margin of both wings crenulate	Crinocraspeda.
	Outer margin entire	Malacosoma.
21.	Primaries with vein 6 from the cell..	22
	Primaries with vein 6 stalked with 7 and 8	Alompra.
22.	Female with a large abdominal tuft of hairs; veins 4, 5 of secondaries from cell	Lachneis.
	Female without this tuft; veins 4, 5 of secondaries stalked	Kosala.
23.	Primaries with the stalk of 9, 10 short, less than half-way to apex	24
	Primaries with the stalk long, more than half-way to apex	27
	Primaries with the stalk reaching the apex, vein 10 absent	Hetropacha.
24.	Primaries short, apex rounded	Lenodora.
	Primaries longer, apex square or acute	25
25.	Palpi long	Cosmotriche.
	Palpi short	26
26.	Outer margin of primaries crenulate; head prominent ..	Selenephera.
	Outer margin entire; head sunken	Diplura.
27.	Secondaries with vein 3 from the cell	28
	Secondaries with veins 3 to 5 stalked	Estigena.
28.	Palpi long; anal angle of primaries slightly emarginate..	29
	Palpi short; anal angle of primaries with a square notch	Epicnaptera.
29.	Primaries produced at apex, outer margin very oblique ..	Stenophylloides.
	Primaries broader; outer margin convex, crenulate ..	Eutricha.
30.	Forewings of male with twelve veins; female without woolly anal tuft	Eustaudingeria.

In 1898, Grote published "Die Lachneiden der europäischen

Fauna" (*Illust. Zeitschrift für Entomologie*, iii., pp. 70-71). In this he catalogued the European species and made some alterations in the synonymy. We shall attempt to justify the synonymy that we shall ourselves use, but it may be well here to compare that of the British species as used by Kirby (1892), Aurivillius (1894), Dyar (1898), and Grote (1898).

Kirby.	Aurivillius.	Dyar.	Grote.
Poecilocampa populi	*Poecilocampa populi*	*Poecilocampa populi*	*Poecilocampa populi**
Trichiura crataegi	*Trichiura crataegi*	*Trichiura crataegi*	*Achnocampa*† *crataegi*
Clisiocampa neustria	*Malacosoma neustria*	*Malacosoma neustria*	*Malacosoma neustria*
Clisiocampa castrensis	*Malacosoma castrensis*	*Malacosoma castrensis*	*Malacosoma castrensis*
Macrothylacia rubi	*Macrothylacia rubi*	*Macrothylacia rubi*	*Macrothylacia rubi*
Eriogaster lanestris	*Eriogaster lanestris*	*Eriogaster lanestris*	*Eriogaster lanestris**
Lasiocampa quercûs	*Lasiocampa quercûs*	*Lasiocampa quercûs*	*Lasiocampa quercûs*
Lasiocampa trifolii	*Lasiocampa trifolii*	*Lasiocampa trifolii*	*Lasiocampa trifolii*
Philudoria potatoria	*Cosmotriche potatoria*	*Cosmotriche potatoria*	*Euthrix potatoria*
Gastropacha quercifolia	*Gastropacha quercifolia*	*Eutricha quercifolia*	*Eutricha quercifolia*
Phyllodesma ilicifolia	*Epicnaptera ilicifolia*	*Epicnaptera ilicifolia*	*Phyllodesma ilicifolia*

The disagreements between these authors will be dealt with in our notes on each genus.

Practically nothing has been written relating to the phylogeny of the Lachneids, and the little that we have seen does not commend itself as bearing out the result of our limited study of the group. We have already stated (*ante.*, vol. i., pp. 111-112) that Dyar's position (*Proc. Bost. Soc. Nat. Hist.*, xxvii., p. 146) is quite untenable, for he derives them from the Notodonts, a superfamily which, from egg, larval and pupal characters, most certainly belongs to our Noctuo-Hepialid stirps. Packard's suggested derivation (*Bombycine Moths of America*, p. 83) through the specialised Arctiid groups, *Lithosiidae* and *Syntomidae*, appears to us to be still more impossible, and to be negatived by all the characters that have yet been studied. Meyrick appears (*Handbook*, p. 22) to have not given his *Lasiocampina*, at any rate, an impossible phylogeny, since he derives them from his *Psychina*, which is essentially our position, except that we do not derive one from the other but make them members (low down) of a common stirps. He states (*loc. cit.*, p. 319) that, "a near relation to the *Psychina* is indicated by the pseudoneuria or false veins which are often developed (in exotic forms sometimes much more numerously) as branches from vein 8 of the hindwings to the costa; these are very subject to variation, and are also frequently ill-defined or irregular, or partially obsolete." Although not questioning the general position indicated by Meyrick for the origin of the group, we are somewhat inclined to disagree with his reasons for giving them this position and we would suggest that he has mistaken two parallel cases of evolution for a relationship, the development of these extra nervules being

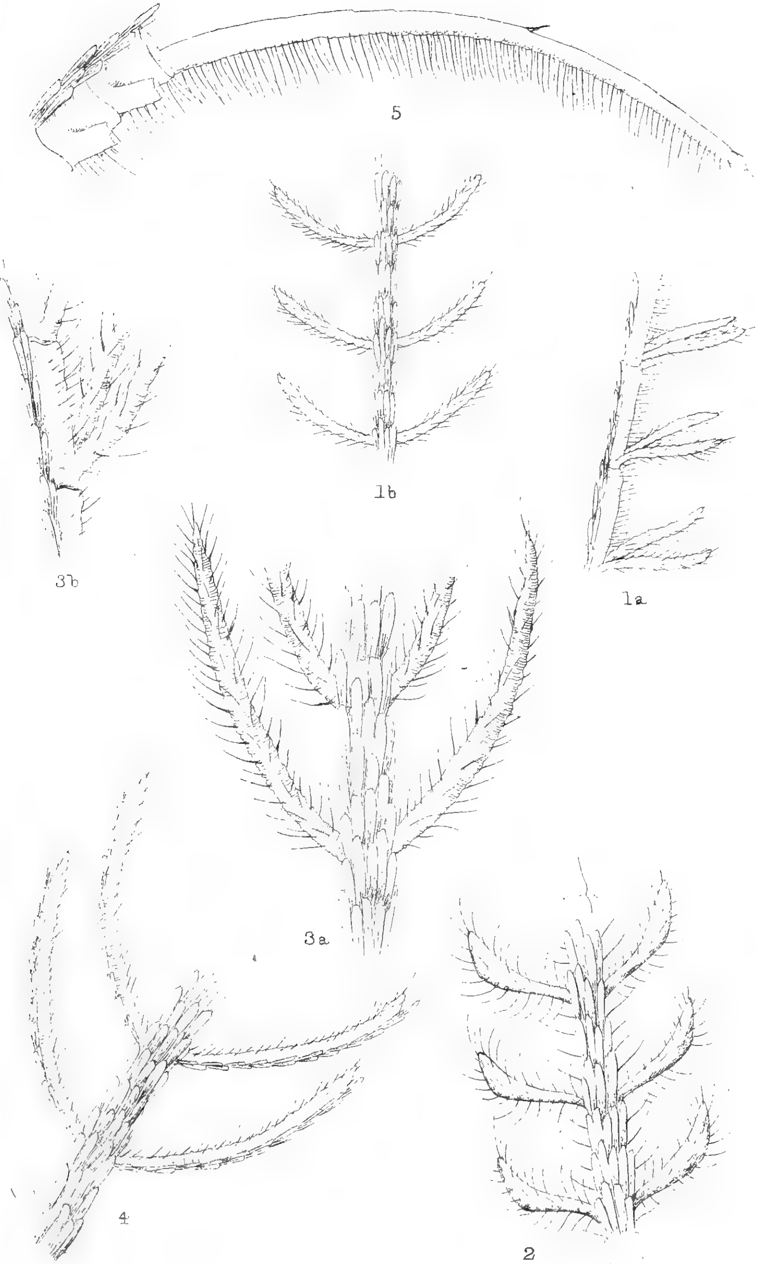
* Grote notes: "If *lanestris* should be congeneric with *Lachneis catax*, then *populi* becomes the type of *Eriogaster*, and *Poecilocampa* a synonym." We have discussed this, *ante*, p. 450, where we have shown that *populi* cannot be the type of *Eriogaster*.

† *Trichiura* rejected as being too near *Trichura*, Hb. (1816).

evidently quite independent in origin, and for purposes that are quite clear, *viz.*, the strengthening of the wing in this region in the Psychids, because of the mode of copulation and chance of injury to the wing (*vide, ante.*, pp. 275, 368, 373, 377), and in certain Lachneids (usually of the most specialised type), to carry the extension of the wing-membrane in the costal region of the base of the hindwings, which is developed in order to complete the similarity of the imagines possessing this enlargement, to a leaf, which they resemble when at rest. These and our own remarks on the subject (*ante.*, vol. i., pp. 111, 123-124, and *Proc. South Lond. Ent. Soc.*, 1898, pp. 1-11) and Dyar's friendly criticism thereof (*Ent. Record*, xi., pp. 141-2) comprise, so far as we are aware, all that has been written on the subject.

The question that interests us here, however, is the relationship of the Lachneid genera, &c., *inter se*, and anything we may say must be taken largely as an expression of ignorance, so little do we know of the structure of the early stages of any but our British and one or two common European species. Our species are representatives of isolated and separate genera, mostly belonging structurally to widely differing tribes, and an attempt to show their relationship is, as Bacot suggests, an attempt to "obtain the configuration of a submerged continent, with only a few mountain peaks that one can examine above the surface, together with a few soundings, and a glance at the colour of the water." In an earlier paper (*Proc. South Lond. Ent. Soc.*, 1898, pp. 1-11) we suggested that our British species fell into at least six tribes, and we see no reason for altering our opinion, except that we now suspect that *Macrothylacia* is rather more separate from *Malacosoma* than we asserted, and that we should give equal if not greater weight to the Eutrichid side of our tree, separate *Pachygastria* from *Lasiocampa* generically (this is evident from a study of the newly-hatched larva), and give *Malacosoma* and *Lachneis* (*Eriogaster*) a much lower position as generalised forms. These we can discuss in more detail later. Meyrick dismisses the phylogeny of the Lachneids thus: "*Odonestis* (*Cosmotriche*) and *Gastropacha* (*Eutricha*) are correlated early types; *Clisiocampa* (*Malacosoma*) and *Eriogaster* (*Lachneis, Poecilocampa, Trichiura* and *Macrothylacia*) are developments of *Odonestis* (*Cosmotriche*) and *Lasiocampa* of *Eriogaster* (*Lachneis*, &c.)." We may agree at once that *Cosmotriche* and *Eutricha* are correlated types, since both are well-defined Eutrichid genera, but how can *Malacosoma* and *Eriogaster*, Meyr. (which includes *Poecilocampa, Trichiura, Macrothylacia* and *Lachneis*) be developments of *Cosmotriche?* Can the eggs of the former genera be derived from the latter? Can the generalised tubercular warts of the first larval stadium of *Malacosoma* be derived from the large specialised warts of the latter? Is the pupa of *Cosmotriche* more generalised than the pupæ of *Eriogaster*, Meyr., which comprises the species of four of our Lachneid genera? Even in neuration, can we derive the comparatively simple, supplementary, basal cell of the hindwings of *Poecilocampa, Trichiura, Eriogaster* and *Macrothylacia* from the more specialised one of *Cosmotriche*, which Dyar, we think erroneously, places even higher than *Epicnaptera?* We suspect that *Lasiocampa* is derivable from Meyrick's *Eriogaster*, inasmuch as the latter includes the more generalised branches of the stem of which *Lasiocampa* is the most specialised branch, but the phylogeny that places *Poecilocampa populi, Trichiura crataegi, Lachneis lanestris* and *Macrothylacia*

Plate VI.



West, Newman lith.

Antennæ of Psychides

rubi in one genus, and derives the whole from *Cosmotriche*, is not likely to commend itself to earnest students. As a friendly criticism of our own views, Dyar added (*Ent. Rec.*, xi., pp. 141-2) an important contribution to the subject. He writes : " The English species divide into four phyla :

Phylum A.—The larva is cylindrical, primary warts not altogether obscured, secondary hairs simple ; no special structures. Moth with ordinary venation, veins 6 and 7 of hindwings from the end of the cell, vein 8 forming a small intercostal cell at base by anastomosis with the discal cell—*Malacosoma*.

Phylum B.—Larva flattened, primary warts visible only as far as the largest ones i and iii ; secondary hairs modified with white hairs subventrally : lateral lappets and coloured thoracic bands. Moth with extraordinary venation, intercostal cell of hindwings greatly expanded, confluent with discal cell nearly to apex, and finally forming a connection with vein 7—*Epicnaptera* and *Eutricha*.

Phylum C.—Larva degenerating, less flattened, but still with white tufted hairs subventrally ; primary warts obscured, the other special structures lost. Moth with the intercostal cell of hindwings less expanded, but carrying vein 7 back with it from the apex of discal cell—*Cosmotriche*.

Phylum D.—Larva again cylindrical, densely hairy, some of the secondary hairs specially modified into irritating hairs ; white subventral hairs lost. Moth with intercostal cell very small, but vein 7 arises from its apex with vein 8, and is not connected with the discal cell—*Macrothylacia*, *Lasiocampa*, *Eriogaster*, *Achnocampa* (*Trichiura*), and *Poecilocampa*.

Dyar then observes : " Phylum A, I regard as distinctly the most generalised. Phylum B, I was at first inclined to place much higher, but the venation of the moth seems to preclude any other position. Phylum C is closely allied, but the larva is decidedly less specialised. I take this to be due to degeneration, rather than to generalisation, since the venation of the genus, *Cosmotriche*, seems derivable from *Epicnaptera* and not the reverse. Phylum D is the highest. A degeneration from the flattened larva of phylum B having been once assumed, it is easy to imagine this proceeding further to the round hairy larvæ of *Lasiocampa* and *Macrothylacia*. *Eriogaster* has the hairs less developed, but evidently belongs here, and I presume that *Achnocampa* (*Trichiura*) and *Poecilocampa* do also, though their larvæ are not at present before me. The venation is very singular. Vein 7 instead of arising from the discal cell is quite separate from it, and arises from the basal loop of vein 8. I think this is only explicable by supposing a contraction of the large intercostal cell of phyla B and C, which has carried vein 7 with it away from the discal cell.

" So much for the British species. The accompanying tree (pl. vii), in large part explains itself. I have added several European and American genera, and one Australian genus, which are distinguished from the English ones by the absence of shading on their respective branches. Five special points may be noted :—

Phylum E is the Australian *Colussa*. It is the most generalised larva of the whole group, closely resembling that of *Eustaudingeria*. Indeed the genus scarcely belongs here, as the moth still retains the frenulum.

Phylum F is the most generalised phylum known of the true Lasiocampids. The females are wingless, but the male venation closely resembles *Malacosoma*.

Phylum G is a very curious form. The larva has much the structure of *Malacosoma*, but the adaptation to the flattened form has begun, and the subventral shadow is neutralised by a *white band*, not by white hairs as higher in the scale. The moth has already the large intercostal cell of the hindwings.

Phylum H is an American group, at first sight quite contradictory with the larva of *Eutricha* or even more specialised, and the venation almost of *Malacosoma*. I interpret the absence of the large intercostal cell to degeneration, by a process different from that of phylum D. Here it seems that the lower border of the cell has joined the discal cell, leaving vein 7, again arising from it, but before the tip of the cell.

Phylum J is a group not represented in England, intermediate between phyla B and D. The larva retains most of the characters of phylum B, though they are generally less strongly developed, while the moth has assumed the venation of phylum D."

With much that Dyar writes we are in evident agreement. His phyla A and D make up the bulk of our Palæarctic *Lachneidae*, his phyla B, C and J the bulk of our Palæarctic *Eutrichidae*. When, however, it comes to a consideration of detail we are at issue on many points. Dyar essentially makes his phylum C the generalised section of the Eutrichids, with which we are somewhat in accord, but when he would derive the neuration of *Epicnaptera* (phylum B) from that of *Cosmotriche* (phylum C) we can only demur. We presume that these genera, having reached a certain point of development in common, have then gone on independently to their present forms. Certainly in the direction of the specialisation of the supplementary cell at the base of the hindwings and the supplementary nervules arising therefrom *Eutricha* has specialised much further than *Cosmotriche*, and presents with *Gastropacha* (*Epicnaptera*) the most highly developed neuration of the Eutrichid (and Lachneid) stem. The specialisation of this supplementary cell and its nervures may be readily traced from the plates by Aurivillius (*Iris*, vii., pl. 3-4). Our own notes of the neuration read as follows: The supplementary cell, placed just above the base of the median cell of the hindwing is very small in *Poecilocampa* and *Trichiura*, with one small nervule branching from its upper edge in *Trichiura* and two in *Poecilocampa*. The cell has a similar character in *Lachneis*, but there is considerable modification in the upper branching nervule. The cell is also simple in *Malacosoma*, somewhat elongated in *Lasiocampa* and *Pachypasa*, and the same conditions are noticed in all those genera that have no great extension of the basal area of the hindwings. When, however, we turn to the Eutrichids, in which this extension is most marked, the cell gradually becomes modified, maintaining its simplest form in *Dendrolimus* in which the costa of the hindwing is almost straight, and having only one small upper nervule arising from it. *Odonestis* is but little in advance of this, but *Cosmotriche* shows considerable development and gives rise to three branches, the extended cell separating the (normally) branched nervure arising from it into its two constituent parts. In *Gastropacha* (*Epicnaptera*) and *Eutricha* the cell and the supplementary nervules are remarkably specialised, the latter, perhaps, being the most specialised of all. Intermediate stages of development are well illustrated by *Diplura* and *Selenephera*, the latter more particularly in the Eutrichid direction. *Malacosoma* is very peculiar in its neuration, being specialised with regard to the loss of the transverse nervule at the end of the discoidal cell (a peculiarity that it shares with *Chondrostega*), while the supplementary basal nervures seem to be somewhat specialised, otherwise the character of the neuration in other respects appears to be generalised, and to call for no special comment. Bacot observes that on larval characters he considers Dyar incorrect in deriving *Eutricha* from *Cosmotriche*. *Eutricha* (as represented by *quercifolia*) is, he considers, on larval characters, more specialised than *Dendrolimus* (*pini*) which clearly, in this stage, occupies a position between *Eutricha* and *Cosmotriche*, but nearer to the latter. *Cosmotriche*, he adds, certainly appears to be much more generalised than *Eutricha*, for it has retained many more ancestral characters common to the Eutrichid and Lachneid (*in sensu strict.*) branches, than has *Eutricha*. Again Dyar's separation of the phyla B and J is scarcely justified on the grounds given, for so great is the resemblance between the larvæ of *Eutricha* (*quercifolia*) and *Odonestis* (*pruni*) up to the hybernating stages, that one doubts whether they can belong to different genera. Our interpretation of the neuration appears to bring the phylogeny as shown by this character into harmony with that presented by the structural features offered by the larvæ and pupæ.

We conclude from the facts presented by newly-hatched larvæ of the *Lasiocampidi* and *Eutrichidi*, that both have specialised almost to the same extent on their respective stems, having i, ii, iii, and iv + v large many-haired warts when they leave the egg, the earlier generalised stages evidently having been pushed back into the egg; but Bacot considers that *Eutricha* is, as a larva, rather more specialised than *Lasiocampa*. The ancestral Lachneid larva appears to have had generalised tubercles, i and ii trapezoidal, iii supraspiracular, iv and v subspiracular (iv tending to be somewhat posterior), vi below these, and vii marginal at base of legs. These carried setæ with chitinous bases. Development proceeded by the formation of warts (somewhat as in Anthrocerids) each individual seta having a chitinous base, i, ii, iii, iv and v being especially well-developed. In some genera later necessities for the perfection of protective resemblances necessitated the flattening of the warts, so as not to disturb the larval contour, and these ultimately merged in the general skin clothing, driving back the preceding evolutionary stages into the egg. Thus *E. quercifolia*, *D. pini*, *L. quercûs*, and *P. trifolii* hatch with i, ii, iii and iv + v well-developed. In the reduction of the warts, i, ii and iii, as most disturbing the outline, were the first and most completely eliminated. A small ii and iii may, therefore, suggest either a generalised or highly specialised form, and care must be taken in forming any conclusion based on the character of these tubercles. The small size of ii compared with i, is, of course, not necessarily on the same line of development as the flattening of the warts and diffusion of the setæ of the dorsal and supraspiracular tubercles. The tendency to lose i is already well-marked in some cases in which the tubercles are quite ancestral and scarcely wart-like in appearance, *e.g.*, *Malacosoma* (*castrensis*), &c. The wart-like cushions, seen in the larvæ of *Eutricha* (*quercifolia*), *Lasiocampa* (*quercûs*), &c., are probably a further development of the *Malacosoma* form. In the flattening and diffusion of the warts, these processes affect i and ii simultaneously, there being a general tendency to the loss of all dorsal and subdorsal warts in certain genera. The newly-hatched larvæ of *Eutricha* and *Lasiocampa* are quite a moult in advance of *Pachygastria* and distinctly in advance of *Dendrolimus*. It is necessary then to clearly recognise that the tendency to have ii weak is a distinctly earlier character than the tendency to the flattening and dispersion of all the dorsal and subdorsal warts.

The pupæ have undergone but slight modification in the group, but the imagines appear also to have specially developed along different lines, *Eutricha* with a complicated branching of the costal nervure of the hindwing, *Lasiocampa* in the strong costal and median nervures which enable it to maintain its rapid flight. On the other hand, the females of *Eutricha*, *Macrothylacia* and *Lasiocampa*, are very specialised as egg-producing organisms. Bacot notes: The ova of *Eutricha* (*quercifolia*) are much smaller than those of *Cosmotriche* (*potatoria*), even smaller than those of *Lasiocampa* (*quercûs*), and consequently the larva in the first instar is also much smaller than those of *Cosmotriche*, *Lasiocampa* or *Macrothylacia*, and one is strongly inclined to suspect that the small size of the eggs of these species compared with the size of the moth represents a specialised condition. In conclusion we may add that we should certainly be inclined to disagree with any phylogeny that did not separate Dyar's phyla B, C and J from the main stem at the same point, that did not find a much less specialised position for *Lachneis* and *Trichiura*, and an entirely independent one for *Poecilocampa* (*vide*, pl. viii). The peculiarities in the neuration noticed by Dyar (*suprà*) certainly appear to us, as we have attempted to show, to be explicable on other grounds than those offered by him. We suspect that he will grant that the "large intercostal cell" of the hindwings in phyla B and C is a specialisation, and that it is much more in accordance with fact that those genera that have never had the large expansion of the area at the base of the costa of the hindwings, have never required this large cell, nor the nervures that arise therefrom to carry the enlargement. We suspect that the isolation of nervure 7 from the discal cell is a generalised and not a specialised feature of the neuration, and that this has been maintained in the *Lachneidae*, both in otherwise generalised and specialised forms, and lost more or less, in the *Eutrichidae*, under the stress of costal development.

Some of Bacot's suggestions as to the phylogeny of the group, have already been embodied in the preceding pages (*ante*, pp. 460-461), but he adds that he is not sure that "the highly specialised larvæ, offer such good characters for the purposes of phylogeny as the relatively more generalised imagines. The larval life is usually long, and the imaginal short and often retired. Taking the *ensemble* of the characters offered, the mode of making the cocoon and the structure of the pupæ are very likely to give a correct view—although the similarity of cocoons of the 'eggar' type (even in quite unrelated orders), which must have been independently evolved, may easily be pushed too far, and one cannot think that the similarity of the cocoons of *L. quercûs* to those of the Cochlidids is really one of close relationship, for it is impossible not to place such forms as *rubi*, *quercifolia*, &c., with their divergent cocoons, much nearer to *L. quercûs* than one would the Cochlidids, *i.e.*, it is impossible to conceive that *L. quercûs* and *L. lanestris* have an unbroken descent from the Cochlidids to the exclusion of such forms as *Cosmotriche*, *Malacosoma*, *Macrothylacia*, &c." He further adds: "The species *trifolii* and *quercûs*, *potatoria* and *quercifolia*, *castrensis* and *neustria*, represent three well-marked and distinct groups, supported by all the characters yet obtained from the oval, larval and pupal stages as well as the imaginal habits, but when it comes to placing any of the other species with these groups, difficulties at once crop up. *Lachneis lanestris* might be placed on the evolutionary line with the *quercûs* group, there is nothing in the larva, pupa, or cocoon of which one knows that contradicts this position, but the egg and egg-laying habit suggest a position nearer *Trichiura* and perhaps between *Trichiura* and *Malacosoma*. *Macrothylacia rubi* has a larva closely approximating to that of *L. quercûs* in structure and develop-

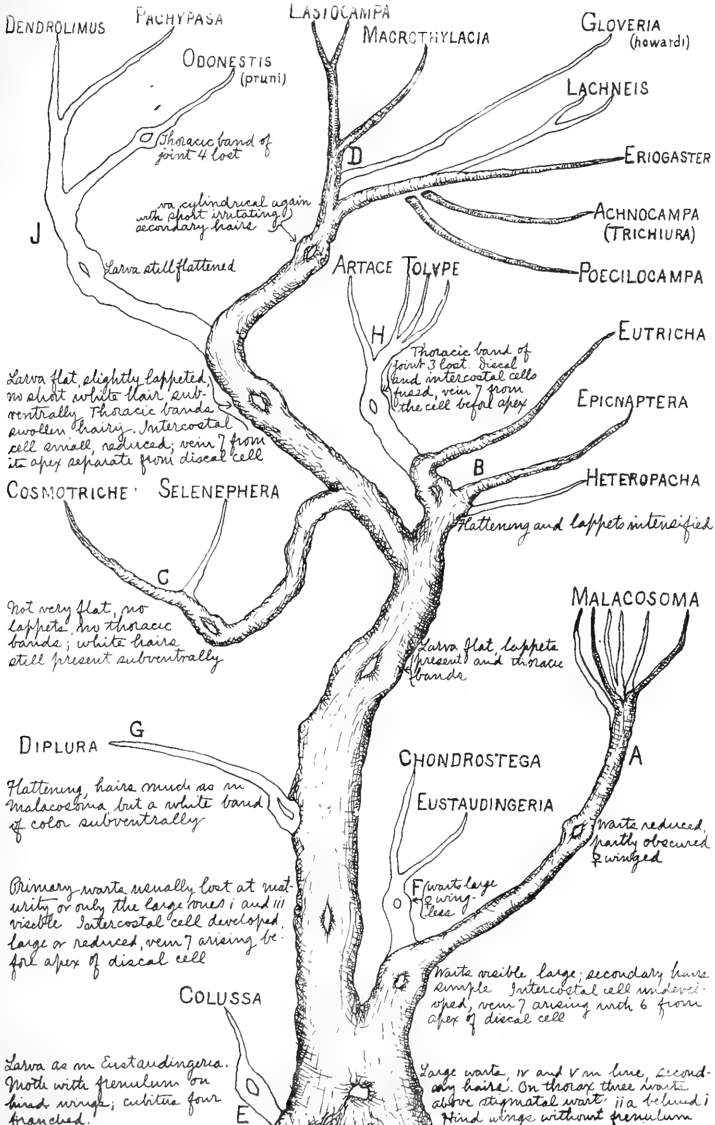


PLATE VII.

DYAR'S PHYLOGENY OF THE LACHNEIDES.

ment, and, on the other hand, a pupa and cocoon more nearly approximating to that of *Malacosoma*. The egg is not unlike that of *L.* var. *callunae*, and the young larva, in some respects (from memory), to *Lachneis lanestris*. Thus *M. rubi* gives a good hint as to the connection of the *Lasiocampa-Lachneis* group with the Malacosomas, and perhaps by way of cocoon with the Eutrichids, but if one once accepted this line of argument, one implies an immense gap in the relationship of the 'eggar' cocoons of the Lasiocampids and Lachneids (*in sens. restr.*) on the one hand and the Cochlidids on the other. *Dendrolimus pini* (the only continental species besides *pruni* that I know in the early stages) certainly goes with the Eutrichid stem. The eggs and egg-laying habits of *Trichiura* suggest a relationship between it and *Poecilocampa* on the one hand and with *Lachneis* on the other; the anal tuft of the females supports the latter suggestion, whilst the similarity of the cocoons supports the former; yet the larvæ of *Poecilocampa* and *Trichiura* have no characters in common. *Poecilocampa* bears in the larval stage a certain similarity to *Eutricha quercifolia* but this is probably only a case of parallel development. *Trichiura* larvæ have more in common with *Malacosoma*, but possibly this impression is gained rather from a superficial than from any structural similarity."

Family: Lachneidae.

We can readily separate our British species of the Lachneids into two very distinct families, the *Lachneidae* proper, including the "eggars," and the *Eutrichidae* or "lappets," with their leaf-like appearance when at rest and the marvellous development of the hindwings to aid this similarity. Of the genera referable to the *Lachneidae*, one genus, *Poecilocampa*, stands somewhat isolated, for whilst it possesses the typical basal wing-markings characteristic of *Trichiura* and *Lachneis* and approaches them in other respects, yet its early stages show such complete isolation that one cannot but separate it very distinctly therefrom. As a matter of fact with one or two striking exceptions, *e.g.*, *Malacosomidi* and *Lasiocampidi*, the whole of our British Lachneid moths are widely separated, and representative of isolated groups, not only in Britain, but also in the Lachneid fauna of the world, *Trichiura*, *Lachneis* and *Macrothylacia* being as it were each terminal of its own tribe, and consisting merely of two or three very strongly defined and not very variable species. In fact we doubt whether *crataegi* is not the sole representative of *Trichiura*, and *rubi* of *Macrothylacia*. On the other hand *Pachygastria* (and *Lasiocampa*) represent a recent, if not existent, evolutionary group, similar to *Malacosoma*, although these groups are small compared with the much larger ones of closely allied forms that have been occasionally developed from the main generic stems into which the *Eutrichidae* branch. Taken as a whole one cannot but conclude that the Eutrichids are a dominant and progressive group, the Lachneids a more conservative and stagnant one.

Subfam.: Poecilocampinae.

Tribe: Poecilocampidi.

This tribe is, structurally, the most isolated of all the Lachneid (as apart from the Eutrichid) moths, and in the larval stage appears to show considerable affinity with the Eutrichids, and to be very distinctly separated from *Trichiura* with which it is sometimes said to be very closely allied. The habit of the imago in sometimes laying its eggs scattered, at others in little groups, is noteworthy in a superfamily where egg-laying is pretty constant in the same species. The larva, structurally, appears to be quite an exception to the other Lachneid larvæ so far examined, in that the anterior trapezoidals i on the abdominal segments are considerably smaller than the posterior ii, although on the meso- and metathorax the reverse is the case, the anterior i being much larger than the posterior ii. There is a small supraspiracular, and of the two subspiraculars iv and v, the former is much larger than the latter on the abdominal segments, but situated close together, and suggest strongly the process by which they have coalesced on the thoracic segments, a feature that is very characteristic also on the abdominal segments of most other Lachneid larvæ. All the tubercles have a wart-like structure and bear many hairs. The pupa is enclosed in a small tough cocoon, not of the "eggar," nor of the loose Eutrichid type, and in this one peculiarity bears a resemblance to *Trichiura crataegi*. Sexual dimorphism is well marked as in all Lachneid moths, but there is no ♀ anal tuft as in *Trichiura* and *Lachneis*, and the appearance of our only European species in midwinter is sufficiently remarkable to notice.

Genus: Poecilocampa, Stephens.

Synonymy.—Genus: *Poecilocampa*, Stephs., "Ill. Haust.," ii., p. 44 (1828); "Cat. Brit. Ins.," p. 47 (1829); "List Br. An. Br. Mus.," v., 1st ed., p. 47 (1850); 2nd ed., p. 43 (1856); Wood, "Ind. Ent.," no. 46 (1839); Dup., "Cat. Lép. Eur.," pp. 76-77 (1844); Humph. and Westd., "Brit. Moths," 2nd ed., p. 54, pl. x., figs. 7-8 (1851); Walk., "List Lep. Het.," (6), p. 1474 (1855); Sta., "Man.," i., p. 154 (1857); Humph., "Gen. Brit. Moths," p. 24 (1860); Rbr., "Cat. Lep. And.," p. 351 *note* (1866); Guén., "Lép. Eure-et-Loir," p. 80 (1867); Wallgrn., "Skand. Het.," ii., p. 71 (1869); Newm., "Brit. Moths," p. 41 (? 1874); Buck., "Larvæ, &c.," iii., pp. 58, 78, pl. xlviii., fig. 2, pl. xlix., fig. 1 (1889); Auriv., "Nord. Fjär.," p. 61 (1889); "Iris," vii., pp. 143, 144 (1894); Ström., "Danm. Somm.," p. 82 (1891); Kirby, "Cat.," p. 834 (1892); Barr., "Brit. Lep.," iii., p. 2 (1896); Tutt, "Brit. Moths," p. 59 (1896); "Proc. South Lond. Ent. Soc.," pp. 1-11 (1898); Dyar, "Can. Ent.," xxx., pp. 4, 5 (1898); "Ent. Rec.," xi., p. 41 (1899); Grote, "Illus. Zeits. für Ent.," p. 71 (1898). *Bombyx*, Linn., "Sys. Nat.," 10th ed., p. 502 (1758); 12th ed., p. 818 (1767); "Faun. Suec.," 2nd ed., p. 291 (1761); Fab., "Sys. Ent.," p. 566 (1775); "Species Ins.," ii., p. 179 (1781); "Mant.," ii., p. 113 (1787); "Ent. Sys.," p. 429 (1793); Schiff., "Sys. Verz.," p. 58 (1776); Esp., "Schmett. Eur.," iii., pl. xxv., figs. 1-8 (1782), p. 136 (1784); Bork., "Sys. Besch.," iii., p. 129 (1790); Hb., "Eur. Schmett.," iii., p. 141 (? 1800); Donov., "Nat. Hist.," ix., p. 41 (1800); Schrank, "Fauna Boica," i., p. 280 (1801); Haw., "Lep. Brit.," i., p. 127 (1803); Godt., "Hist. Nat.," iv., p. 119 (1822); Bdv., "Gen. et Ind.," p. 70 (1840); Frr., "Neu. Beit.," p. 159 (1845); Boh., "Vet. Ak. Handl.," p. 133 (1848); Snell., "De Vlind.," p. 187 (1867); Nolck., "Lep. Fn. Est.," p. 126 (1868); Staud., "Cat.," p. 68 (1871); Curò, "Bull. Soc. Ent. Ital.," viii., p. 148 (1876); Mill., "Ann. Soc. Ent. Fr.," (5), vii., p. 5 (1877); Frey, "Lep. der Schweiz," p. 95 (1880); Lampa, "Ent. Tids.," p. 41 (1885); Rühl, "Soc. Ent.," v., p. 170 (1891); Caradja, "Iris," viii., p. 90 (1895); Reutti, "Lep. Bad.," p. 57 (1898). *Noctua*, Müll., "Fauna Frid.," p. 47 (1764). *Eriogaster*, Germ., "Sys. Gloss. Prod.," i., p. 16 (1811); Curt., "Guide," p. 142 (1829); Bang-Haas, "Nat. Tids.," (3), ix., p. 411 (1874); Meyr., "Handbook," p. 321 (1895). *Gastropacha*, Ochs., "Die Schmett.," iii., p. 276 (1810); Frr., "Neu. Beit.," p. 159 (1845); H.-Sch., "Sys. Bearb.," ii., p. 105 (1847); Hein., "Schmett. Deutsch.," i., p. 207 (1859). *Diaphone*, Hb., "Verz.," p. 188 (1822).

Stephens' diagnosis of the genus (*Illus. Haust.*, ii., p. 43) reads as follows:

Poecilocampa, mihi. Palpi extremely minute, subglobose, enveloped in slender elongate hairs; maxillæ obsolete. Antennæ densely bipectinated in the males, the pectinations scarcely decreasing towards the apex, strongly serrated in the females;

head very small and hairy; thorax stout and hairy; abdomen abbreviated, tufted in the male, and pilose laterally in both sexes, the female without a downy mass at the apex; wings entire, elongate, acute, subdiaphanous, not reversed during repose; legs with the femora and tibiæ pilose. Larva slightly hairy, a little depressed, maculated, not gregarious; pupa short, obtuse, enclosed in a silken folliculus, superficially subterranean.

After thus diagnosing the genus, Stephens remarks on the necessity of separating it from *Eriogaster* (*lanestris*), observing that its single species (*populi*) differs in habit and structure as much from the latter genus as does *Clisiocampa* from *Lasiocampa*. He observes that the ♂ antennæ are more densely pectinated and stouter than in *Eriogaster*, the females destitute of the woolly anal tuft, thus also differing from *Cnethocampa* (*processionea*), which, with *Eriogaster*, it resembles in wing-texture. He further notes that the larvæ live solitarily, that the pupa is obtuse, and the eggs naked. As only *populi* is placed in the genus it necessarily becomes its type. Kirby places two other species in the genus—*subpurpurea*, Butl., from Tokei, and *habitus*, H.-Edw., from Vera Cruz. The inclusion of these suggests that Kirby's genus may be heterotypical. We have already shown (*ante.*, p. 450) that *Poecilocampa* is the correct name for the genus, and that Grote's suggestion that, if *catax* and *lanestris* be congeneric, *populi* must become the type of *Eriogaster*, Germ., is inadmissible, since *populi* disagrees with the diagnosis of the genus *Eriogaster* in which Germar placed it. Meyrick considers *populi* as congeneric with *lanestris*, *rubi* and *crataegi*, evidently uniting them on the general character of the neuration, and thus showing want of knowledge of the nature of the structural differences in the early stages. Aurivillius observes that *Poecilocampa* differs from *Trichiura* in the following points: The elevated part of the forehead is broader and shorter; the middle tibiæ without spurs; hind tibia with two very tiny (hardly to be discovered) terminal spurs; the wings thinly scaled, almost entirely with very characteristic scales, which are cleft almost as far as the base into 3-4 long hairs; the fore-wings longer and narrower than *Trichiura*. He further gives the following characters:

Neuration: 8 of forewings from the front margin of middle cell shortly before the apex, from the apex, or from the stalk of 6 and 7, or very rarely united with 7 from the apex; the stalk of 9 and 10 much longer than the free part of the nervures; these both run into the costa, or 9 rarely into the apex. 4 and 5 of hindwings from one point or united in a very short stalk; 7 and 8 from one point or often with a long stalk from the front margin of middle cell. Antennæ: ♂ antennæ with long pectinations; ♀ antennæ with short, appressed pectinations, wanting in basal part. Abdomen: ♀ without anal wool. Larva: The larva has thin short hairs and is somewhat flattened. The dorsal warts of segments 1-10 are entirely wanting, the 11th segment is slightly raised. All, laterally, underneath the spiracles, project in wart-form, and above the legs stand 1-2 warts. In this it somewhat reminds one of the *Gastropacha* larvæ, but all the members are uniformly coloured and marked. Pupa: Naked, red-brown, with numerous "fastening-bristles" on cremaster; rests in a firm cocoon, mixed with earth.

Poecilocampa populi, Linné.

Synonymy.—Species: *Populi*, Linn., "Sys. Nat.," 10th ed., p. 502, no. 32 (1758); 12th ed., p. 818, no. 34 (1767); "Faun. Suec.," 2nd ed., p. 291, no. 1101 (1761); Fab., "Sys. Ent.," p. 566, no. 38 (1775); "Sp. Ins.," ii., p. 179, no. 54 (1781); "Mant.," ii., p. 113, no. 62 (1787); "Ent. Sys.," iii., pt. 1, p. 429 (1793); Schiff., "Sys. Verz.," p. 58 (1776); Esp., "Schmett. Eur.," iii., pl. xxv., figs. 1-8, p. 136 (1784); Bork., "Sys. Besch.," iii., p. 129, no. 35 (1790); Hb., "Eur. Schmett.," iii., p. 141, fig. 163 (? 1800); "Larvæ, &c.," iii., M, *b* (by error), figs. 1*a*-*c* (? 1803); "Verz.," p. 188 (? 1822); Donov., "Nat. Hist.," ix., p. 41, pl. 307 (1800); Schrk., "Fauna Boica," ii., pt. 1, p. 280, no. 1467 (1801); Ochs., "Die Schmett.," iii., p. 276 (1810); Germ., "Sys. Gloss. Prod.," i., p. 16 (1811); Godt., "Hist. Nat.," iv., p. 119, no. 26, pl. x., fig. 4 (1822); Stephs., "Illus. Haust.," ii., p. 44 (1828); "Cat. Brit. Ins.," p. 47 (1829); "List Br. An. Br. Mus.," v., 1st ed., p. 47 (1850); 2nd ed., p. 43 (1856); Curt., "Guide," p. 142 (1829); Wood, "Ind. Ent.," no. 46 (1839); Bdv., "Gen. et Ind.," p. 70 (1840); Dup., "Cat. Lép.," pp. 76-77 (1844); Frr., "Neu. Beit.," p. 159, pl. 477 (1845); H.-Sch., "Sys. Bearb.," ii., p. 105, figs. 87, 151 (1847); Boh., "Vet. Ak. Handl.," p. 133 (1848); Humph. and Westd., "Brit. Moths," 2nd ed., p. 54, pl. x., figs. 7-8 (1851); Walk., "List Lep. Het.," (6), p. 1474 (1855); Sta., "Man.," i., p. 154 (1857); Hein., "Schmett. Deutsch.," i., p. 207 (1859); Humph., "Gen. Brit. Moths," p. 24 (1860); Rbr., "Cat. Lép. And.," p. 351 *note* (1866); Snell., "De Vlinders," p. 187 (1867); Guén., "Lép. Eure-et-Loir," p. 80 (1875); Nolck., "Lep. Fn. Est.," i., p. 126 (1868); Wallgrn., "Skand. Het.," ii., p. 71 (1869); Staud., "Cat.," p. 68 (1871); Newm., "Brit. Moths," p. 41 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 411 (1874); Curò, "Bull. Soc. Ent. Ital.," viii., p. 148 (1876); Frey, "Lep. der Schweiz," p. 95 (1880); Lampa, "Ent. Tids.," vi., p. 41 (1885); Buckl., "Larvæ, &c.," iii., pp. 58, 78, pl. xlviii., fig. 2, pl. xlix., fig. 1 (1888); Auriv., "Nord. Fjär.," p. 61 (1889); "Iris," vii., pp. 143, 144 (1894); Ström, "Danm. Somm.," p. 82 (1891); Rühl, "Soc. Ent.," v., p. 170 (1891); Kirby, "Cat.," p. 834 (1892); Caradja, "Iris," viii., p. 90 (1895); Meyr., "Handbook," &c., p. 321 (1895); Barr., "Brit. Lep.," iii., p. 2 (1896); Tutt, "Brit. Moths," p. 59 (1896); "Proc. South Lond. Ent. Soc.," pp. 1-11 (1898); Dyar, "Can. Ent.," xxx., pp. 4-5 (1898); Grote, "Illus. Zeits. für Ent.," p. 71 (1898); Reutti, "Lep. Bad.," 2nd ed., p. 57 (1898). *Desolata*, Müll., "Faun. Frid.," p. 47, no. 11 (1764). *Populeus*, Haw., "Lep. Brit.," i., p. 127, no. 85 (1803).

Original description.—*Phalaena* (*Bombyx*) elinguis fusca antice pallida, alis reversis immaculatis fuscescentibus; striga sesquialtera albida repanda (Linné, *Sys. Nat.*, xth ed., p. 502). To this Linné afterwards added: "Thorax antice exalbidus; margo alarum ciliaris albopunctatus" (*Sys. Nat.*, xiith ed., p. 818).

Imago.—Anterior wings very deep greyish-black ("bluish-black," Stainton), a reddish- or orange-brown basal patch edged with pale yellowish; costa and base of inner margin brown; transverse elbowed line yellowish, doubly angulated; rather thinly scaled, fringes brown, chequered with yellowish. Posterior wings greyish-black, with a distinct, transverse, median shade, fringes as in forewings.

Sexual dimorphism.—The males 31mm.-38mm. are considerably smaller than the females 41mm.-46mm. (average difference about 8mm.-10mm.), they are also usually more densely scaled, and the fringes more distinctly chequered with light and dark. The prothoracic scaling is whitish or yellowish-white in the males, brownish in the females. The wing-texture of the female appears to be more delicate, and there is usually much more brown colouring along the inner margin and costa. In one example in the Brit. Mus. coll. (from the Frey coll.), this brown tint is especially noticeable, filling out the basal area and extending broadly along the inner marginal area and costa, whilst the general colour of the wing partakes slightly of the same hue. The fringes of this ♀, too, are especially distinctly chequered, although in most examples of this sex the brown fringes are almost uniform.

Variation.—One would expect that a species with the wide geographical distribution of this, extending from Ireland to Amurland, from Sicily to Scandinavia, and with a vertical distribution from the sea-level in the Riviera to some 7-8000ft. in the Swiss and Tyrolean Alps, would show considerable variation, but this is scarcely the fact, and the actual variation either in the development of local races or in the production of aberrations is really very small. The central and south European forms are usually distinctly reddish-black compared with our British and the more northern examples, which are almost purplish-black but with a slight brownish tinge developing into brown at the base and along the costa and inner margin. Oberthür notes the ordinary European type as reddish-brown, whilst that at Rennes is much darker and blackish-brown, possibly near the English form, this latter we suspect being Linné's northern type. Some examples, it is true, are rather deeper tinted than others, and some slight variation exists in the intensity and direction of the pale transverse lines crossing the fore- and hindwings, the pale outer line of the forewings sometimes being without the two angles, the line looking broken at these points, in others it is strongly marked throughout. Gordon observes the males captured at Corsemalzie as being of a rather light brown colour; Staudinger notes that Graeser bred some examples in Amurland from oak, far darker than European examples. A male from the Zeller coll. has the outer margin of the wings dusted with grey, and the pale elbowed line, edging the central band externally, very pale, whilst the central area is darker than usual and hence the specimen appears to be distinctly banded. A very extreme form of the banded aberration is figured by Herrich-Schäffer (*Sys. Bearb.*, v., pl. xxix., fig. 151). This is a male of ordinary shape, the thorax, abdomen and bases of fore- and hindwings almost typical, but the outer part of both pairs of wings whitish, and the central band of the forewings almost uniformly black, a most strikingly banded form, the fringes distinctly chequered (ab. *virgata*, n. ab.). Normally, however, in both sexes the central area is not really darker than the outer area. Barrett notes a specimen in the "Bond coll.," as being of a "semi-transparent, pale, smoky-buff colour." Three different forms have been described, the two south European ones possibly referring to slight modifications of the same form, whilst the alpine form is also referred to as the same race as that from the Riviera by some lepidopterists. These forms are described as follows:

a. var. *canensis*, Mill., "Lép. Alp.-Mar.," p. 194 (sep. p. 293) (1875); "Ann. Soc. Ent. Fr.," (5), vii., pp. 5-7, pl. i., fig. 9 (1877); "Rev. d'Ent.," ii., p. 41 (1883); Bell., "Ann. Soc. Ent. Fr.," (5), vii., p. 367 (1877); Oberth., "Bull. Soc. Ent. Fr.," (5), viii., p. 81 (1878); Auriv., "Iris," vii., pp. 143-4 (1894).—*Bombyx canensis*, Mill. (sp. nov.). Envergure (♂) 37mm. Les ailes sont bien développées, épaisses, moins arrondies que celles du *B. crataegi*, mais moins aiguës à l'apex que chez le *B. populi*. Tout l'insecte est très-velu, avec les ailes bien fournies d'écailles. Les dessins sont nets et les couleurs tranchées. Le fond des quatre ailes est d'un brun foncé, presque noir au bord costal des supérieures. Il n'existe bien qu'une seule ligne, la coudée, laquelle se continue sur les secondes ailes. A la place de la basilaire, on voit une grande tache d'un fauve obscur entourée de blanchâtre; cette tache, placée à la base de l'aile, occupe la moitié de la largeur de celle-ci. La ligne coudée est blanchâtre, ombrée de noir intérieurement avec le coude prononcé qui touche à une éclaircie aboutissant à l'apex. L'espace médian ne porte nulle trace du gros point cellulaire blanc qui caractérise si bien les *Bombyx everia, loti, catax* et *lanestris*. Les ailes inférieures très-obscures sons traversées diagonalement par une ligne blanchâtre, droite, ombrée de noir intérieurement. La frange, d'une largeur normale, d'un blanc carné, est entrecoupée de brun rougeâtre. Les antennes sont brunes et fortement pectinées. Le thorax est presque noir et les ptérygodes grisâtres. L'abdomen est d'un gris brun. En dessous, les quatre ailes se présentent à peu près ce qu'elles sont en dessus, bien que la ligne transverse soit moins apparente; cependant la grande tache de la base des supérieures a disparu (Millière).

Millière adds that the insect belongs to the same group as *T. crataegi* and *P. populi*, has the same shape of wings as the former, the lines placed as in the latter, but it would never be possible to confound *canensis* with either of its neighbours, from which it differs also in its larger size and rich parure. It appears in the second fortnight of December; the first example was taken at light on December 18th. In the *Ann. Ent. Soc. Fr.*, vii., p. 7, he further notes that four were taken altogether, by himself and a friend, all males, between December 12th-20th, 1876. Bellier de la Chavignerie (ibid., p. 367) states that he considers the Sicilian form the same as Millière's *canensis*, and that there was no doubt of their being referable to *P. populi*. Oberthür considers (ibid., viii., p. 81) *canensis* to be a good geographical race of the latter species—of larger size, more robust form, the general tone of coloration clear grey, the lines strikingly developed, yet more vague than in *P. populi* from the centre of France.

β. var. *calberlae*, Ragusa, "Nat. Sic.," viii., p. 223, pl. iii., figs 1-2, ♂ and ♀ (1889).—Il ♂ e la ♀ di Sicilia sono una volta e mezza più grande di quelli del l'Europa centrale, ed hanno entrambi la macchia basilare delle ali anteriori grande e ben marcata e la fascia lineare nei due sessi interrotta da due macchie gialle che formano per così dire un'altra fascia (Ragusa).

This form was first noticed by Bellier de la Chavignerie (*Ann. Soc. Ent. France*, 1860, p. 687), who states that he reared on January 1st, 1860, a ♀ from a larva taken with others in May, 1859, on the bark of *Quercus ilex*. He noted it as differing from *P. populi* in its wider wings, in having grey-yellowish powdering, and by the yellow fringe being chequered with brown. Later, he referred (ibid., 1877, p. 367) the insect to *canensis*, stating that he could not agree with Millière in considering the latter a distinct species, and asserting that its cocoon, habits, and time of appearance are identical with those of *P. populi*. Really there appears to be but little, if any, difference between this form and var. *canensis*. Both appear to have the basal mark exceedingly well characterised, and the tendency to the doubling of the elbowed line mentioned by Ragusa in the Sicilian form is shown in Millière's figure of *canensis* (*Ann. Soc. Ent. France*, 1877, pl. i., fig. 9). Ragusa's examples were obtained at Girgenti.

γ. var. *alpina*, Frey, "Lep. der Schweiz," p. 95 (1880); "Mitt. Schw. Ent. Ges.," vii., p. 18 (1887). *Cannensis*, Püng., "Stett. Ent. Zeit.," l., p. 144 (1889). *Canensis*, Ibid., lvii., p. 223 (1896).—The var. *alpina* is a fine mountain-form, with more white on the forewings, especially those of the ♂. Hnateck reared it years ago at Sils-Maria, in the Engadine, and Zeller-Dolder then acquired it for his collection. It is at present a great rarity (Frey).

Frey says (*Mitt. Schw. Ent. Ges.*, vii., p. 18) that he was informed by Zeller that this was the same form as, and agreed with, *canensis*, Mill. Frey was inclined to think the original types wanted comparison before the two were united. There appears to be no specimen labelled as this variety in the "Frey collection," nor, indeed, any alpine examples, unless they be among the unlabelled specimens, so that it is probable it was described from Zeller-Dolder's collection. Püngeler records the occurrence of larvæ of var. *alpina* at St. Maurice in August, 1877, on larch (*Pinus larix*), the cocoons with pupæ also found in numbers, in the neighbourhood, under stones. An empty cocoon was also obtained under a stone at the Riffel-alp.

Egglaying.—The eggs described were laid by a captive female on the inside of a chip box. Some are placed close together side by side, and with their long axes parallel, in little rows of five or six, others are scattered here and there over the surface of the box. Newman states that they are laid, three or four together, on the bark of oak (*Quercus robur*), poplar (*Populus nigra*), &c. Miss Miller observes that the eggs are laid singly or in batches of twelve or less, whilst Pearson notes the eggs as laid singly, and Bacot says that the similarity of the eggs to those of *Bombyx mori* is very striking, and they appear to be laid in the same scattered fashion. Robertson obtained a female from a Cheltenham pupa on December 6th, 1898, which laid most of its eggs the following day. Eggs are noted as hatching April 19th, 1865 (Todd), April 14th, 1890, at Brentwood (Burrows), March 26th, 1880, April 14th, 1890 (Bower), February 3rd-14th, 1894 (Studd), April 20th, 1899 (Bacot), middle of February, 1895 (Woodforde).

Ovum.—The eggs are flat, roughly rectangular in shape, with a shallow depression on the upper surface; the micropylar end squared and slightly thicker than its nadir which is somewhat rounded. To the naked eye, the egg looks dark brown with the micropylar end whitish and with a dark micropylar point. The egg has no covering of scales. Under a lens the ground colour is seen to be white, this tint being especially noticeable around the sides of the egg; the upper surface is almost covered with irregular, dark grey, and black, polygonal cells, usually in patches, and with a distinct opalescent appearance, the proportion of grey and black varying greatly; the sides are irregularly and less thickly marked with dark grey and black blotches made up of similar polygonal cells. Some eggs are almost devoid of these lateral blotches, on the other hand some are strongly marked with them, the black predominating. The surface is shiny, finely reticulated with very shallow polygonal cells (? pits), which give one the idea that the markings are really made up of groups of such cells; the reticulation is very bright and shiny. The micropylar end is white, with a comparatively large micropylar depression of a dark brown hue, finely reticulated, the micropyle proper consisting of a small black depression at the centre of the larger depression. The nadir of the micropyle is characterised by a round whitish central blotch, surrounded by the same type of markings as those on the upper surface. The larvæ, when they escape, make a large irregular hole at the micropylar end of the egg, in order to leave it [Description made October 27th, 1897, under a two-thirds lens from ova laid by a ♀ on October 21st, and sent by Mr. Head of Scarborough.] Bacot describes the egg as a flattened oval, slightly depressed on exposed face; the shell thick, opaque-looking, whitish-grey, much mottled with black and brown; a large round dark spot at micropylar end; the surface covered with an irregular hexagonal reticulation, the mottling due to the hexagons being differently coloured (and giving the idea of the pattern being mapped in Tunbridge ware).

Habits of larva.—Eggs laid in November usually hatch from the end of March to the middle of April, and the young larvæ feed up readily on oak and poplar. Eggs in Todd's possession, hatched on April 19th, 1865, the larvæ changed skin only once up to May 6th, when a second change took place. When twenty days old they were greyish, just as if sprinkled over with the dust of bran. At this time, he says, the young larvæ cling by their claspers to the stem of the food-plant, and, when one moved, the others usually followed, and appeared to keep close together. On May 16th a third exuviation took place, when two conspicuous red spots appeared on the prothorax. The long white fringe that hangs laterally over each side aids its close resemblance to the branch on which it rests. The larvæ changed skin again on May 23rd, and spun up from June 2nd-4th. When full-fed the larva rests in a perfectly straight position on the trunk of a tree, or on a branch, and is especially fond of the sun. Near Perth the larva lies flat on the thick branches of oak, and is not easily beaten in the daytime (Wylie). The larva is found in Bishop's Wood at rest on trunks of black poplar near the ground, and may be also beaten from oak (Ash), at Croydon the larvæ are beaten from lime (Sheldon), in Scotland the larvæ are almost confined to the higher branches of tall oak trees resting flat against the bark (Reid), the larvæ are found in crevices of the bark of oak trunks, the general colour of which, the tints of the larva match admirably (Merrin). Bankes notes that the larva generally rests clinging closely along the dark bark of the branches and is thereby rendered very inconspicuous; its hold is very tenacious and owing to this habit it probably often escapes the beating-tray.

Larva.—In the *first stadium* (hatched April 20th, 1899), the head is black, shiny, not large, with a few scattered white hairs, and a yellow transverse band just above the mouth. The body black, with partial subdorsal row of deep yellow or orange spots or blotches; on the 2nd and 3rd thoracic segments these are large and bright, not present on 1st abdominal, large and bright on the 2nd, faint on the 3rd-6th, bright and large on the 7th, and small on the 8th; they are placed at junction of segments, and are really on two segments, the so-called spot of the 2nd abdominal being partly on the posterior margin of the 2nd and partly on the anterior margin of the 3rd abdominal, and so on. [These spots seem to be an ancestral feature and perhaps give a clue to the origin of the yellow intersegmental bands of *M. rubi.*] The body is of even width, rather thin in dorso-ventral section, mounted well up from crawling surface, legs and prolegs widely spread, the latter square-ended and not yet ⊥-shaped; segmental incisions fairly distinct, especially noticeable when crawling; thoracic segments longer than abdominal; scutellum large, distinct, chitinous, but thin and fragile in appearance; the hairs are of two kinds—(1) long, large, black, some of the lateral hairs quite one-third of larva in length, (2) small white hairs; both kinds appear to be minutely serrated, a feature more conspicuous in the white than in the dark hairs. On the meso- and metathorax, tubercles i form large many-haired warts, whilst ii appear smaller but are overshadowed by the crowded hairs around them; on the abdominal segments, i and ii are both many-haired warts, ii being larger than i (thus different from all other Lachneid larvæ examined); the lateral tubercle (iv + v) on prothorax very large; also large and coalesced on meso- and metathorax; on the abdominal segments iii is small and two- or three-haired only, iv and v both subspiracular, rather close together, the posterior the larger; the subspiracular tubercles iv and v are on the as yet ill-developed lateral ridge. The skin is wrinkled, but subsegments not clear, nor does the newly-hatched larva show any trace of the specialisation it undergoes later. When fullgrown in first stadium the body has already flattened, the venter is but little raised above the resting-surface, whilst the subspiracular lateral ridge is becoming prominent, and the hairs from iv, v, and vii all sweep downwards to resting-place. In the *second stadium* (May 8th) the body is more flattened and carried close to twig when crawling; ventral area flattened, pale in colour; dorsal tubercles flatter, more distributed, and less sharply defined; numerous secondary hairs present; 8th abdominal segment slightly above level of other segments. Head rounded, not large, surface dull, numerous scattered hairs. The body pale bluish or slaty-grey, much mottled with dark blue or blue-black, also with yellow or orange on the lateral areas; a well marked subdorsal reddish-brown band present, not uniform in width, expands particularly at the 2nd-3rd abdominal incision, where it is also paler, and at the posterior margin of 2nd abdominal segment encloses a conspicuous white spot; the band also forms a broad yellowish blotch on the 10th abdominal segment (this widening can be traced towards the close of the first stadium, but the lines are rather intercepted in this stage); tubercles black, supraspiracular inconspicuous, forming merely a group of hairs rising from skin-surface; the lower lateral tubercles conspicuous, especially on thoracic segments, being raised on projections of the skin as in *E. quercifolia*; hairs black and brown; iv and v give rise to lateral tufts or loose pencils of hair which curve downwards to resting-surface; this is also the case with the hairs from vii. (The hairs appear to be raised and lowered to a slight extent, before moving and on ceasing to crawl, much less so, however, than in *E. quercifolia*.) In the *third stadium* (May 19th) there is little change, the ventral surface is still flatter; the ground colour paler (dirty white), the yellow (or reddish) subdorsal band less conspicuous, although the pale extension on abdominal segment 2 is still noticeable. Head dull black. The tubercles very inconspicuous, their position, however, well marked by groups of hairs; on dorsal area their position is marked by black blotches, and on the 8th and 9th abdominals are slightly raised above the skin-surface; the subspiracular are still raised on short fleshy processes which go to form the subspiracular flange (broken at segmental incisions); the hairs long, slender, tapering, simple and not serrated, mostly black on dorsal area, whitish on lateral area, great diversity as to length occurs, some (the grouped hairs) being quite long, others (the secondary) short; the lateral area is tinged with yellowish in addition to the dirty white and black mottling. In the *fourth stadium* (May 24th) the head is now greyish-white, mottled with black; the scutellar area is red or reddish-brown; two white dorsal spots on the meso- and metathorax, and four on each of the abdominal segments to the 8th; the other colours are much as in the preceding instar, with considerable individual variation, some being greyer, others browner; the venter and inner side of prolegs dull yellowish-white, with a fine blackish medio-ventral line that enlarges into a black central spot on each segment* (these form large blotches on the abdominal segments 3-6); the lateral tufts or brushes of hair are rather stronger and more compact, and the prolegs are widely spread; the larva is soft and flaccid, a condition that allows it to fit exactly any contour of the twig on which it may be resting; the spiracles are large, black, situated directly above the lateral ridge. By July 6th the larvæ were full-grown in the ? *sixth stadium*; there is then no important change from the fourth instar; the black ventral spots on the yellowish ground colour are strongly marked, and there is considerable individual difference in colour, some being much darker than others (Bacot). Todd remarks that when twenty days old (after the second moult) the larvæ are greyish, just as if sprinkled over with the dust of bran, the markings indistinct, with a reddish flame on each side of the

* This character of the markings reminds one of the similar arrangement found on the venter of the larvæ of the Catocalas, *Miselia oxyacanthae*, and other twig-resting larvæ.

6th segment (2nd abdominal), very pale, and which seemed to die away in a few days. After the third moult two conspicuous red spots appeared on the 2nd segment; the long white fringe hanging over and along each side, together with four large black spots on the ventral surface, very clearly defined; the venter quite flat. Before its last moult the larva is usually of a delicate violet or dove-grey tint, with two, orange, subdorsal stripes, and has a very different appearance from any forms of the adult larvæ. Buckler says: The full-fed larva is about $1\frac{3}{4}$ inches in length. The head is full and rounded, but smaller than the prothorax, bluish-grey in colour, freckled with reddish- and brownish-grey. The prothorax is margined with bluish-grey anteriorly, followed by a fusiform mark of brown divided dorsally by a pale line. On the back of the other segments is a series of dark grey blotches, bearing the form of inverted urns. These blotches are freckled with blackish atoms, the hinder portions being the darkest. Through these a darker dorsal line runs, and within them, on each side of the dorsal line, are two acute angular marks, of a bright ochreous-orange colour extending transversely. Laterally, there are dark grey curves, on a whitish ground, on the lower part of each segment, above which is a large, ochreous-orange blotch, freckled with dark grey, and surrounded above with a dark-grey blotch in front, and a larger blotch behind, of squarish form and finely freckled with black. The dorsal marks on the meso- and metathorax are blackish and rather conspicuously relieved by a whitish marginal side blotch, only faintly indicated on the other segments. On the meso- and metathorax also are oblique, dark grey, lateral streaks, running downwards and forwards. On the 2nd and 3rd abdominal segments, the dark dorsal blotches are relieved on either side by conspicuous whitish blotches. The ventral surface is buff-yellow, and there is a central black spot on the middle of each segment. On each side of the front of the prothorax, is a round wart-like tubercle. The head, as well as the dorsal and lateral areas, is covered with a fine pubescence, the sides being fringed below with longer grey and dark brown hairs. The ventral surface is only slightly pubescent. Fenn describes the larva as having the head rounded and flattened, hairy; the body elongate, flattened beneath, back and sides transversely wrinkled; sides puckered, with a fringe of rather long hairs pointing downwards above the legs; umber-brown; dorsal spots ochreous shaded with black atoms; sides also shaded in a similar manner round the pale lateral spots; an inconspicuous row of orange subdorsal spots, the 2nd segment with a red transverse band containing a yellowish spot; the lateral hairs whitish or pale grey; the venter orange-tawny with a series of prominent black spots connected by a grey line, these spots very large and prominent between the prolegs; legs yellowish-brown. Borkhausen observes that the larva agrees somewhat in its build with that of *E. quercifolia*, being flattened ventrally and arched dorsally. It is entirely covered with fine short hairs, with longer hairs laterally; its colour ash-grey, sometimes nearly blackish, at other times quite inclined to whitish; on the dorsum it is marked with large, connected, black spots, in which, on each segment, are four yellowish knobs, standing in a square. The head small in proportion to the size of the larva. The flat venter is whitish-yellow with round cinnamon-brown spots. Crewe says that the larva may be at once recognised by its orange belly.

Variation of larva.—The study of Buckler's figures of the larva of this species (*Larvae Brit. Moths*, pl. xlviii., figs. 2, 2*a*, 2*c*, and pl. xlix., fig. 1) will give a much better idea of the forms this larva may take, than any descriptions. Besides the form already described, *i.e.*, with a dorsal series of dark grey blotches, bearing the form of inverted urns on all the segments following the prothorax, and through which runs the darker dorsal line, with two acute angular marks of bright ochreous-orange extending transversely within them (*Buckler's Larvae*, iii., pl. xlviii., fig. 2*a*), there are: (1) A distinctly bluish form with orange-red, transversely oblique, dorsal stripes, directed backwards on the anterior segments (*loc. cit.*, fig. 2). (2) A dark grey form with a small round white spot margined with black on either side of the median line on the meso- and metathorax, a pair of small yellow, and a pair of larger blackish, dorsal spots taking the place of the trapezoidals on the abdominal segments. Other modifications occur in the colouring of the larva, but there is no evidence to show that the various forms are hereditary, nor do they appear to be confined to special districts.

Pupation.—The cocoon is remarkably small for the size of the larva, and is almost always formed so as to be adherent to the base of oak-trunks just beneath the soil (Merrin); Greene says the cocoon is found on various trees—ash, poplar, &c.—in August and September, sometimes firmly glued to the inside of a piece of loose bark or to the tree itself, at others spun-up tightly among decayed leaves, dead grass, &c. Sheldon notes pupæ found under bark of wych-elm at Derby, and Miss Miller that the tough cocoon is spun-up under bark at Chelmsford. Burrows says that he finds the tough black cocoons among dead leaves in hedgerows or attached to the upper surface of cavities in roots of ash and oak; Wolfe at Skibbereen obtains them at roots of elm, and Bostock under loose bits of bark at Tixall; Eddrupp writes that the cocoons are fairly common in rubbish at roots of elm at Bremhill, whilst Robertson generally finds them under the loose bark of various large trees at Sketty Park. Other notes are: at roots of oak in Worcester Park (Kaye), at roots of ash at Leek (Hill), at ash roots (Moss), often made up in the forks of the small stems of oak in June (Cross), on bark of willow (Clutten), at roots of isolated hawthorn tree at Emsworth (Christy), at the foot of ash trees (Raynor), at roots of oak under moss (Grover), under the bark of trees, under moss on rocks, and among rubbish at roots of willow near Hartlepool (Gardner), in crevices of bark, of poplar and oak near Selby (Ash), at roots of oak at Worcester (Hancock).

Cocoon.—The cocoon is composed outside of particles of extraneous matter (earth, wood, leaves, moss, &c.) spun together with silk. It averages about 17mm. in length, and 11mm. at its widest part. It is of about the consistency of good notepaper, rather tough, covered inside with coarse whitish silk, but with a smooth appearance to the naked eye. The imago escapes by means of a round hole at one end of the cocoon, the piece forced off, reminding one somewhat of the lid of the cocoon of *Lachneis lanestris*, but, owing to the difference in the nature of the cocoon, the lid is not broken off in a single piece. The pupa occupies very completely the whole space within the cocoon, and is very firmly attached in its cocoon by its cremaster. Poulton states (*Trans. Ent. Soc. London*, 1892, p. 448) that "four cocoons were spun among leaves and twigs of *Quercus cerris*, these were quite black on all exposed parts, while two spun between pieces of white paper were not nearly so dark. The blackness is, however, due to something which is not silk, the latter being of a much lighter brown; it probably comes from the digestive tract (for neither the paper nor the leaves or twigs around the cocoons appeared to be gnawed), and it has the appearance of bitten-up food or fæces. . . . Under any circumstances, there seems to be no question of colour adjustment, for the larvæ in the paper made the most use of all the material they had, and spread it out so as to cover the exposed part of their cocoons as completely as possible." Our observations lead us to believe that normally the larva stains the silk very little but that the excellent protective coloration is due to the mixing of particles, of whatever substance the larva is spinning up amongst, in the outer part of the cocoon. Those spun in earth have particles of earth, those on bark, fragments of moss and wood, those in leaves, fragments of the leaf, &c. Whittle says: Cocoon, close, mud-coloured, somewhat unsymmetrical, with inside lining of fine silk.

Pupa.—The pupa is about five-eighths of an inch in length and one-quarter of an inch in width. It is of a shiny black colour, with the movable incisions wide, dull, and dark red-brown in colour. The antennæ reach exactly to the apices of the wings; the abdominal segments ventrally red-brown; the cremaster formed of a dense tuft of hooked red-brown bristles. *Dorsally:* Of a dark blackish-brown colour, the abdominal segments rather more red-brown; shiny, except the abdominal incisions, which are duller and redder. The dorsal head-piece, not very prominent nor extending far beyond the prothorax; the prothorax well-developed, the mesothorax large, and swollen medially; the prothoracic spiracle forms a narrow linear slit at the junction of the pro- and mesothorax with the antenna; the metathorax is narrow centrally, wider at the bases of the hindwings; the skin of the thoracic segments is wrinkled transversely, the thoracic and abdominal segments have a slender raised mediodorsal line extending their full length, except at the movable incisions between the abdominal segments 4-5, 5-6, 6-7. The abdominal segments form shiny circular bands, slightly depressed centrally, and raised at the anterior and posterior edges; this development is less marked on the abdominal segments 4, 5, 6 and 7, the front part of which presents much the same structure, but the intersegmental membrane is smooth and silky in appearance; there is a median transverse depression on each abdominal segment; the 7th to terminal segments are shiny black. The cremaster is composed of a large number of red-brown hooks, very strong-looking, bent ventrally. *Ventrally:* The mouth and appendages shiny black, the lines separating the maxillæ from each other and from the first pair of legs bright red in colour, tending to crimson; abdominal segments reddish-brown. Directly above the mouth is a prominent median ridge, which is continued dorsally to form the mediodorsal ridge before described. The antennæ reach exactly to the apices of the wings; the maxillæ are short, ending between the first pair of legs, which extend about two-thirds, whilst the second pair extend well, towards the end of the antennæ, between which they are enclosed; the surface of the second pair of legs is concave, and these pass beneath the antennæ, so that the bases are not to be seen; the skin of the maxillæ, legs, and antennæ, is striated transversely. The glazed eye is very well marked, but not conspicuous; at the base of each antenna is a prominent projecting papilla. The abdominal segments maintain the ridged or hooped condition noticeable dorsally, each segment being composed of a smooth dull raised posterior band, and a slightly depressed shiny anterior one; the dull portion, although beyond the movable area, forms a part of the movable incision; the abdominal segments 7 to anal segment are entirely shiny. The genital organs and anus well marked. *Laterally*: The antennal papilla, the glazed eye, and prothoracic spiracle more distinct from this point of view. The wings shiny, dark red-brown, the neuration not conspicuous, the base of the forewing swollen; Poulton's line is present as a transverse depression parallel to the hind margin; the hindwing extending only just a short distance along the inner margin of forewing, terminating at the incision between the 2nd and 3rd abdominal segments. The spiracles on abdominal segments 2-8 distinct, each forming a double convex depression, with a well-defined narrow rim; there is a slight subspiracular depression; the cremaster blunt; the cremastral hairs numerous and prominent. [Described November 18th, 1897, from pupæ sent by Mr. Head.] Borkhausen says: "Die Chrysalide ist sehr kurz gestaltet und ziemlich gerundet. Anfangs ist sie grün und wird hernach dunkelbraun." Fenn notes the pupa as "very stout and rounded, the anal extremity with a rough pubescence; spiracles prominent; red-brown wing-cases, not shining; enclosed in a hard papery oval cocoon of blackish or dark earth-coloured silk, spun in crevices of bark, &c."

Parasites.—*Apanteles difficilis*, Nees (bred by Robson *teste* Bignell). *Hemiteles areator* (bred by Bower *teste* Bignell).

Food-plants.—*Populus*, *Corylus*, *Malus*, *Pyrus* (Linné), oak, lime, birch, whitethorn, wild rose (Borkhausen), aspen, fruit trees (Stephens), apple, sycamore and almost every forest tree, lettuce (Studd), alder (White), elm (Porritt), ash, willow (Raynor), sallow (A. H. Jones), crab apple (Prout), beech (Whittle), plum (Kretschmer), *Pinus larix* (Frey), larch—five larvæ all belonging to the least brightly marked form, *i.e.*, pale ash-grey dorsally, found at beginning of August, 1876, at Trafoi, produced normal imagines (Wocke), cherry (Wullschlegel), maple (Bankes), horsechestnut (Daws).

Habits and Habitat.—The habits of the imagines are but little known, most of the specimens in our collections having been either bred or captured at light. Reid notes that in Scotland the insect prefers open woods; the males sometimes fly by day, but mostly at night and are readily attracted by light. Barrett says the males fly from 10 p.m. till midnight, and that the ♀ certainly flies late at night. Butterfield has found imagines by day resting on oak trunks in November in the Keighley district. Grover has found them also on oak trunks near Guildford, and Smith on birch trunks at Bramham. The insect, too, is uncertain in its appearance—at Bristol very common some years, in others not seen (Bartlett), exceedingly common in 1896 but rare in 1897 in Gloucester district (Merrin), unusually abundant in 1891 in the Zürich district (Rühl), very common at Salisbury in 1898 (Ridley). Pitman says that at Norwich in 1894 and 1895 the larvæ were in great abundance in spring, and in the late autumn dozens of the imagines were attracted to light, but none have been seen since. Studd notes it as exceedingly abundant at light in 1897, when *Asteroscopus sphinx* and other contemporaneous moths were scarce; he further observes that the males are very common at light at Oxton, the females only occasionally so taken. Burrows notes it as especially abundant at light in foggy weather. Female at light on October 27th, 1897, at Boxworth (Thornhill), a female with several males taken at light December 17th, 1898, at Gloucester (Clutterbuck), females very rarely taken at light, the males abundantly at Tixall (Bostock), a female at light, with several males, at Bishop's Stortford, November 21st, 1897 (Bayne), a female at light November 20th, 1898, at Hitchin (Cottam). The males come to light at about 8.0 p.m. in November and early December at Kingsmill (Watkins). On January 5th, 1891, several were taken from the gas lamps at Clevedon, the thermometer at freezing-point, the atmosphere foggy, the roads sheets of ice, with snow lying about (Mason), whilst on the same date, at Chichester, one was discovered frozen tightly to a parapet, the specimen afterwards being thawed and recovering its vitality (Anderson), also at Seaton on lamps when freezing hard (Still). Todd gives a remarkable experience. He notes that on November 14th, 1864, he accidentally broke a pupa of this species, so the imago was taken out and its wings expanded after several hours. On November 16th he broke another pupa, the imago perfecting itself in half-an-hour. On November 9th, 1865, two pupæ were broken and moths released, one, a male, expanded its wings in about half-an-hour, the other, a female, did so on November 13th. The following note by Studd suggests that one cannot force *P. populi* either in the direction of double-broodedness, or even to obtain an earlier emergence of the imago: A female *P. populi* taken at light on December 7th, 1893, deposited ova December 7th-9th, the eggs hatched February 3rd-14th, 1894, between 50 and 60, fed on lettuce till beginning of March, during which time they also ate each other, and by March 4th only eleven were left, the largest nearly ½in. long; from March 1st they had a few sycamore buds as well as lettuce; they commenced spinning up April 16th-17th, and a ♂ emerged on November 21st. This shows that in spite of being fed up, and having pupated so early, the species will not emerge before its due time, even though kept all along in a warm room. Two ♂s were taken wild at light the same year, on November 23rd (see *Ent. Rec.*, viii., 318). Newman states that if the weather is unfavourable at the normal time for its emergence, the insect will remain in the cocoon "one, two, three, four, or even five years." Sharp repeats this statement which wants substantiating for this species. Its habitat is exceedingly varied. The larvæ sometimes occur in profusion on the oak-trunks in Chattenden Woods, and it is generally a true woodland species. Christy finds it in the woods on the chalk downs at Emsworth, and Clarke says that it is common in the oakwoods, parks, and shrubberies around Reading, and is often taken in the town itself. At Lewes it is most abundant on lamps near trees of *Quercus cerris* (Nicholson), in a plantation of small oaks at Perivale (Montgomery), by woodsides and hedgerows at Leicester (Dixon). Burrows also notes it as an inhabitant of hedgerows as well as of large isolated trees, whilst Robertson thinks it prefers large trees in parks in South Wales. Homeyer states that he found many cocoons firmly spun on stones or lying free among the same, beneath a lime avenue that ran through the moorland meadows between Anclam and Ziethen. Oberthür states that at Rennes the larvæ are very common on trees, and the imagines at light; he has taken as many as 40 in a single night flying around the electric light in his garden. Bankes observes that it occurs in both the woodland and heath districts of the Isle of Purbeck. In the breeding-cage both sexes commence to fly almost before dusk (Woodforde).

Time of appearance.—The *larvae* may be beaten throughout the latter half of May and June, they were very abundant on alders in May, 1885, at Fochabers (Scott), and are also to be found in May and June on the trunks of various trees in woods and gardens. Haggart notes the larvæ on alder in June, at Galashiels, the imagines at light in November and December. Rühl observes that the larva is found on oak and fruit trees in May and June in the Zürich district. The following are actual dates of capture: June 2nd-16th, 1862, at Darenth, common, May 31st, 1863, at Darenth, May 18th, 1895, at Lyndhurst, June 25th, 1875, at Chattenden, June 10th, 1886, at Bexley, May 26th, 1890, at Chattenden, May 19th, 1894, at Bexley, May 26th, 1894, at Chattenden (Fenn); June 18th, 1875, at Rannoch (A. H. Jones); June 12th-16th, 1871, at Sherwood Forest, May 29th-June 2nd, 1876, at Abbott's Wood, June 14th, 1880, from elm, at Wicken, June 1st-4th, 1881, at Barnwell Wold, June 27th-29th, 1892, at Abbott's Wood (Porritt); June 8th, 1880, fullfed at Eltham, May 30th, 1892, at Bexley (Bower); June 6th, 1881, at Hatfield (Mera); May 29th, 1881, August 11th, 1884, June 4th, 1888, &c., in the Isle of Purbeck (Bankes); June 10th, 1888, at Ranmore (emerged November 18th) (Whittle); August 18th, 1886, larva at Surbiton (T. Briggs); June 2nd, 1886, May 28th, 1890, May 30th, 1893, at Brentwood (Burrows); June 1st-6th, 1890, at Brockenhurst (Ogden); August 6th, 1891, pupated on August 18th, 1891, at Woodwalton (Bloomfield); May 20th, 1891, larvæ very young, near Plymouth (Briggs); June 7th, 1892, on oak at Bristol, spun up June 10th (Bartlett); a larva pupated May 7th, 1892, at Emsworth (Christy); May 13th, 1891, May 23rd, 1892, at Drumreaske (Kane); May 30th-June 7th, 1894, at Enniskillen (Brown); June 2nd, 1894, in Epping Forest (Tremayne); June 9th, 1894, at Perivale (Montgomery); larvæ pupated June 1st, 1895, from Chingford, imagines emerged November 21st, 1895 (Bell); May 27th, 1896, and June 27th, 1897, at Bishop's Wood (Ash); May 31st, 1897, at Windermere (Freeman); June 10th, 1897, at Loughton, pupated July 22nd-August 4th, one female emerged November 11th, another November 22nd, 1897 (Lane); May 14th, 1898, at Enniskillen (Allen); larvæ May 19th-22nd, 1899, New Forest (Prout). The *imagines* occur from the end of October until the end of January. The average time of emergence at Oxton, where the insect is very common, extends from November 20th-December 25th, extreme dates being October 26th, 1897 (early), and January 11th, 1894 (late) (Studd); common at light at end of October and in November, at King's Lynn (Atmore); September and October, in Scotland (Reid); September and October, at Frankfort (Borkhausen); October, in Upper Austria (Himsl); September 20th-November 18th in 1878, one as late as January 28th, 1879, at Salzburg (Fritsch); from November 2nd to December 18th, at Gölnitz (Hudák); in October, in Silesia (Prittwitz); in October, in Zürich district (Rühl); end of September to November, in Baden (Reutti); November 4th, 1893, at electric light, at Berne (Hiltbold); larvæ in May, imagines from October 14th onwards in the Baltic provinces (Lienig), from October 19th-November 3rd in the same district (Nolcken), whilst Sodoffsky even gives the imagines as appearing as early as August in the neighbourhood of Riga; common in December, at Rennes (Oberthür). Mason believes there are two periods of emergence at Clevedon, one in November and early December, the other in late December and January. Merrifield notes a most unexpected appearance on March 25th, 1861, when a male was bred from a Tilgate larva. Actual dates are as follows: October 29th, 1856, at Carlisle (Gregson); November 21st, 1861, bred from Wallingford, December 26th, 1863, bred from Darenth, November 21st, 1864, at Charlton, November 18th, 1865, at Eltham, October 16th to December 4th, 1875, bred several from Chattenden and Lyndhurst, November 29th, 1884, from Northbourne, November 28th, 1886, from Bexley (Fenn); November 19th, 1864, at Emsworth (Buckler); November 20th, 1864, November 10th, 1865, at light at Oxford, June 2nd, 1898, larva at Lynmouth, pupated June 20th, imago emerged November 20th the same year (T. Briggs); October 25th, 1866, at Northleach (Todd); October 14th, 1867, at Rannoch (White); November 18th, December 6th, 1875, at Eltham (A. H. Jones); November 18th, 1875, at Reading, December 5th, 1888, at Caversham, November 21st, 1889, at Bulmershe, November 28th, 1889, at Tilehurst, November 14th, 1890, at Warren, November 19th, 1892, at Wokingham (Holland); November 24th, 1880, at Aldborough (Andrews); October 15th, 1881, at Hartlepool (Robson); November 9th, 1881, at Rickmansworth (Mera); December 3rd-5th, 1881, at Derby (Pullen); December 17th, 1882, from Epping, November 18th, 1888, from Ranmore (Whittle); December 17th, 1882, November 15th-17th, 1890, November 8th-December 5th, 1891, November 14th, 1892, at Emsworth (Christy); October 31st, 1883, at Hitchin (Durrant); November 30th, 1883, at Sutton Coldfield (Bath); November 12th, 1885, November 23rd, 1886, November 3rd-December 20th, 1888, November 12th, 1892, at Rainham (Burrows); November 12th, 1885, November 16th, 1889, November 20th, 1890, at Brentwood, November 17th, 1889, at Wickford, October 21st, 1892, at E. Barkwith, November 12th-16th, 1892, November 11th-28th, 1893, November 1st-20th, 1894, November 17th-21st, 1895, at Panton (Raynor); November 20th, 1886, November 10th, 1887, November 15th, 1888, November 16th, 1889, November 18th, 1890, November 11th, 1892, at Reading (Butler); November 21st-December 5th, 1887, at Woodbridge (Freeman); until December 2nd, 1887, at Radley (Steuart); October 28th, 1889, at Hayton (Routledge); November 15th, 1889, at Derrynoose (Johnson); November 20th, 1890-January 25th, 1891, emerged at Durham (Maddison); November 16th-20th, 1890, at Grange-over-Sands (Booth); December 29th, 1890, December 5th, 1891, at Plymouth (Briggs); November 12th, 1890, January 5th, 1891, at Clevedon (Mason); January 1st, 1891, at Drumreaske (Kane); January 5th, 1891, at Chichester (Anderson); January 24th, 1891, at Bath (Jefferys); November 1st, 1891, at Chingford, November 22nd, 1896, at Hoddesdon, November 20th-21st, 1897, at Bishop's Stortford (Bayne); December 4th-8th, 1891, December 7th, 1894, at Bristol (Bartlett); November 21st, 1891, November 12th-28th, 1892, November 28th-30th and December 26th, 1893, at Worcester Park (Kaye); November 21st, 1892, December 5th, 1892, in Isle of Purbeck (Bankes); November 21st, 1892, at Woodwalton (Bloomfield); November 1st, 1892, at Rickmansworth (Mera); November 19th-December 15th, 1892, November 27th, 1893-January 11th, 1894, November 23rd-December 26th, 1894, November 20th-December 25th, 1895, November 12th-December 27th, 1896, October 27th-December 19th, 1897, November 17th-December 19th, 1898, November 10th-December 24th, 1899, at Oxton (Studd); November 22nd, 1892, November 15th, 1893, at Uckfield (Bower); December 3rd, 1891, November 6th, 1892, November 22nd, 1895, November 20th, 1897, at Chilwell (Pearson); November 8th, 1892, December 4th, 1893, November 7th, 1895, at Leicester (Dixon); bred November 17th, 1893, several at light November 20th-December 20th, 1896, at Mansfield (Daws); bred November 9th-24th, 1894, at Enniskillen (Brown); November 16th, 1894, from Perivale (Montgomery); December 2nd, 1894, November 22nd, 1895, at Coxhorne (Robertson); November 20th-27th, 1895, November 12th - December 10th, 1896, November 9th - 22nd, 1897, November 8th-December 12th, 1898, at Chelmsford (Miller); November 19th, 1895, December 4th, 1898, at Enniskillen (Allen); November 21st, 1895, from Chingford (Bell); October 18th, 1895, January, 1896, at Perth (Bush); November 9th-22nd, 1895, November 29th-December 9th, 1896, at Worcester (Rea); November 15th, 1895, at York, November 1st, 1896, from Bishop's Wood (Walker); November 10th-12th, 1896, at Newtown (Tetley); November 30th-December 2nd, 1896, at Brechfa (Newland); December 3rd, 1896, at Kinnoull Hill (Wylie); January 1st, 1896, at Bognor (Lloyd); October 2nd, 1897, at Scarborough (Head); December 9th, 1897, at Burnley (Clutten); November 20th, 1897, at Prestbury (Robertson); November 11th-22nd, 1897, from Loughton (Lane); November 13th-28th, 1897, at Feering (Reid); October 27th, 1897, at Boxworth (Thornhill); ♀ on lamp at Hitchin, November 20th, 1898 (Cottam); November 6th-12th, 1898, at Corsemalzie (Gordon); November 11th, 1898, at Buckerell (Riding) November 17th, 1898, at Chester (Arkle); December 12th-17th, 1898, at Gloucester (Clutterbuck).

Localities.—All the Scotch counties in which I have collected, but has not been seen in Orkney or Shetland (Reid). Distributed throughout Ireland (Kane). Aberdeen: Inverurie, Pitcaple, Fyvie (Reid), Aberdeen (Horne). Antrim: Shanes Castle (Bristow). Argyll: Lochgoilhead (Dalglish), Dunoon (Colquhoun), Kilmun (Somerville). Armagh: Derrynoose, Armagh (Johnson). Ayr: coast districts—Troon (Chapman). Beds: Potton (Sandy). Berks: general in the county (Clarke), Reading (Butler), Bulmershe, Wokingham, Tilehurst (Holland), Wallingford (Fenn). Brecknock: Builth (Vaughan). Bucks: Chalfont Road (Prout), Buckingham (Slade), Halton, Wavendon, nr. Newport Pagnel (Stainton). Cambridge: nr. Cambridge (Farren), Boxworth (Thornhill), Wicken (Porritt), Cambridge (Moss), Whittlesford, Ely, Chatteris, Warboys Wood, Wisbech, Cowbit (Balding). Carmarthen: Langhorne (Jefferys), Brechfa (Newland). Cheshire: generally distributed (Ellis), Chester, Knutsford (G. O. Day), Bidston, Birkenhead (Brockholes), East Cheshire (Walker). Cork: Killetra, Mallow (Newland), Skibbereen (Wolfe). Cumberland: Carlisle (Armstrong), Hayton, Castle Carrock (Routledge), Keswick (Beadle), Cockermouth (Mawson), Lake dist. (Stainton). Derby: Derby (Sheldon), Needwood Forest (Harris), Repton (Mason), Ashby dist. (Smallwood), Burton-on-Trent dist. (Stainton). Devon: Oxton (Studd), Buckerell (Riding), Exeter (Porritt), Seaton (Still), Bickleigh Vale, Plymouth (E. F. Briggs), Lynmouth (T. Briggs), Hillsborough (Basden-Smith). Dorset: Blandford (Stainton), I. of Purbeck (Bankes). Dublin: Howth (Kane). Dumbarton: Shandow (Grant), Garelochhead (Henderson). Helensburgh (Dalglish). Durham: generally distributed, Castle Eden, Crimdon Cut (Robson), Hartlepool, Teesdale (Gardner), Darlington (Meldrum). Elgin: Fochabers (Scott). Essex: Epping Forest (Prout), Ongar Park (Doubleday), Chelmsford (Miller), Southend, Loughton, Brentwood, Rainham (Burrows), Feering (Reid), Chingford (Bell), Colchester (Harwood), Theydon (James), Hazeleigh, Brentwood, Wickford (Raynor). Fermanagh:

Enniskillen (Allen). GALWAY: Clonbrock (Lawless). GLAMORGAN: Swansea, Sketty Park (Robertson). GLOUCESTER: Bristol dist. (Hudd), Kingsmill (Watkins), Wotton-under-Edge (Perkins), Gloucester (Merrin), Coxhorne, Cheltenham, Prestbury (Robertson), Clifton (Griffiths), Northleach (Todd), Stonehouse (Nash), Grange Court, Upton (Lifton), Lower Guiting (Stainton). HANTS: general in the county (Clarke), New Forest (Adkin), Lockerley (Burrows), Bisterne (*Substitute*, p. 29), Brockenhurst (Ogden), Emsworth (Christy), Ringwood (Fowler), Lyndhurst, Crabbe Wood, Winchester, Ampfield (Hewett), Romsey (Burrows), Winchfield (Robertson). HEREFORD: Hereford (Chapman), Leominster (Hutchinson), Tarrington (Wood). HERTS: Hitchin, Knebworth (Durrant), Bushey (Cottam), Hoddesdon, Waltham, Bishop's Stortford (Bayne), Hatfield (Mera), Hertford (Stephens). HUNTS: Woodwalton (Bloomfield). KENT: South-eastern London district, not common (Fenn), Eltham (Jones), West Wickham (Machin), Darenth, Rochester, Cuxton, Strood, Chattenden, Plumstead district (Tutt), Charlton, Bexley, Northbourne nr. Deal (Fenn), Birch Wood (Stephens). KERRY (Barrett). KILDARE (Lawless). KING'S COUNTY: Tullamore (Kane). LANCS: generally distributed (Ellis), Grange (Booth), Bolton (Johnson), Liverpool (Pierce), Manchester dist. (Chappell), Preston dist. (Hodgkinson), Warrington (Cooke), West Derby (Gregson), Burnley (Clutten), Rossall (Moss). LEICESTER: generally common, Ashby (Smallwood), Knighton (Bouskell), Leicester (Dixon). LINCOLN: Hartsholme, Skellingsthorpe (Carr), E. Barkwith, Somersby, Panton (Raynor). LONDONDERRY: Derry (Campbell). MERIONETH: Newtown (Tetley). MIDDLESEX: Perivale (Montgomery), Harrow Weald (H. R. Brown), Kingsbury (Bond), Wealdstone (Rhoades-Smith), Harrow (Bonhote), Rickmansworth (Mera), Enfield, Bush Hill Park (Edelsten), Southall (Battley), Hampstead Heath, Muswell Hill (Southey). MONAGHAN: Drumreaske (Kane). MONMOUTH: Abergavenny (Chapman). MORAY: Mosstowie (Horne). NORFOLK: King's Lynn (Atmore), Whitnall (Freeman), Merton (Durrant), Norwich dist. (Burrows). NORTHAMPTON: Barnwell Wold (Porritt), Sherwood Forest (Postill), Newark (Gascoyne). NORTHUMBERLAND: Generally distributed (Robson), Meldon Park (Finlay), Jesmond (Henderson), Chopwell Wood (Rhagg). NOTTS: Chilwell (Pearson), Sherwood Forest (Porritt), Mansfield (Daws). OXFORD: Radley (Steuart), Warren, Caversham (Holland), Oxford (Briggs). PERTH: Forth, Earn, Gowrie, Perth and Rannoch districts of Perthshire—Kinnoull, Broxy, Dupplin, &c. (White), Rannoch (Jones), Kinnoull Hill, Perth (Wylie). RADNOR: Wye Valley (Vaughan). RENFREW: Johnstone (Watson). ROSCOMMON: Lough Arrow to Roscommon (Ffolliott). ROSS: Contin (White). ROXBURGH: Roxburgh, Biddle, Hawick dist., Duke's Wood (Guthrie), Galashiels (Haggart). SHROPSHIRE: Wyre Forest (Rea), Shrewsbury (Stainton), Church Stretton (Newnham), Market Drayton (Woodforde). SOMERSET: Clevedon (Mason), Taunton (Rawlinson), Bath (Jefferys), Weston-super-Mare (Smallwood), Castle Cary (Macmillan). STAFFS: Swynnerton, Chorlton Moss (Daltry), Stone, Tixall, Stafford (Bostock), Cannock Chase (Freer), Leek (Hill). SUFFOLK: somewhat common in the county (Bloomfield), Woodbridge (Freeman), Ipswich, Bentley (Burrows), Stowmarket (Stainton), Waldringfield (James), Aldborough, Borough Bridge (Andrews). SURREY: Worcester Park (Kaye), Croydon (Sheldon), Guildford (Grover), Epsom (Morley), Ranmore (Whittle), Leatherhead (Raddon), Coombe Wood (Stephens), Surbiton (Briggs). SUSSEX: East Sussex, general (Jenner), Abbott's Wood, Lewes (Nicholson), Hastings, St. Leonard's dist. (Bloomfield), Balcombe, Tilgate Forest (Merrifield), Bognor (Lloyd), Brighton (Stainton), Chichester (Anderson), Weald dist. (Cooke), Uckfield (Bower), Polegate, Tilgate, Holmbush (McArthur). TYRONE: Favour Royal (Kane). WARWICK: Spetchley Park (Rea), Knowle (Bradley), Sutton (Johnson), Farnboro (Lifton), Coleshill (Bree), Wyre Forest, Yardley (Wainwright). WATERFORD: Portlaw (Flemyng). WESTMEATH: Cromlyn (Battersby). WESTMORLAND: Windermere (Freeman). WICKLOW: Tinahely (Bristow). WIGTOWN: Corsemalzie (Gordon). WILTS: Salisbury (Ridley), Bremhill, Calne (Eddrupp). WORCESTER: Newland, Worcester (Rea), Bradley (Tye), Brockleton (Decie). YORK: Bishop's Wood (Ash), Keighley district (Butterfield), Stokesley (Gribble), Selby (Porritt), Hull (Boult), Edlington Wood, York (Wilson), Sheffield (Thomas), Bramham (Smith), Askham (Prest), Thirsk (Grassham), Harrogate, Richmond (Sang), Huddersfield (Varley), Leeds (Birchall), Pontefract (Hartley), Ripon (Wate), Scarborough (Wilkinson), Wakefield (Talbot), Sandburn (S. Walker), Pateley (Storey), Birstwith (F. F. Walker), Bretton Park (Mosley), Rotherham (Young), Everingham (Sumner).

DISTRIBUTION.—AMURLAND (Staudinger). AUSTRO-HUNGARY: Brünn (Müller), Rosenau, Salzburg (Fritsch), Taufers, Innsbruck (Weiler), Epiries, not rare (Husz), Chemnitz (Pabst), Gölnitz (Hudák), Galicia, widely distributed (Garbowski), Franzenshöhe, Lemberg (Nowicki), Upper Carinthia (Nickerl), Fiume (Mann), Lavantthal (Höfner), Bucovina, distributed (Hormuzaki), Pressburg (Rozsay), Bohemia, not common (Nickerl), Neu Sandec (Klemesiewicz), Stanislawow (Werchratzki), Buda (Speyer), Upper Austria—nr. Raab (Himsl), Trafoi (Wocke). Belgium: rare, Soignes, Louvain, Liège, &c. (Donckier), Virton (Bray). Denmark: rather common, everywhere (Bang-Haas). France: almost throughout (Berce), Rennes, very common (Oberthür), Paris (Bellier), Meuse, Moselle and Meurthe districts (Speyer), Puy de Dôme (Guillemot), Morbihan (Griffith), Gironde—Pessac (Trimoulet), Doubs (Bruand), Loire-Inférieure (Bonjour), Seine-et-Loire, Burgoyne (Const. coll.), St. Quentin (Dubus), Aube (Jourdheuille), Douai (Foucart), Auvergne dist.—Nohant, Forêts du Cher, Sologne, Royat, &c. (Sand), Eure-et-Loir, Châteaudun (Guénée), Haute-Garonne—Toulouse (Caradja), Rouen (Lhotte), Château-du-Loir (Graslin). Germany: general (Heinemann), north-west Germany, generally distributed (Jordan), south-west Germany—Frankfort, Niedgau, Taunus, &c. (Koch), Spires (Linz), Würtemberg (Seyffler), Giessen (Dickore), Lower Elbe dist. (Zimmermann), Waldeck, not rare (Speyer), Erfurt (Keferstein), Zeitz-on-Elster (Wilde), Halle (Stange), Munich, common (Kranz), Lower Elbe dist.—Blankenese (Zimmermann), Rudolstadt (Meurer), Mecklenburg (Schmidt), Bremen, common (Rehberg), Saxon Upper Lusatia (Schütze), Dresden, distributed (Steinert), Thuringia, not rare (Krieghoff), Gotha, Herzberg (Knapp), Dantzig, Konigsberg (Schmidt), Restenburg (Klups), Silesia, not rare (Prittwitz), Upper Lusatia (Moeschler), Nassau (Rössler), Ratisbon (Schmid), Dessau (Richter), Alsace (Peyerimhoff), Wernigorode (Fischer), Pomerania (Hering), Brunswick, common (Heinemann), Hanover, common (Glitz), Baden, Rhine Palatinate (Reutti). Italy: North Italy, rather rare (Curò), Sicily, rather rare (Mina-Palumbo). Netherlands: whole country, but rare (Snellen), Breda (Heylaerts). Roumania: common—Grumazesti, Kloster Neamtz, Slanic (Caradja). Russia: St. Petersburg (Erschoff), Baltic Provinces (Sintenis), Moscow dist. (Albrecht), Wolmar (Lutzau), Schleck, Frauenburg, Riga, and Kokenhusen (Nolcken). Scandinavia: distributed, but not common (Aurivillius), Stockholm, Hudiksvall, &c. (Wallengren). Spain: Teruel—Huesca, &c. (Zapater and Korb), Barcelona (Cuní y Martorell), Catalonia (Martorell y Peña). Switzerland: generally distributed over the lower parts of the country (Frey), Weissenburg (Huguenin), Grisons (Killias), Zürich dist.—Trichtenhausen, Adlisweil, on the Zürichberg, between Höngg and Engstringen, Alstetten (Rühl), Berne (Hiltbold), Sils-Maria (Hnatek).

Subfam.: Trichiurinae.

Tribe: Trichiuridi.

The genus *Trichiura* appears to be practically isolated from any other Palæarctic Lachneid genus. Kirby, in his *Catalogue*, p. 837, unites in the same genus *khasiana*, Moore, *aliaria*, Druce, *obscura*, Walk., and ? *albiplaga*, Walk., whilst in the British Museum coll., *khasiana*, Moore, and *obsoleta*, Kl. (a species from Cairo) are placed with *crataegi* under this title. We are unable to detect any real connection between these three species, and consider (after making all due allowance for the vagaries resulting from protective resemblance) that the species are all widely apart, and that the two exotic species are possibly not even Trichiurids. On the other hand, the Chilian species placed under *Macromphalia*, Feld.—*dedecora*, Phil., *chilensis*, Feld., and *purissima*, Butl.—have a very distinct Trichiurid facies, although possibly, when the early stages are known, it may be proved that they really have no very definite relationship. To us, the Trichiurids appear to form a terminal Lachneid branch, with possibly but two genera, each represented by a single species, *viz.*, *Achnocampa* (*ilicis*), and *Trichiura* (*crataegi*).

Genus: Trichiura, Stephens.

Synonymy.—Genus: *Trichiura*, Stephs., "Ill. Haust.," ii., p. 42 (1828); "Cat. Brit. Ins.," p. 47 (1829); "List Br. An. Br. Mus.," v., 1st ed., p. 47 (1850); 2nd ed., p. 44 (1856); Wood, "Ind. Ent.," no. 45 (1839); Dup., "Cat. Lép. Eur.," p. 75 (1844); Humph. and Westd., "Brit. Moths," 2nd ed., pp. 55, 56 (1851); Sta., "Man.," i., p. 155 (1857); Humph., "Gen. Brit. Moths," p. 24 (1860); Rbr., "Cat. Lép. And.," p. 360 (1866); Wallgrn., "Skand. Het.," ii., pp. 66, 267 (1869); Newm., "Brit. Moths,"

p. 41 (1869); Guénée, "Lép. Eure-et-Loir," p. 80 (1875*); Buckl., "Larvæ, &c.," iii., pl. xlix., fig. 2 (1889); Auriv., "Nord. Fjär.," p. 61 (1889); "Iris," vii., pp. 140, 142 (1894); Kirby, "Cat.," p. 837 (1892); Barr., "Brit. Lep.," iii., p. 5 (1896); Tutt, "Brit. Moths," p. 59 (1896); "Proc. Sth. Lond. Ent. Soc.," pp. 1-11 (1898); Dyar, "Can. Ent.," xxx., pp. 4-5 (1898). *Bombyx*, Linn., "Sys. Nat.," 10th ed., p. 502 (1758); 12th ed., p. 823 (1767); "Faun. Suec.," p. 299 (1761); Fab., "Sp. Ins.," p. 194 (1781); "Mant.," ii., p. 126 (1787); "Ent. Syst.," iii., p. 460 (1793); Schiff., "Sys. Verz.," p. 58 (1776); Esp., "Schmett. Eur.," iii., pt. 1, p. 233 (1785); Bork., "Sys. Besch.," iii., p. 127 (1790); "Rhein. Mag.," i., p. 367 (1793); Donov., "Nat. Hist. Brit. Ins.," iv., p. 23 (1795); Hb., "Eur. Schmett.," iii., p. 141 (?1800); Haw., "Lep. Brit.," i., p. 105 (1803); Godt., "Hist. Nat.," iv., p. 122 (1822); Bdv., "Gen. et Ind.," p. 70 (1840); Frr., "Neu. Beit.," vi., p. 14 (1846); Boh., "Vet. Ak. Handl.," 1848, p. 133 (1848); Snell., "De Vlind.," p. 186 (1867); Nolck., "Lep. Fn. Estl.," p. 126 (1868); Staud., "Cat.," p. 67 (1871); Curò, "Bull. Soc. Ent. Ital.," viii., p. 148 (1876); Frey, "Lep. der Schweiz," p. 94 (1880); Lampa, "Ent. Tids.," vi., p. 41 (1885); Rühl, "Soc. Ent.," v., p. 170 (1891); Carad., "Iris," viii., p. 90 (1895); Reutti, "Lep. Bad.," 2nd ed., p. 56 (1898). *Noctua*, Linn., "Fauna Suec.," 2nd ed., p. 309 (1761). *Phalaena*, Fuessly, "Mag. Ent.," ii., p. 11 (1779); Retz., "Gen. Spec. Ins.," p. 36 (1783). *Gastropacha*, Ochs., "Die Schmett.," iii., p. 278 (1810); H.-Sch., "Sys. Bearb.," ii., pp. 101, 105 (1847); Hein., "Schmett. Deutsch.," i., pp. 201, 207 (1859). *Lasiocampa*, Germ., "Prod. Sist. Bomb.," p. 49 (1811); Meig., "Eur. Schmett.," ii., p. 203 (1830). *Diaphone*, Hb., "Verz.," p. 188 (?1822). *Clisiocampa*, Curt., "Brit. Ent.," expl. pl. 229 (1828); "Guide," p. 142 (1829). *Eriogaster*, Bang-Haas, "Nat. Tids.," (3), ix., p. 411 (1874); Meyr., "Handbook," p. 322 (1895). *Poecilocampa*, Ström, "Danm. Somm.," p. 82 (1891). *Achnocampa*, Grote, "Illus. Zeits. für Ent.," iii., p. 71 (1898); Dyar, "Ent. Rec.," xi., p. 141 (1899).

Stephens' diagnosis of the genus (*Illus. Haust.*, ii., p. 43) reads as follows:

Trichiura, mihi. Palpi very minute, concealed by elongate hairs, triarticulate; basal joint as long as the second, and stouter; terminal joint minute, ovate; maxillæ obsolete; antennæ straight, short, bipectinated in the males, serrated in the females; head moderate, densely pilose, distinctly visible from above; thorax stout, pilose; abdomen slender, with an elongate sub-bifid tuft at the apex in the males, very robust in the females, with a dense woolly mass at the tip; wings rounded at the apex, not reversed during repose, abbreviated in both sexes; legs short, stout, densely clothed with elongate hairs to the claws. Larva cylindrical, hairy, solitary. Pupa stout, enclosed in an ovate rigid cocoon.

Stephens placed only *crataegi* in *Trichiura*. It, therefore, becomes the type of the genus. Hübner was the first author to separate *crataegi* and *populi* from the allied Lachneids, but united them strangely enough in the genus *Diaphone* with the quite extraneous form, *sylviana*, Stöll, from S. Africa, which has since been named the type of the latter genus. Aurivillius notes that as all authors since Stephens have applied to *crataegi* Stephens' generic name *Trichiura*, it would be quite purposeless to change the name. Grote (*Illus. Zeits. für Entomologie*, iii., p. 71) rejects the name as being the same as that of the Arctiid genus *Trichura*, Hb., and includes *crataegi* in the genus *Achnocampa*, Rambur, with *ilicis*; but *crataegi* is not congeneric with *ilicis*, the neuration is different, and the female is without the characteristic anal tuft. To us the syllabic difference between *Trichiura* and *Trichura* appears to be quite sufficient to justify its retention. Stephens notes that "*Trichiura* offers many distinctions which separate it from *Clisiocampa* (with which it had hitherto been united), and its habits are totally dissimilar. The ♀ *Trichiura* lays her eggs in irregular longitudinal rows on the bark of trees, covering them with down from the apex of her abdomen. *Clisiocampa*, on the other hand, deposits them in a solid compact ring, round a slender twig, without

* This work is incorrectly dated 1867 and is so quoted by Aurivillius *vide.*, *Zool. Record*, 1875.

any protection. The larvæ of *Trichiura* when hatched very speedily separate*, and do not form a general nest, whereas those of *Clisiocampa* form a general web, which they increase in bulk until it becomes nearly as large as a man's head, and do not separate until they have undergone their final moult. When the larvæ pupate they make a hard, oval, egg-like cocoon, not a subfusiform double silken web, suffused with a loose powder, as do those of *Clisiocampa;* the imago differs from that of the latter genus by having the antennæ straight, serrated in the females; the wings rounded, obtuse, and abbreviated in both sexes; the legs stout and very pilose; the abdomen strongly tufted in both sexes, that of the female furnished at its extremity with a downy mass; the head distinct and very hairy, and the proportions of the palpi different." There is only one known species in the genus —the widely distributed *crataegi*. The species placed in the genus by Kirby appear, as we have already said, to differ considerably and not to be congeneric. The structural peculiarities of the early stages of *Achnocampa ilicis* are, at present, a very great desideratum, as its affinities with *T. crataegi* are by no means clearly made out. Among other things, Aurivillius notes that "nervures 9-10 of the forewings have a long stalk only as long as the free part of the nervure in *ilicis*, whilst it is more than double as long in *crataegi*"; also "in the hindwing nervures 7-8 are quite free in *ilicis*, but united into a short stalk in *crataegi*." He then adds: "The larvæ of the two species are very different, and give ground for the erection of a special genus for *ilicis*. Unfortunately I only know the larva of *ilicis* from the description and the figures of Rambur and Millière. According to these, the larva of *ilicis* differs principally in having the body much narrowed towards the head and in the conical elevation on the 11th segment. Like the larva of *crataegi* it is provided with warts, but on the arrangement of the warts the authors are silent. If, as I suspect, they are developed in the same peculiar way as in *crataegi*, it would be a further proof of the near relationship of the species, and the other outward differences might be explained as adaptations to different modes of life. It is further to be remarked that the 11th segment of *crataegi* also is slightly elevated. The larva of *crataegi* is almost cylindrical, and thinly clothed all over with short soft hairs; on the warts are stronger and stiffer hairs; the warts flattened, little raised. Segments 1-3 have a large wart on each side, with another weakly indicated behind it; first segment above is without warts, the two next bear two each; segments 4-11 have each two large dorsal warts, and on each side a small one below and a larger above the spiracle. Pupa red-brown, thin-skinned, naked, with several hooks at blunt anus."

Trichiura crataegi, Linné.

Synonymy.—Species: *Crataegi*, Linn., "Sys. Nat.," 10th ed., p. 502 no. 30 (1758); 12th ed., p. 823, no. 48 (1767); "Faun. Suec.," p. 299, no. 1126 (1761); Poda, "Ins. Mus. Graec.," p. 86 (1761); Fab., "Sp. Ins.," p. 194, no. 104 (1781); "Mant.," ii., p. 126, no. 150 (1787); "Ent. Syst.," iii., p. 460, no. 166 (1793);

* There is possibly here some distinct difference of habit, for Millière (*Lép. Alpes-Maritimes*, p. 141), says that the young larvæ hybernate under a common web fixed to the small branches of *Crataegus oxyacantha*, and at their last moult (in the spring), separate and live singly. Bacot notes that, in confinement, at least, the larvæ undergo their first moult in little groups, like those of *Eutricha quercifolia*.

Schiff., "Sys. Verz.," p. 58, no. 8 (1776); Göze, "Beit.," iii., pt. 2, p. 340 (1779); Esp., "Schmett. Eur.," iii., pl. xlv., figs. 1-6, p. 232 (1785); Bkh., "Sys. Besch.," iii., p. 127, no. 34 (1790); "Rhein. Mag.," i., p. 367 (1793); Don., "Nat. Hist. Brit. Ins.," iv., p. 23, pl. 117 (1795); Hb., "Eur. Schmett.," iii., p. 141, no. 4, fig. 162 (? 1800); "Larvæ, &c.," iii., Bomb. M. *b.* (*by error*) figs. 1*a-d* (? 1803); "Verz.," p. 188 (? 1822); Ochs., "Die Schmett.," iii., p. 278 (1810); Germ., "Prod. Sist. Bomb.," p. 49 (1811); Godt., "Hist. Nat.," p. 122, no. 27, pl. xii., figs. 3-4 (1822); Curt., "Brit. Ent.," expl. pl. 229 (1828); "Guide," p. 142 (1829); Stphs., "Ill. Haust.," ii., p. 42, no. 43 (1828); "Cat. Brit. Ins.," p. 47 (1829); "List Br. An. Br. Mus.," v., 1st ed., p. 47 (1850); 2nd ed., p. 44 (1856); Meig., "Eur. Schmett.," ii., p. 203 (1830); Wood, "Ind. Ent.," no. 45 (1839); Bdv., "Gen. et. Ind.," p. 70 (1840); Dup., "Cat. Lép. Eur.," p. 75 (1844); H.-Sch., "Sys. Bearb.," ii., pp. 101, 105 (1847); Boh., "Vet. Ak. Handl.," 1848, p. 133 (1848); Humph. and Westd., "Brit. Moths," 2nd ed., pp. 55, 56, pl. x., figs. 13-14 (1851); Sta., "Man.," i., p. 155 (1857); Hein., "Schmett. Deutsch.," pp. 201, 207 (1859); Humph., "Gen. Brit. Moths," p. 24 (1860); Rbr., "Cat. Lép. And.," p. 360 (1866); Snell., "De Vlind.," p. 186 (1867); Nolck., "Lep. Fn. Est.," i., p. 126 (1868); Wallgrn., "Skand. Het.," ii., pp. 66, 67 (1869); Newm., "Brit. Moths," p. 41 (1869); Staud., "Cat.," p. 67 (1871); Bang-Haas, "Nat. Tids.," (3), ix., p. 411 (1874); Guénée, "Lép. Eure-et-Loir," p. 80 (1875); Curò, "Bull. Soc. Ent. It.," viii., p. 148 (1876); Frey, "Lep. der Schweiz," p. 94 (1880); Leeuwen, "Tijds. v. Ent.," xxiii., p. 195, pl. xii., figs. 1-9 (1880); Lampa, "Ent. Tids.," vi., p. 41 (1885); Buckl., "Larvæ etc.," iii., pl. xlix., fig. 2 (1889); Auriv., "Nord. Fjär.," p. 61 (1889); "Iris," vii., pp. 140, 142 (1894); Ström, "Danm. Somm.," p. 22 (1891); Rühl, "Soc. Ent.," v., p. 170 (1891); Kirby, "Cat.," p. 837 (1892); Carad., "Iris," viii., p. 90 (1895); Meyr., "Handbook," p. 322 (1895); Barr., "Brit. Lep.," iii., p. 5 (1896); Tutt, "Brit. Moths," p. 59 (1896); "Proc. South Lond. Ent. Soc.," pp. 1-11 (1898); Dyar, "Can. Ent.," xxx., pp. 4, 5 (1898); "Ent. Record," xi., p. 141 (1899); Grote, "Illus. Zeits. für Ent.," p. 71 (1898); Reutti, "Lep. Bad.," 2nd ed., p. 56 (1898). *Floccosa*, Clerck, "Icones," pl. v., fig. 1 (1759). *Vitis-ideae*, Linn., "Fauna Suec.," 2nd ed., p. 309, no. 1163 (1761). *Sylvina*, Fuess., "Mag. Ent.," ii., p. 11 (1779). *Bicaudata*, Retz., "Gen. Spec. Ins.," p. 36 (with ref. to De Geer, *Mém.*, i., p. 193, ii., p. 300) (1783). *Mali*, Fab., "Mant.," ii., p. 115, no. 75 (1787); "Ent. Syst.," iii., p. 434, no. 85 (1793); Bork., "Sys. Besch.," iii., p. 468 (1790). *Avellanae*, Fab., "Mant.," ii., p. 116, no. 76 (1787); Bork., "Sys. Besch.," ii., p. 468 (1790). *Crataegus*, Haw., "Lep. Brit.," p. 105, no. 37 (1803). *Pallidus*, Haw., "Lep. Brit.," p. 105, no. 38 (1803).

Original description.—*Phalaena* (*Bombyx*) elinguis, alis deflexis cinereis rotundatis: fascia obscuriore, ano barbato. Habitat in Crataego (*Sys. Nat.*, xth ed., p. 502).

Imago.—Anterior wings whitish, ashy, or brownish-grey, with a more or less distinct darker median transverse band; this is bounded internally by a blackish line curved to the thorax, externally by a doubly-angulated transverse line; the curved line includes a darker somewhat oval patch (grey or brown) at base of costa; there is also a waved submarginal line. Posterior wings grey with a pale median transverse shade internally edged with darker.

Sexual dimorphism.—The males vary from 26·5mm.-34mm. (our British examples being some 3mm.-5mm. less in expanse than the continental ones in the European collection), the females from 30mm.-40mm. (the British examples also averaging some 3mm.-4mm. less than the continental). The males are thus smaller than the females; the antennæ of the males much more strongly pectinated, the ground colour greyish (sometimes whitish), with a darker band, and waved submarginal line. The females are larger, rounder-winged, more uniformly coloured, much darker, cinereous-grey, often brownish; the basal patch browner; the median band rather darker, edged externally with paler, which increases the banded appearance. The fringes are usually much more distinctly chequered in the males than in the females; the latter sex, too, has a distinct anal tuft.

Gynandromorphism.—We have observed the following records of gynandromorphous examples of this species:

α. Esper figures and describes (*Beobachtungen ein. neu. Zwitterphaläne der B. crataegi*, pp. 12-20, pl. i., fig. 5) a gynandromorphous example, the right wings, the right antenna, and perhaps the right half of body ♂, the left antenna, wings, and half of body ♀. The specimen belonged to Jung of Uffenheim, and he notes that there is a preponderance of female characters about the abdomen. It was bred in 1777 by Jung, larva found (with others) on apple trees, nothing peculiar observed about any of them, and six examples finally bred, of which this was one.

β. One of my entomological friends here has bred this season a specimen of *Gastropacha crataegi*, the right antenna of which, as well as the exact right half of the body and the right wings are ♂, whilst the whole left side is ♀. The anal organs are also male on the right and female on the left side. The differences in the wings are very great, as the male side is much darker* than the female one, the right male half of the abdominal segment is black, whilst the left female half is simply pale grey. The larva did not appear to differ in any way from others of the species (Müller, *Ent. Mo. Mag.*, iii., p. 213, who received the note from Haury, of Prague).

γ. The right forewing bears an exact resemblance in shape, colour, and markings to that of an ordinary male, whilst the opposite wing has all the characteristics of the female. The hindwings are identical with those of a male and female respectively, as also are the antennæ. The left side of the body and corresponding legs are brown, the opposite side and legs being grey, and agree with the colour of the respective sexes. Bred August 26th, 1890 (Jackson, *Entom.*, xxiii., p. 345).

δ. Another specimen similar to the last, in which the line of division down the thorax and abdomen, between the pale grey of the male on the right hand and the brownish-grey of the female on the left is very sharply defined. Bred August, 1890, at Bristol (Prideaux, *Entom.*, xxiv., p. 45).

ε. A perfect specimen, with distinct division into a right ♀ and left ♂ half. Right forewing deep brown-grey, the central area paler towards the base, ♀; both left wings white-grey, ♂. Antennæ right ♀, left ♂. Thorax and abdomen ♂, dark coloured with conspicuous anal tuft. Right wings only little larger than left. Bred by Kolar, Prague (Nickerl, *Verh. z.-b. Ges. Wien*, 1872, p. 731).

Variation.—There is a considerable amount of minor variation exhibited by both sexes of this species. The ground colour of the males varies from almost clear white to a dull cinereous-grey, that of the females is usually much darker cinereous-grey, sometimes with a distinct brownish tinge. The median band may, in the male, consist merely of the two transverse boundary lines, with a slightly greyer included area, or it may be of a well-defined, blackish-grey coloration, whilst the outer area of the wing may be of an uniform tint, unbroken even by the usual wavy submarginal line, or the latter may be sufficiently developed to give the outer area a distinctly fasciated appearance. In the female, which, owing to the darker ground colour, is usually much more uniform in appearance, the band is generally less defined, and, in some examples, the whole wing-area may be unicolorous, the usually paler areas having taken on the darker tint of the median and basal portions of the wing. In the British Museum coll. some female examples have the outer area showing a greyish tint and with a well marked subdorsal line, and hence more nearly approach the male in appearance. One example from Livonia has the median band clearly shown up by very pale outer and inner marginal transverse lines, and the outer area of the wing is very distinctly marked with a grey transverse fascia on either side of the submarginal line; the fringes, too, are distinctly speckled (much as in some well-marked males). Another ♀ is almost unicolorous, the fore- and hindwings and fringes being uniformly

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* These colours as applied to the sexes appear to us to be accidentally transposed.

tinted, except for the slightest suspicion of the central band of the forewings. The British males are, on the whole, smaller, whiter, and much more clearly marked than the continental specimens. Oberthür notes that the Rennes form is very much like the English, and we observe that the Frankfort and Hanover examples approach the latter in tint. Among the aberrational forms noted, Raynor says that the Panton district (larvæ on whitethorn hedges) produced fine large dark imagines, and that he reared a pale chalky form from ova received from Coventry. Ash observes that a Skipwith larva produced a crippled male with dark band, similar to Lincolnshire examples, which latter Raynor notes as very large and dark compared with Essex specimens, whilst Barrett states that the ground colour of the forewings varies from grey to nearly white. There are specimens with creamy-white ground colour in the Doubleday coll., and Mason has one of a blackish-grey colour with a still darker band (possibly var. *ariae*). Staudinger records a very dark aberration from Asia Minor, bred in October (*Hor. Soc. Ent. Ross.*, xiv., p. 365). In the more ordinary forms of the male we appear to get two distinct types of coloration:

(1) ♂. Whitish, with darker median band. ♀. Pale buff = ab. *pallida*, n. ab.
(2) ♂. Ashy-grey, with darker median band. ♀. Dark grey-brown = *crataegi*, Linn.

Besides these there is an extreme form of the latter, which has developed into a very distinct race in moorland districts and at high altitudes and latitudes. This race appears to have an almost parallel life-history with that of *Lasiocampa quercûs* var. *callunae*, although perhaps there is a larger percentage of autumnal emergences in this than in the latter, and was named *ariae* by Hübner. The very pale, almost white, form with grey median band is recorded from Château-du-Loir by de Graslin. Nolcken observes that in the Baltic provinces there are specimens with suffused coloration, in which the markings are not so sharply defined, and which come near *ariae*, Hb., and he has a male in which the black shading of the central band is not developed.

a. var. (et ab.) *ariae*, Hb., "Schmett. Eur.," figs. 288-289 (? 1800); Staud., "Cat.," p. 68 (1871); Schöy., "Norg. Ark. Lep.," p. 177 (1881); Hoffmn., "Stett. Ent. Zeit.," xlix., p. 148 (1889); Kirby, "Cat. Lep. Het.," p. 837 (1892); Reut., "Act. Soc. F. F. Fenn.," ix., p. 27 (1893). *Arbusculae*, Pfaff., "Stett. Ent. Zeit.," xxi., p. 126 (1860).—Hübner's figures (*Schmett. Eur.*) 288-9 represent the upper and undersides of a large and dark ♀ specimen of this form, which shows the same uniform cinereous-grey tint as the examples of this variety in the British Museum collection, but with the median band of the forewings darker than usual, and showing also the pale line edging the external border of the band; one traces also the dark transverse shade of the hindwing. [The colour of the figures has changed and is now very unsatisfactory.] The British Museum examples (Frey coll.) from the Engadine and Upper Hartz may be diagnosed as follows: ♂. About 38mm. Cinereous or ash-grey, with a dark median band, strongly margined with two very dark transverse lines, the median band extending narrowly inside along the inner margin to thorax; the area between the median band and the thorax almost as dark as the band, outside the band the wing area is paler and with only a faint trace of the slightly darker submarginal line. Hindwings unicolorous, ashy-grey, slightly brownish towards base, with dark transverse shade towards the base, and dark nervures. ♀. About 40mm.-42mm. With cinereous or ashy-grey forewings, the median band but little darker, edged externally with paler, which makes the edge of the fascia look still darker than it really is, but both the outer and inner edges are rather darker than the fascia; the hindwings grey, with a darker grey transverse fascia near base, paler on either side. Localities: This variety is recorded from:—Austro-Hungary: Innsbruck, on the Schlückenalpe (? = *freyeri*) (Weiler). Belgium: Brussels (Breyer). France: Douai, rare (Foucart). Germany: Silesia (Assmann), Riesen (Hofmann), Hartz (Hoffmann), Augsburg (Pfaffenzeller), Mangfall dist. (v. Gumppenberg). Italy: rare in Alps (Curò). Russia: Lapland (Teich). Scandinavia: up to Finmark (Aurivillius), Tromsö (Schneider), Stockholm, Jämtland, Lapland (Lampa), Dovre (Schöyen), S. Varanger (Collett), Lycksele (Zetterstedt). SWITZERLAND: Upper Engadine, 5000ft.-8000ft. (Pfaffenzeller), Gadmenthal, Simplon (Rätzer).

It is evident that the large mountain form, which has a habit of spending its first winter as an egg or young larva, and its second as pupa, has a different facies in different districts, and presents, as does the smaller lowland type, males with white, and males with grey ground-colour, for Freyer describes the large *ariae* that he bred from the Tyrol as being "bright white-grey" in tint. This form we have named ab. *freyeri* in the succeeding paragraph. Staudinger diagnoses var. *ariae* as "major obscurior." Aurivillius observes that the type form occurs in the south of Scandinavia, the var. *ariae*, on the other hand, as far north as Finmark. Schneider says that he possesses two examples from Sydvaranger and bred one at Tromsö all of the var. *ariae*, and further remarks on the different life-history of the insect from the far north, observing that the larva hybernates* quite small, is full-fed in July or August, that the pupa then hybernates, the imago appearing the following June, thus taking two years to reach maturity. Teich observes that a Lapland pupa which he expected to emerge in the autumn of 1879 (as does the type in Livonia), did not do so until the spring of 1880. Wocke notes the var. *ariae* as flying on the crest of the Riesen in May and June, the larva feeding on *Sorbus* and *Vaccinium myrtillus*. Hoffmann says that in the moorland districts of the Upper Hartz the larvæ are exceedingly variable, are found throughout June till mid-July, principally on *Vaccinium uliginosum* and *V. myrtillus*; the greater part of the imagines appear in August and the beginning of September†, the remainder of the pupæ yield the moths in the early spring of next year; almost all the imagines belong to the dark var. *ariae*, a few specimens only forming transitions between this mountain form and the lighter form of the lowlands; the imagines emerge from the pupa towards evening, and the male flies about swiftly as soon as the wings are dry. This experience is identical with that of Horne, who notes the species as "common in the larval stage on heather, on all the moors near Aberdeen, from these, imagines appear in August and September, and 25 per cent. generally pass the winter in the pupal state and emerge the following summer. All the imagines from this district are darker than the English specimens." Reid confirms this, and notes that on the Scotch moors the larvæ are common, that they hybernate the first winter, pupate the next summer, and emerge the following autumn. Guthrie notes larvæ

* Barrett observes (*Brit. Lep.*, iii., pp. 7-8) that "a statement has been made that in the north-east of Scotland, the larva does not feed up within the year, but hybernates as a larva, producing the moth in the following season, but this seems so improbable that one is led to suspect a confusion with the larva of one of the larger Bombyces." We suspect Mr. Barrett was not aware that Schneider, Millière, Reid, and others, had noticed the larval hybernating habit. The Scotch entomologists could not well "confuse it with the larva of one the larger Bombyces," for, with the exception of half-fed *L.* var. *callunae*, full-fed *M. rubi*, and *C. potatoria*, none of the larger Bombyces found in Scotland hybernate in the larval state.

† Hoffmann suggests that it is a question whether they do so in a state of nature. He thinks it may only be a reversion of the mountain-form to the habit of the lowland form, due to breeding them indoors. He adds that in a state of nature the moth has never been found in the autumn. Bischoff, however, observes that in the Engadine the larvæ of var. *ariae* are full-grown in July and the imagines appear in October.

on heather in the Hawick district pupating the third week in May. Frey observes that the variety feeds in the Upper Engadine on *Alnus viridis*, and sometimes emerges after remaining in the pupal stage for several years. Webb has examples from the Bond coll., which Weaver obtained at Rannoch, of undoubted var. *ariae*. Zetterstedt bred one December 10th, 1832.

β. ab. *freyeri*, n. ab.=*ariae*, Frr., "Neu. Beit.," vi., p. 14, pl. 488 (1846) (*nec ariae*, Hb.).—Hübner has done right in separating this as a distinct species from *crataegi*, both its size and its habitat—the highest Alps—help to indicate this. I, myself, have had the opportunity to breed the larva, which occurs only on a species of *Salix* which is confined to the higher Alps. Like that of *crataegi*, it is a variable larva, but always larger. The varieties are three in number: first, black-brown, with orange girdles or incisions, reminding one of a half-grown *B. rubi*; second, likewise with yellow incisions, but also with golden yellow lateral spots; third, brown, with yellow incisions and blue spots seated on a white ground. They were full-grown from middle of July to beginning of August. They ate little, and were difficult to breed except in their native heights. All attempts to feed them on the other food-plants of *crataegi* failed, except only that they occasionally ate a little blackthorn. From twenty larvæ four males and three females were bred, which latter were immediately recognised as Hübner's *ariae*. The imago appears partly in mid-October, partly not till June of the following year. The ♂ differs from *crataegi* in its bright *white-grey* ground colour, and both sexes by their larger size (Freyer).

Pfaffenzeller very reasonably calls attention (*Stett. Ent. Zeit.*, xxi., p. 126) to this description by Freyer, and states that, if Freyer's statement "that *ariae* differs principally from *crataegi* in the clear white-grey ground colour of the male" be correct, then the moths that he had himself bred from the Upper Engadine, 5000ft.-8000ft. elevation, being black and directly opposite in appearance to those of Freyer, could not be var. *ariae*, but would, necessarily, form a special and distinct alpine variety, which might retain the name *arbusculae*, that he had at first applied to it. He had no doubt from the description of Freyer's larvæ that the latter's *ariae* and his own *arbusculae* were varieties of *crataegi*, the larvæ agreeing. Pfaffenzeller's specimens were, of course, the true *ariae*, and Freyer's evidently a local form of it of pale coloration in the males. The latter came from the Reinthal or Schlückenalpe, near Reutte, in the Tyrol, where one would almost expect pale forms as a result of natural selection.

Egglaying.—The eggs are laid, usually the day after the female has paired, on the bark or on a twig of *Crataegus oxyacantha*, *Prunus spinosa*, or other of its food-plants. They are glued firmly to the twig by the long side, in contact with each other, so as to form a ribbon, eight to ten in number, with the long axes parallel, all the micropyles pointing in the same direction. In one batch under observation one row of eggs was laid so as to overlap, partially, a second row. The eggs are covered with coarse, dark grey, silky hairs from the abdomen of the female. The silk fibres are firmly attached to the upper surface of the egg, crossing each one obliquely in the same direction; a quantity of loose fibres is also scattered about. The number of eggs deposited varies from 100 to 220. The eggs normally do not hatch until the spring—towards the end of March and on through April—April 6th-7th 1867, March 24th, and onwards, 1874; April 14th-25th, 1878, April 22nd-May 16th, 1879, April 2nd, 1886, April 22nd, 1889, April 11th and following days, 1890, April 3rd, 1891, to end of month, April 8th and following days, 1896. Doubleday and others observe that the eggs of the same batch do not all hatch at once, a few of the larvæ generally appearing daily for two or three weeks.

Williams notes that a batch spread its hatching from April 3rd, 1891, to the end of the month. Millière notes the eggs as hatching in the autumn in Cannes, and this seems to be the general habit of the moorland var. *ariae*.

Ovum.—The egg forms a flattened oval, inclining to rectangular in outline; the length, 15 micro-millimètres; breadth, 10 micro-millimètres; height, 5 micro-millimètres; with a large shallow depression occupying the greater part of the upper surface; the micropylar end is a little squarer than its nadir, the latter being perhaps a little broader. The shell is of a dark chestnut-brown colour, shining, and is seen to be exceedingly finely pitted, and longitudinally striated under a high power. The micropylar area occupies the whole of one end, the micropyle proper being placed centrally in a slight depression at this. The embryo does not develop until late in the winter (Bacot failed to find any trace of it in an egg opened on January 18th, 1896). The whole of the micropylar end is eaten out circularly when the larva makes its escape; but there is no colour change in the egg-shell before hatching owing to its opacity. Crewe describes the egg as of a rich chestnut colour, paler at the base, which is flattened. When looked at through a glass, he says, it reminds one much "of a ripe acorn." We fail to see the similarity. The simile is, however, repeated by Barrett.

Habits of larva.—We have already noted that the var. *ariae* lays eggs that hatch in the autumn, that the young larvæ hybernate the first winter, feed up and pupate the following summer, some emergences taking place in autumn, other pupæ going over the winter and not producing imagines till the following summer (an exactly parallel life-history to that of *Lasiocampa quercûs* var. *callunae*). Millière strangely notes a similar habit of autumn-hatching larvæ along the Riviera, where one would scarcely expect it, and where the need of a long larval life is less evident than in the high altitudes and latitudes that var. *ariae* inhabits. Generally in central Europe the eggs are laid in autumn, do not hatch until spring, the larvæ become full-fed in June, remain as pupæ until September, when the imagines emerge. The young larvæ when newly emerged spin a slight web over a part of the food-plant, and are gregarious for a time. In their second stadium they rest in small groups, and appear to prefer a twig with no smaller twigs branching from it. They cover such parts of it as they rest upon with silk, and though they leave it to obtain food they return again to rest on the same twig. They love to bask in the morning sun, and towards the end of May and beginning of June, when they have separated, and also later when they are almost full-fed, they may usually be found sunning themselves on the small blackthorn or whitethorn bushes, stretched out lengthwise on a twig, on the outskirts of woods and thickets. Holland notes that it is an irregular feeding species—only the quickest feeding ones appear to be successful, some batches feeding on slowly through most of the summer and then almost always die in the last instar. This appears to be a remnant of the moorland habit, which is unsuitable to the low-lying districts, and which natural selection, perhaps, does its best to eliminate, although one might suppose that the necessity for rapidly coming to maturity in its southern localities would be of little moment to a species with such diverse larval habits as this. Williams notes the larvæ as feeding by preference on closely-cut hawthorn hedges and loving the sun. Merrin observes that in the Bristol district the females prefer to lay their eggs on closely-cut hedges by roadsides, and notes that although the larva is somewhat conspicuously coloured it is not very readily seen. Burrows remarks that the larva climbs to the tops of the shoots in the hedges in the evening to feed. It always prefers the young shoots, and hence is often noted as resting on such. Daws observes that he can never find the larvæ until after sunset when they are fairly plentiful on the young upright shoots of whitethorn hedges, especially those by running streams. Raynor observes that the larvæ of *T. crataegi* may be found by day especially in dull weather, but by far the best plan is to search for them between 8 p.m. and 9 p.m., when they crawl up the young shoots at the top of the hedges especially those cut the previous year. Moberly says that very small larvæ are to be met with the first week in May, but are three-quarters grown by the first week in June.

Larva.—The *newly hatched* larva (April 15th, 1895), has a black, broad and flattened head, as wide as the prothoracic segment, with a few scattered hairs upon it. The body is of a dark brownish-black colour, the thoracic segments wider than the abdominal segments, and the tubercular warts on them larger. The scutellum is represented by two pale brown or yellowish plates bearing several small tubercular points which emit hairs. In this stadium, i and ii are arranged trapezoidally, ii farther from mediodorsal line than i. The anteriors (i) are large many-haired warts, those on the 2nd and 3rd thoracic, being larger than those on the abdominal segments, while the posteriors (ii) are extremely minute, and bear a single very small hair; the posteriors are present on metathorax (and ? mesothorax) as well as on the abdominal segments; iii is supraspiracular, and many-haired, and iv + v make a very large subspiracular, which is oval in shape. (There is also on one of the abdominal segments a minute but distinct prespiracular hair, and this may have been present on the other abdominal segments although not detected.) The prothoracic subdorsal warts are large, and have an ear-like appearance (as in Liparids). The tubercular hairs are either thorny or serrated. In the *second instar* (April 27th), the larva is more cylindrical in shape. The head is not so large proportionally, is squarer in outline, and its colour black, with short white hairs on it. The body is blue-black, the scutellum black, except just in front, where it is raised, and forms two bright, orange-coloured, hair-bearing prominences, looking very like tubercles. The anterior dorsal warts (i) are still well-developed, and are of a bright orange colour. The lateral warts (iii, iv and v) are smaller, the supraspiracular being low and flat, and giving rise to short black hairs; the subspiracular (iv + v) is larger than iii and gives rise to bright orange hairs. The warts are larger on the thoracic than on the abdominal segments. The prothoracic, ear-like tubercles are not so prominent as in the previous stadium. There is an oblong orange patch round each of the anterior dorsal warts, forming two broad, but interrupted, stripes down the back. In the *third instar* (May 5th) the secondary hairs appear on the skin surface and warts; the patches forming the broad interrupted stripes down the back from the 1st to the 7th abdominal segments are narrower than in previous instar, and each has a short line branching off at right angles, each pair of extensions nearly meeting in the centre of the dorsum. In the *fourth instar* (May 12th), the lateral warts are very insignificant, a little stronger on the thoracic than on the abdominal segments. The dorsal warts are still in evidence and fairly well-developed, and the ear-like tubercles are still fairly prominent. The warts are of a bright red or deep orange colour, and the longitudinal and jutting transverse lines are yellowish. (In one larva these short transverse lines were very dark and scarcely noticeable.) In the *fifth instar* (May 19th) the hairs are very long, the dorsal ones brown, but becoming whitish towards the tip. The head is dull, black, with whitish and red-brown hairs; the scutellum is dull red; the subspiracular warts are about as well-developed as the dorsal, which are flattened, but show up somewhat distinctly on the 6th, 7th and 8th abdominal segments. The supraspiracular warts are now only to be detected on the thoracic segments; the prothoracic ear-like tubercles are still fairly well-developed (Bacot).

Variation of larva.—The larva is very variable. Newman says that in some examples the orange markings on the side are tinged or irrorated with white, and alternate with pure white amorphous blotches, which form a broad irregular stripe on each side. Bacot writes that there is considerable variation in the larvæ in the fourth instar, but when full-fed, those of one brood that he once had, separated into two very distinct forms:

(1) Dark brown, with deep red dorsal tubercles, an interrupted pale yellow or cream-coloured band down either side of the back. This band is formed by a slightly oblique stripe on each segment. These stripes are white centrally and yellow at ends. The lateral hairs are white, and the dorsal golden brown.

(2) A form that suggests in some respects the larvæ of *M. castrensis* and *P. trifolii*. It is rather darker in colour, both lateral and dorsal hairs are reddish-brown; the dorsal stripes are less interrupted at the segmental incisions, and are deep red instead of cream colour. On each segment, just below these stripes, there is a subdorsal row of blue spots, and below these, again, a faint yellow spiracular line. The spiracles of this form are greyish-white in colour, those of the first form are darker and less conspicuous. The short transverse stripes are quite gone from the dorsum of the first form and only faintly developed in the second.

There are forms connecting these two extremes, and others equally distinct as those described are possibly to be obtained. Buckler gives (*Larvae Brit. Moths*, pl. xlix., figs. 2*b*, 2*c*, 2*d*, 2*e*, 2*f*) five very different figures of adult larvæ:

(1) Black, with bright red trapezoidals, an orange-yellow supraspiracular line running from the 1st to the 8th abdominal, a grey spiracular line running from the 1st abdominal to the anal flap and including the white spiracles, the ventral surface yellowish (fig. 2*b*).

(2) Black, with two red spots on the dorsum of each segment, yellow segmental incisions, white spiracles, and a broken white spiracular line; blackish ventral area (fig. 2*c*).

(3) Whitish, with a broad brown mediodorsal band, widening at the centre of each segment, and containing dull brownish-yellow dorsal spots in place of the red; faint brownish-grey segmental incisions and subsegmental lines; a fine blackish longitudinal line separates the whitish subdorsal and supraspiracular areas (fig. 2*d*).

(4) The dorsal area yellow, with a black median dorsal line, and black, dorsal, segmental incisions; a black cincture running round the centre of each segment transversely, and containing the two red dorsal spots; the supraspiracular line black; the spiracles red; the ventral area (below supraspiracular line) dull purplish-grey (fig. 2*e*).

(5) The dorsal area continuously black, forming a diamond-shaped marking on each segment, each one united broadly with that before and behind; the wide part of each mark carrying two red dorsal spots on each segment. The lateral areas white, the subspiracular line yellowish, the ventral area brownish (fig. 2*f*).

Newnham records a form in which the usual white dorsal lines are represented by light blue spots. Van Leeuwen describes and figures (*Tijd. v. Ent.*, xxii., p. 195, pl. 12) some varieties of the larva. Fenn describes two forms of the larva as:

(1) Hairy, elongate, cylindrical, sooty-black in colour, the sides greyer and paler; the whole body covered with fulvous hairs not sufficiently dense to obscure the markings; a broad irregular and whitish, interrupted with orange, subdorsal stripe, having a black dash below it on each segment; two orange dorsal spots on each segment; a threadlike fulvous line above the spiracles, which are black edged with white; beneath them a waved fulvous line; the hairs emitted from the pairs of dorsal spots are longer and darker than those on the other parts of the larva. Head and legs black, prolegs yellowish.

(2) Black on the back and sides; a brilliant white subdorsal stripe, composed of numerous blotches; beneath it an ill-defined series of small yellowish spots; two orange dorsal spots on each segment (May 21st, 1875).

He later, June 30th, 1876, described three forms of the larva obtained at Rannoch (not on the heaths) as follows:

(1) Velvety black; the sides with a series of cream-coloured blotches conspicuously produced transversely, interrupting the black ground colour; the blotches alternate with smaller lateral silvery-white spots; upper part of each of the larger blotches shaded with orange; hairs pale greyish-brown.

(2) Back black; sides dark bluish-grey; a broad and much interrupted orange-tawny subdorsal band, and a transverse dorsal similarly coloured stripe on each segment; below the tawny band is a broad white stripe much interrupted with black spots and shading into the grey ground colour of the sides; this form is a variation of the English type by the suffusion of orange-tawny in the vicinity of the subdorsal spots.

(3) Sooty black; the back with broad velvety-black, transverse bands; one on each segment; a series of very conspicuous orange subdorsal dashes (two on each segment) alternate with small whitish blotches; the latter are only visible when the larva is curled up; hairs yellowish-brown; head and legs black; prolegs dull orange. [When moving the back appears velvety-black with numerous transverse orange dashes, below them a row of white dots.]

Borkhausen notes the larva as bluish-black, covered thinly with hairs, some of which are rather long. Each segment has, next the incision, a yellow or white semicircular band, beside which, on each, stand two dark red tubercles with stiff bristles. Varieties occur in which only four of the middle tubercles have the red colour, the rest being darker coloured. On one occasion a larva was found in which all the tubercles were dark. There is a broken white longitudinal line running the whole length of the body on either side of the larva. Briggs observes that from 80 eggs that hatched April 6th-7th, 1867, two forms of larvæ were produced in almost equal numbers; the difference was most striking and there were no intermediate forms: (1) A "banded" form, resembled at first glance, the early stage of the larva of *M. rubi* and was like Albin's pl. xxxiv., fig. *a*, and Buckler's pl. xlix., fig. 2*c*. (2) A variegated form. These produced only 24 pupæ, the imagines from which gave three pairings—(1) Between ♂ and ♀ moths from larvæ of the "banded" form. (2) Between a ♂ and ♀ from larvæ of the variegated form. (3) Between moths, one from a banded and the other from a variegated larva, sex not observed. The larvæ obtained in due course from these, were entirely of the variegated form, and in the third generation were darker, and the linear markings much bolder, than in the first brood.

Cocoon.—The larva spins a tolerably hard cocoon of an oval (tending to oblong) form, and compact in texture. We have seen two distinct forms of the cocoon: (1) Dark brown in colour, spun among moss, dead leaves or twigs on the surface of the ground. This usually has a considerable quantity of loose outside spinning in which moss and pieces of leaves are mixed up. (2) Composed of fine particles of earth spun together, of about the consistency of thick brown paper and with its outer part very smooth. This is usually spun just below the surface of the ground, and is sometimes loosely attached to grass roots. The cocoon is about two-thirds of an inch in length, and slightly over one-third of an inch in width, and leaves inside only just sufficient space to accommodate the pupa. The inside of the cocoon is lined with whitish silk. It is not very unlike the cocoon of *Poecilocampa populi*. Greene observes that he has once or twice found the cocoon at roots of poplar, the larva having "probably wandered from some neighbouring hawthorn"—the larva is, of course, occasionally a poplar feeder. Raynor notes the cocoon in confinement as generally attached to the side of a flower-pot or to a sherd among loose soil. Arkle records a brood pupating among moss. Burrows notes that a larva pupated in a tough cocoon on surface of ground on June 17th, 1889. Fenn describes the cocoon as very hard, compact, oval, shell-like, very rough outside, internally lined with whitish shiny silk, spun among rubbish on the surface of the ground.

Pupa.—The pupa is about 14mm. in length and 4·7mm. in width at the 4th abdominal segment. It is dark brown in colour, somewhat shiny, except the wing-cases, which are noticeably dull. The skin is somewhat wrinkled transversely. There is a trace of a central median ridge on the thoracic segments, and a double on the abdominal. *Dorsally:* The prothorax forms an almost vertical face; the mesothorax large, with a faint mediodorsal ridge in front, and a depression on either side of the swollen median area; the metathorax is narrow centrally, widening out at the sides, whence the hindwings originate. The 1st, 2nd, 3rd, and 4th abdominal segments increase gradually in size, both longitudinally and transversely, the pupa having its greatest width at the 3rd and 4th segments. Thence the segments gradually decrease in width to the cremaster, which is covered with short, stiff, black hairs. Each of the abdominal segments after the 3rd consists of two areas—the anterior roughened, the roughnesses suggesting the bases of an aborted spine or bristly structure, the posterior smooth to prevent friction in the movable incisions. Movement occurs between 4-5, 5-6, 6-7. The spiracles protrude so as to be seen dorsally. *Laterally:* The prothoracic spiracle is placed in the incision between the prothorax and mesothorax, and in contact with the antenna; the glazed eye forms a smooth, shiny, dark brown lunule, extending from the antenna to the base of the leg; the skin of the antennæ and wings is much wrinkled; there is a raised shoulder and, parallel to the hind margin of the wing, a distinctly elevated ridge (? Poulton's line). The spiracles are seen on the 2nd, 3rd, 4th, 5th, 6th, 7th and 8th abdominal segments, each consists of a projecting black oval rim. The segmental incisions between 4-5, 5-6, 6-7 are very conspicuous. The 8th abdominal is of a brighter red-brown than are the other segments, and the spiracle is more prominent and looks somewhat double, although the slit is evidently somewhat aborted. The skin about the spiracles is pitted and sparingly covered with fine, pale, short hairs that do not extend into the dorsal region. *Ventrally;* The dorsal head-piece projects slightly in front of the prothorax; the first pair of legs is short, the second not quite so long as the antennæ which extend almost to the apex of the wings, whilst the tips of the third pair project just beyond the apices of the wings. The mouth, head, and dorsal head-piece are shiny; the legs and antennæ dull, rough, and deeply grooved; the antennæ and apices of forewings are red-brown inclining to crimson. The 5th and 6th abdominal segments are depressed on either side of the median line, and suggest traces of the position of the larval prolegs; the 7th abdominal is narrow, and the 8th, which is very smooth, bears at its posterior extremity the genital organs; the anal orifice is quite ventral, and some distance below the cremaster, which, ventrally, bears some resemblance to a projecting flap with a few black, bristly hairs extending from its outer edge [Described September 29th, 1897, from pupæ received from Butterfield.] Fenn describes the pupa as "very stout and round, wing-cases short; incisions well defined; anal extremity rounded with a small projection furnished with very minute hooked bristles; red-brown or dull-red in colour; wing-cases and incisions darker; spiracles black and prominent."

Food-plants.—Apple (Newnham), whitethorn, sloe, willow (Stephens), sallow (Stainton), oak, birch, poplar (Thurnall), crab-apple (Holland), hazel (Christy), ling (Harris), beech (Edmunds), bramble (Montgomery), cherry (Esper), pear (Speyer), *Cotoneaster* (Standfuss), *Escallonia serrata* (Zach *teste* Staudinger), *Salix caprea*, *Populus tremula* (Hering), *Alnus viridis* (Frey), *Populus nigra* (St. John), willow, plum (Barraud).

Habits and Habitat.—There is something peculiar in the habits of all the early stages of this insect, the irregular hatching of the ova, the power to hybernate as egg or larva (according to habitat), have been already noted, as also the power of the insect to hybernate a second winter as pupa after passing the previous one as egg or larva. But the pupal stage may be prolonged and pupæ may give forth their imagines after existing two or three years in the pupal state. A second winter is common in all English localities, and Wilson notes six out of twelve going over in 1876 (a very hot season) at York, whilst normally the pupal existence lasts from 8-12 weeks. The imagines emerge in the early evening, 5 p.m. to 7 p.m., and the males fly about swiftly almost as soon as the wings are dry, the female remaining very quiet until fertilised, and then flying somewhat heavily when searching for a place to lay its eggs. In confinement the males are rarely noticed to pair when on their evening flight, 6 p.m. to 7 p.m., but are generally seen *in copulâ* in the morning. Barrett notes that they have a second active period late at night. They are strongly attracted to light, although the females appear to be immune in this direction, the latter sex also being rarely captured. Jefferys notes taking one flying in the evening at Chagford, near Dartmoor, when about to deposit ova on blackthorn. The insect loves the outskirts of woods and thickets, or the sides of open ridges in the woods of southern England, and here the larvæ may be found sunning themselves in May and June. But its habitats are widely different. It is found in the woods on the chalk hills at Emsworth (Christy), on the blackthorn bushes growing on the slopes between Benfleet and Southend, and on the bushes on the sea-wall at Great Wakering (Whittle), prefers pruned hawthorn bushes round Cambridge (Moss), and whilst in Epping the larvæ are to be found on the sloe-bushes in the open parts of the forest, at Eltham and Oundle they are found in woods (Bower). Raynor notes that at Maldon it is abundant on hedges, both blackthorn and whitethorn, and only once has been found in a wood. It occurs chiefly on hawthorn hedges near Rennes in June (Oberthür). Near Richmond, in Yorkshire, it haunts the moors and feeds on ling (Harris), and the moorlands form its habitat in Perthshire, Aberdeen, and other parts of Scotland, where it is widely distributed on the hills and moors of the mountains.

Time of appearance.—The larvæ appear normally from the commencement of April until the end of June, usually full-fed from June 10th-20th; the imagines emerge usually from about August 20th to the middle of September. The following dates may be interesting: *Larvae:* may be beaten from sallow in April, May and June (Moberly); May 25th-30th, 1865, at Worcester (Edmunds); eggs hatched April 6th-7th, all larvæ completed last moult by May 24th, the first imago emerged August 13th, 1867 (Briggs); ova hatched April 14th, larvæ full-fed May 25th-May 27th, imagines August 18th-25th, 1875, wild larvæ May 22nd-June 23rd, 1875, at Lee (Fenn); June 18th, 1875, fullgrown, at Rannoch, June 10th, 1876, at Epping (A. H. Jones); June 1st-9th, 1881, at Barnwell Wold, June 8th-22nd, 1898, at Rannoch (Porritt); June 6th, 1881, at Hatfield, June 9th, 1890, at Chattenden (Mera); May 30th, 1882, at Eltham, May 3rd, 1893, small, at Oundle, June 10th, 1896, full-fed, at Epping (Bower); May 29th, 1882, at Polegate, May 16th, 1897, at Benfleet (Whittle); eggs hatched April 2nd, 1886, and April 22nd, 1889, larvæ found June 21st, 1887, June 17th, 1889, June 14th, 1890, May 25th, 1893, June 17th, 1897, at Bentley, Brentwood, and Canvey Island (Burrows); June 2nd, 1889, at Arundel, eggs hatched April 3rd, 1891, from Bentley (Williams); June 1st-6th, 1890, at Brockenhurst (Ogden); May 30th-June 12th, 1891, April 5th, 1896, young, April 5th, 1897, at Egg Buckland (Briggs); June 15th-July 5th, 1891-1893, in Wicken Fen (Freeman); May 3rd, 1893, at Benfleet, May, 1897, at Barnwell Wold (Battley); early June, 1894, at Church Stretton (Newnham); June 2nd, 1895, May 16th, 1896, in first instar, June 10th, 1896, full-fed, at Lincoln, May 22nd, 1896, at Peterborough (Pearson); May 15th-26th, June 10th-22nd, 1895, at Skipwith (Ash); May 21st, 1896 (imago emerged September 1st, 1896), at Abbott's Wood, June 14th-18th, 1897, at Polegate (Montgomery); June 21st, 1896, at Aberdeen (Horne); early May, 1896, common, at Epping (Prout); June 6th, 1897, nr. Lincoln (Glenny); May 29th, 1897, at Oundle (Sheldon); June 11th, 1897, at Emsworth (Christy); June 15th, 1898, at Wicken (Studd); eggs hatched April 16th, 1898 (imagines emerged September 7th-14th, 1898) at Chester (Arkle). The notice by Guthrie of full-fed larvæ at Shielswood, in the Hawick district, on heather, spinning up the third week in May, probably refers to var. *ariae*. In the Upper Engadine the larva of this variety is full-fed in July (Frey). In the Netherlands, Sepp notes the eggs as being laid in September, and hatching on April 19th. At Bilbao, the larvæ are full-fed in April and May, and the imagines appear in August (Rössler). In the Zürich district larvæ are full-fed in June, the imagines emerge in September and October, yet some pupæ go over two or three winters (Rühl). In the Baltic provinces the imagines emerge from August 15th on into September (Nolcken). *Imagines:* almost always bred or captured at light. August 9th, 1857, at Rotherham (Rogers); August 28th, 1861, August 22nd-31st, 1865, at Worcester (Edmunds); September 5th, 1862, October 6th, 1874 (also ova laid) at Lee, September 8th, 1894, bred from Brockenhurst (Fenn); September 7th, 1866, at Northleach (Todd); September 6th-8th, 1876, from Epping (A. H. Jones); August 29th, 1876, at Whitchurch, September 3rd, 1889, at Bulmershe, September 10th, 1889, September 1st, 1890, at Reading, September 15th, 1890, at Warren, August 30th, 1891, at Tilehurst, September 16th, 1892, at Pamber Forest (Holland); September 5th-19th, 1879, from Rugby, July 29th-August 3rd, 1890, from Gravesend, August 15th-September 2nd, 1896, and one from same brood July 9th, 1897, from Abbott's Wood (R. Adkin); August 21st-September 1st, 1882, from Polegate (Whittle); September 4th, 1886, at Emsworth (Christy); September 15th-18th, 1887, at Winchfield (Robertson); August 30th, 1887, August 25th, 1889, September 5th, 1892, August 18th, 1893, from Brentwood (Burrows); August 24th-September 3rd, 1889, from Bentley (Williams); August 25th, 1890, from Aylesbury (Bayne); September 1st, 1890, September 29th, 1897, at light, at Knighton (Bouskell); September, 1890, at Chinnor (Spiller); August 26th, 1890, at Walthamstow (Jackson); August, 1890, at Clifton (Prideaux); September 20th-25th, 1891, at light (Atmore); September 24th, 1891, at light, at Chilwell (Pearson); September 10th-October 7th, 1892, at Mansfield (Daws); September 16th, 1892, August 17th, 1893, September 1st, 1896, September 3rd, 1898, at Leicester (Dixon); September 3rd, 1893, at Ipswich (Morley); August 19th, 1896, ♀ on gas lamp, at Wisbech, eggs were laid by this ♀, and the batch reared in 1897, first emergence August 19th, 1897, ♂ s captured at light, August 19th, 1898, and onwards, at Wisbech (Butterfield); August, 1896, from New Forest (Adkin); September 1st, 1896, at Panton (Raynor); September 1st, 1896, from Abbott's Wood (Montgomery); September 3rd, 1896, at Leicester (Kaye); September 6th, 1896, at light, at Oxton (Studd); October, 1897, at Salisbury (Ridley); September 2nd-7th, 1897, August 30th, 1898, at Boxworth (Thornhill); September 21st, 1897, at Feering (Reid); August 22nd, 1898, at electric light, at Taunton (Tetley). Fritsch in Austria gives August 23rd, September 15th, and October 4th, as dates of emergence. Emerges in October in Asia Minor (Staudinger); end of August to end of September at Erlangen (Esper); in the autumn in the plains of Switzerland (Frey).

LOCALITIES.—ABERDEEN: Aberdeen (Horne). ARGYLLSHIRE (Barrett). AYRSHIRE: Ayr (Chapman). BEDS: Potton (Bond-Smith). BERKS: Bulmershe, Tilehurst, Sulham, Reading (Holland), Maidenhead (Raynor). BUCKS: Wolverton (Foddy), Wavendon, nr. Newport Pagnell, Halton (Stainton), Aylesbury (Bayne), Stoney Stratford (Fenn). BUTE: Isle of Arran, Lamlash (Smith). CAMBRIDGE: Wisbech (Butterfield), Cambridge (Moss), Wicken (Freeman), Boxworth (Thornhill), Whittlesford, Cherry Hinton, Swaffham, Littleport, Ely, Chatteris (Balding). CHESHIRE: Saighton (Walker), ? Chester (Arkle). CLARE: Killarney (Birchall). CUMBERLAND: Cockermouth (Robinson), Keswick (Greenip), Carlisle (F. H. Day), Lake District (Stainton). DERBY: southern part of the county (Smallwood), Derby (Pullen), Burton-on-Trent (Garneys), Willington (Payne). DEVON: Egg Buckland (Briggs), Exeter, Oxton (Studd), Chagford, nr. Dartmoor (Jefferys), Dartmouth (Mathew). DORSET: Weymouth (Forsyth), Blandford, Dorchester (Stainton). DURHAM: Durham (Ornsby), Darlington (Stainton). ESSEX: Saffron Walden (Jeffrey), Epping (Tutt), Colchester (Harwood), Hazeleigh, Woodham Mortimer, Woodham Ferris, Maldon (Raynor), Theydon (James), Eastwood, Great Wakering, Southend, Shoeburyness, Leigh (Whittle), Bentley (Williams), Chingford (Prout), Brentwood, Canvey Island, Benfleet (Burrows), Feering (Reid), Walthamstow (Jackson). GLAMORGAN: Cardiff (Tutt coll.). GLOUCESTER: Northleach (Todd), Gloucester, nr. Bristol (Vaughan), Newnham (Bingham), Clifton (Prideaux), Stapleton (Harding), Ashley Hill (Naish). Hants : Pamber (Holland), Ringwood (Fowler), Newbury (Kimber), Brockenhurst (Ogden), Lyndhurst, Winchester (Hewett), Emsworth (Christy), Winchfield (Robertson). Hereford : Leominster (Hutchinson), Tarrington (Wood). Herts : Hatfield (Mera), Hitchin (Durrant). Hunts : Monkswood (Robinson). Inverness (Barrett). Kent : Darenth and Birch woods (Stephens), Cuxton, Chattenden, Higham (Tutt), Cookham Wood (Chaney), Eltham (Bower), West Wickham (Machin), Gravesend (Adkin), scarce in the south-eastern metropolitan district—Lee (Fenn). Kincardine (Mundie). Lancashire : Preston dist. (Stainton), Silverdale (Melvill). Leicester : Loughborough (Wieldt), Knighton (Bouskell), Stoneygate (Headley), Market Harboro' (Matthews), Ashby-de-la-Zouch (Smallwood), nr. Leicester (Kaye). Lincoln : Newball (Carr), nr. Lincoln (Glenny), Panton (Raynor). Londonderry : Magilligan (Curzon). Middlesex : Hendon, Mill Hill (South), Southgate (Lockyer), Pinner (Rowland-Brown), Harrow (Rhoades-Smith). Nairn : Ardlach (Thomson). Norfolk : Norwich (Pitman), Wisbech (Balding), King's Lynn (Atmore), Cawston, Sparham, Foxley, Hockering (Barrett). Northants : Oundle (Sheldon), Peterborough (Pearson), Barnwell Wold (Porritt). Notts : Mansfield (Daws), Chilwell (Pearson). Oxon : Headington (Briggs), Burford (Todd), Whitchurch, Warren (Holland), Chinnor (Spiller). Perthshire : Rannoch (A. H. Jones). Roxburgh : Hawick dist., Shielswood (Guthrie). Shropshire : Church Stretton (Newnham), Shrewsbury (Stainton), Wyre Forest (Blatch), Market Drayton (Woodforde). Somerset : Castle Cary (Macmillan), Yeovil (Parmiter), Leigh Woods (Spencer), Clevedon (Mason), Taunton (Tetley). Stafford : Stone (Bostock), nr. Market Drayton (Woodforde). Suffolk : Tuddenham (Skepper), Ipswich (Morley), Sudbury (Melvill), Bury, Needham, Bentley, Playford, Beccles (Bloomfield), Brandon (Balding), Stowmarket (Stainton). Surrey : Coombe Wood (Stephens), Wimbledon, Leatherhead (Raynor). Sussex : Weald dist. (Cooke), Arundel (Williams), Abbott's Wood (Riding), Hailsham, Polegate (Whittle), Lewes, Ringmer, Tilgate Forest (Jenner). Warwick : Wellington (Payne), Coventry (Raynor), Wyre Forest (Wynn), Trench Woods (Wainwright), Rugby (Adkin). Wilts : Salisbury (Ridley). Worcester : Worcester (Edmunds). Yorks : York (Wilson), Skipwith (Ash), Rotherham (Rogers), Richmond (Harris), Bramham (Smith), Sheffield (Doncaster), Thirsk (Tyers), Wakefield (Talbot), Ayton (Meldrum).

Distribution.—Asia Minor : Armenia (Staudinger). Austro-Hungary : Bukovina—Czernowitz (Hormuzaki), Pressburg (Rozsay), Bohemia (Nickerl), Stanislawow (Werchratski), Galicia—Sambow (Nowicki), Brünn (Müller), Agram, Bregenz (Fritsch), Buda (Speyer), Innsbruck (Weiler), Hermannstadt (Czekelius), Epiries (Husz), Chemnitz (Pabst), Kocsocz (Vángel), Upper Carinthia—Salzburg (Nickerl), Lavantthal (Höfner), Oetzthal (v. Gumppenberg). Belgium : rare—Louvain, Liège, Wavre, Brussels, etc. (Donckier), Limburg (Snellen), Walcourt (Lambillion), Gembloux, common (Poskin). Denmark : generally distributed (Bang-Haas). Finland : Osterbötten, Ryska Karelen (Reuter). France : Aube (Jourdheuille), Douai (Foucart), Nohant, St. Florent, Auvergne dist. —generally distributed (Sand), Eure-et-Loir, Châteaudun (Guénée), Haute-Garonne, distributed (Caradja), Meuse, Meurthe, Moselle districts (Speyer), Puy-de-Dôme (Guillemot), dept. Var (Cantener), Gironde dist., throughout (Trimoulet), Doubs dept. (Bruand), Aude (Mabille), Loire-Inférieure, rather rare (Bonjour), Saone-et-Loire (Constant), St. Quentin (Dubus), Rouen, Seine-Inférieure—Forêt Verte, St. Adrien (Viret), Alpes-Maritimes, rare (Millière), Caussols (Bromilow), Paris (Fallon), Château-du-Loir (de Graslin), Rennes (Oberthür). Germany : north-west Germany, most parts—Göttingen, &c. (Jordan), Rhine Palatinate (Bertram), Giessen (Dickore), Würtemberg (Seyffler), Lower Elbe dist., generally distributed (Zimmermann), Taunus, &c. (Koch), Waldeck, Kosel, Berlin, Mayence (Speyer), Erfurt (Keferstein and Werneburg), Zeitz-on-Elster (Wilde), Halle—Dessau (Stange), Munich (Kranz), Hesse—Grünberg (Glaser), Rudolstadt, rare (Meurer), Mecklenburg dist., distributed, Dantzig, rare (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia, distributed (Schütze), Dresden, rare (Steinert), Thuringia (Krieghoff), Rostenburg (Klups), Silesia (Assmann), Upper Lusatia, rare (Moeschler), Görlitz, Lauban, Lower Friedersdorf (Niesky), Nassau (Rössler), Ratisbon (Schmid), Alsace (Peyerimhoff), Wernigorode, rare (Fischer), Pomerania, rare, Stettin, &c. (Hering), Brunswick, Helmstedt (Heinemann), Hanover, rare (Glitz), Eutin (Dahl), Erlangen (Esper), Thuringia—Gotha, Hirzberg, &c. (Knapp). Italy : north and central, rather rare (Curò), Roman Campagna—Monterotondo (Calberla), Modena (Fiori), Piedmont (Staudinger). Netherlands : rare—

Friesland, Gelderland, North Brabant, &c. (Snellen), Breda (Heylaerts). ROUMANIA: rare—Grumazesti, Slanic (Caradja). RUSSIA: Baltic Provinces (Sintenis), Moscow dist. (Albrecht), Wolmar (Lutzau), St. Petersburg (Erschoff), Transcaucasia, rare—Laghodekhi (Romanoff), Abbastouman (Haberhauer), Livonia, Russian Lapland (Teich). SCANDINAVIA: not rare (Aurivillius), Smoland, E. Gothland, Sköfde, Hudiksvall, Calix, &c. (Wallengren), Tromsö, Sydvaranger (Schneider), Christiania, rare, Driodalen (Siebke), Lapland—Lycksele (Zetterstedt), Dovrefjeld, Norwegian Arctic region (Schöyen). SPAIN: Barcelona, rare (Cuní y Martorell), Catalonia (Martorell y Peña), Andalusia (Staudinger), Bilbao (Seebold). SWITZERLAND: widely distributed in plains and hilly districts—Cantons Basle, Berne, Aargau, St. Gallen (Frey), Grisons—Chur, rare (Killias), Zurich dist. —Frichtenhausen, Fällanden (Rühl), Upper Engadine (Frey). TURKEY: north-east part of country (Staudinger), Slivno (Lederer).

Subfam.: LACHNEINÆ.
Tribe: LACHNEIDI.

The *Lachneinae* (*Lachneides* of Hübner's *Tentamen*, p. 1) form the third coitus of Hübner's *Pigiacae* (*Verz.*, p. 185), which he terms *Dasysomata*, *Dasysoma* being certainly a synonym of *Lachneis*. It contains two very distinct, moderately closely allied genera—*Lachneis*, Hb., and *Autosphyla*, Rbr.—both of which contain species whose females have a very well-defined, woolly, anal tuft and almost simple antennæ, whilst the males have strongly pectinated antennæ and are usually smaller and much more robust in their build than the females. These two genera are maintained by Kirby, and in this we agree, although Aurivillius writes that *Autosphyla*, Rbr., can only be separated from *Lachneis*, Hb., "by artificial and insignificant characters," and adds that the whole of the species included by him in one genus—*lanestris*, *catax*, *rimicola*, *luteus*, *neogena*, *henkei*, *acanthophylli*, *rückbeili*—"appear to form, in all their stages, a very natural and homogeneous unity. Only the ♀ antennæ are of somewhat different structure in the different species, but this appears to be slender ground on which to found new genera." There seems to be more ground in the early stages for separating the genera than is here suggested, and whilst there can be no doubt about the close relationship between the true *Lachneis* species—*lanestris*, *catax*, *rimicola* and *luteus*—on the one hand, and the *Autosphyla* species—*neogena*, *acanthophylli* and *henkei*—on the other, there is a distinct hiatus between the two groups, which is altogether lost by including them in the same genus. *Autosphyla neogena* is very near indeed in its general appearance to *A. acanthophylli*, but the latter, when fresh, has a very large anal tuft of loose fluffy wool, which is remarkably shown in one of the two females in the British Museum collection. Both sexes are excellently figured by Romanoff (*Mém.*, ii., pl. xiii., figs. 2*a-b*) as also is the larva (fig. 2*c*), which does not at all remind one of *Lachneis*, and the cocoon (fig. 2*d*), which is quite like those of the latter genus. Most entomologists before Stephens allied the Lachneids with *Cnethocampa**, and when the latter author isolated *lanestris* and placed it alone in *Eriogaster*, he wrote: "*Eriogaster* may be known from *Poecilocampa* and *Cnethocampa*, which somewhat resemble it in the texture of their wings, by the stoutness and woolliness of its body, especially of the females, and the brevity of the cilia. The males are further distinguished from those of *Poecilocampa* by the more slender and acuminated antennæ,

* We have already stated that the true generic name for this genus is *Eriogaster* (see, *anteà*, p. 450).

and from *Cnethocampa* by their comparatively greater length and straightness; and the females from those of the former genus by the downy mass at the apex of the abdomen, and from those of the latter by the superior bulk of their body and tenuity of their antennæ. Larvæ gregarious, inhabiting a general nest, which they enlarge from time to time, leaving it during the night in search of food, but returning before morning, and finally quitting it when they are about to undergo their change, which they effect on the surface of the ground in an oval rigid cocoon; eggs deposited in an irregular mass on slender branches, and covered by a cinereous down." Since Aurivillius includes *Lachneis* and *Autosphyla* in his genus *Eriogaster*, his diagnosis of the latter is, from our point of view, that of the tribe *Lachneidi*. It reads as follows:

Imago.—♂ antennæ, strongly pectinated; ♀, antennæ with short (in *henkei*), or very short (*catax*, *rimicola*, &c.), pectinations, or only weakly serrated (*lanestris*). Abdomen at end with a large woolly anal tuft, with the hairs of which the hibernating eggs are covered. Larva.—The larva has dorsally on each segment two areas of densely pressed-together (red-yellow) "felt-hairs." These groups of felt-hairs are very small in *rimicola*, of moderate size in *lanestris* and *neogena*, and very large in *everia* and *acanthophylli*. Head black and hairy. Claspers yellow-red to brown-yellow. Pupa.—Very stumpy, thin-shelled, honey-yellow to brown-yellow, in a thin (*henkei*, *acanthophylli*), or thicker, parchment-like, ellipsoid cocoon, with (at any rate in *lanestris*, *catax* and *rimicola*) a special "Athemloch" arranged by the larva, and a round emergence-lid.

The peculiarity of egg-laying, by which the eggs are thickly covered with hairs from the anal tuft, and the characteristic "eggar" cocoon appear to be common to all the species. Ronsin notes (*Ann. Soc. Ent. France*, 1846, p. xxvii) having found two pupæ of *Lachneis everia* in the same cocoon, a rather common habit in *L. lanestris*. The pupæ themselves, also (as well as the cocoons) are more closely allied to those of *Pachygastria* and *Lasiocampa* than to any other of the Palæarctic Lachneids, and one suspects that the *Lachneidi* and *Pachygastriidi* are really more directly allied than is the former to *Malacosoma*, *Macrothylacia*, or even *Trichiura*. As there is only one British species in the tribe its peculiarities will be better dealt with at length in our description of the insect.

Genus: Lachneis, Hübner.

Synonymy.—Genus: *Lachneis*, Hb., "Tent.," p. 1 (1806); Kirby, "Cat.," p. 832 (1892); Dyar, "Can. Ent.," xxx., pp. 4, 6 (1898); "Ent. Rec.," xi., pp. 141-142 (1899); Grote, "Illus. Zeits. für Ent.," iii., p. 71 (1898). *Bombyx*, Linn., "Sys. Nat.," 10th ed., i., p. 499, no. 15 (1758); 12th ed., p. 815, no. 28 (1767); "Faun. Suec.," p. 292, no. 1105 (1761); Fab., "Sys. Ent.," p. 566, no. 37 (1775); "Spec. Ins.," ii., p. 179, no. 53 (1781); "Mant.," ii., p. 113, no. 61 (1787); "Ent. Sys.," iii., p. 429, no. 68 (1793); Wilkes, "Nat. Hist.," pl. liii (1773); Schiff., "Sys. Verz.," p. 57, L, no. 2 (1776); Esp., "Schmett. Eur.," iii., p. 93 (1783); View., "Tab. Verz.," i., p. 36, no. 14 (1789); Brahm, "Ins. Kal.," p. 288, no. 179; p. 544, no. 405 (1790); Bork., "Sys. Besch.," iii., p. 123, no. 33 (1790); "Rhein. Mag.," i., p. 366 (1793); Donov., "Nat. Hist. Brit. Ins.," vi., p. 73 (1797); Hb., "Eur. Schmett.," iii., p. 143 (? 1800); Schrank, "Fauna Boica," ii., Abth. 1, p. 278 (1801); Haw., "Lep. Brit.," p. 124 (1803); Godt., "Hist. Nat.," iv., p. 108 (1822); Bdv., "Gen. et Ind.," p. 69 (1840); Frr., "Neu. Beit.," vi., p. 179 (1852); Snell., "De Vlind.," p. 188 (1867); Nolck., "Lep. Fn. Est.," p. 127 (1868); Staud., "Cat.," 2nd ed., p. 68 (1871); "Rom. Mém.," vi., p. 314 (1892); Curò, "Bull. Soc. Ent. It.," viii., p. 149 (1876); Mill., "Iconog.," iii., p. 285 (1877); Lampa, "Ent. Tids.," vi., p, 41 (1885); Fall., "Bull. Soc. Ent. Fr.," (6), x., p. xlvii (1890); Rühl, "Soc. Ent.," v., p. 170 (1891); Carad., "Iris," viii., p. 91 (1895); Reutti, "Lep. Bad.," 2nd ed., p. 57 (1898). *Phalaena*, Scop., "Ent. Carn.," p. 199 (1763); Müll., "Faun. Frid.," p. 39, no. 352 (1764); "Zool. Dan. Prod.," p. 117 (1776); Fuess., "Mag. Ent.," i., p. 270 (1778); "Neu.

Mag.," ii., p. 72 (1782); Göze, "Ent. Beit.," iii., (2), p. 299 (1779). *Lasiocampa*, Schrk., "Fauna Boica," ii., Abth. 2, p. 154 (1802); Latr., "Genera, &c.," iv., p. 218 (1809); Meig., "Eur. Schmett.," ii., p. 199 (1830). *Gastropacha*, Ochs., "Die Schmett.," iii., p. 289 (1810); Evers., "Fauna Volg.-Ural.," p. 155 (1844); H.-Sch., "Sys. Bearb.," ii., pp. 101, 108 (1847); Hein., "Schmett. Deutsch.," pp. 201, 210 (1859). *Eriogaster*, Germ., "Prod. Sist. Bomb.," p. 16 (1811); Curt., "Guide," p. 142 (1829); Stphs., "Illus. Haust.," ii., p. 44 (1828); "Cat. Brit. Ins.," p. 48 (1829); "List Br. An. Br. Mus.," v., 1st ed., p. 46 (1850); 2nd ed., p. 43 (1856); Wood, "Ind. Ent.," no. 47 (1839); Dup., "Cat. Lép. Eur.," p. 76 (1844); Humph. and Westd., "Brit. Moths," 2nd ed., p. 52 (1851); Sta., "Man.," i., p. 154 (1857); Humph., "Gen. Brit. Moths," p. 26 (1860); Rbr., "Cat. Lép. And.," p. 353 (1866); Newm., "Brit. Moths," p. 42 (1869); Wallgrn., "Skand. Het.," ii., pp. 82, 84 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 412 (1874); Guén., "Lép. Eure-et-Loir," p. 80 (1875); Buckl., "Larvæ," iii., p. 78 (1889); Auriv., "Nord. Fjär.," p. 62 (1889); "Iris," vii., p. 145 (1894); Ström, "Danm. Somm.," p. 81 (1891); Kirby, "Cat.," p. 833 (1892); Reut., "Act. Soc. F. F. Fenn.," ix., p. 29 (1893); Meyr., "Handbk.," p. 321 (1895); Tutt, "Brit. Moths," p. 59 (1896); "Proc. South Lond. Ent. Soc.," pp. 1-11 (1898); Barr., "Lep. Brit.," iii., pp. 8, 9 (1896); Dyar, "Can. Ent.," xxx., pp. 3, 6 (1898); "Ent. Rec.," xi., p. 142 (1899); Grote, "Illus. Zeits. für Ent.," iii., p. 71 (1898). *Dasysoma*, Hb., "Verz.," p. 185 (? 1822).

Lachneis was the generic name given by Hübner in his *Tentamen*, p. 1, to *catax*, which he had already figured as *Bombyx catax* in his *Europ. Schmett.*, pl. xxxviii., fig. 168. In the *Verzeichniss*, p. 185, he correctly united *everia* and *lanestris* with *catax* in the same genus, but renamed the genus *Dasysoma*, which, therefore, became a synonym of *Lachneis*. Stephens applied (*Illus.*, ii., pp. 44-45) Germar's name *Eriogaster* (belonging rightfully to the Eupterotid—*processionea*) to this genus, and in this was followed by Duponchel, Rambur and Guénée. Kirby, in order to retain *Eriogaster*, separates *catax*, L., *rimicola*, Hb., and *luteus*, Oberth., under *Lachneis*, from *lanestris* under *Eriogaster*. We have already stated that we are unable to distinguish these two sections generically, and it follows (*anteà*, p. 450), that *Dasysoma*, Hb., and *Eriogaster*, Stephs. (*nec* Germar) are, in our opinion, synonyms of *Lachneis*. Wallengren attempted (*Skand. Het.*, ii., pp. 84-86) to separate *lanestris* from *catax* and *rimicola* generically, by the neuration, but Aurivillius, in discussing Wallengren's characters, states that he finds that nervures 7 and 8 of the forewings are sometimes separated in the same species, and at others united. The transverse nervure of the middle cell of the hindwings is, indeed, in *catax* and *rimicola*, often perfectly straight, but also sometimes, as in the rest of the species, distinctly broken. The three closely allied species—*lanestris*, *catax*, and *rimicola*—so far as the material in the British Museum collection is concerned, afford several points of interest. *L. lanestris* extends in its variation through various shades of reddish-brown in both sexes which are largely of the same general coloration, except for the excess of grey on the margins of the forewings in many ♂ examples. Of this species, the greyest ♂ is from Sarepta, and in this specimen the normal reddish tint is practically obsolete. The Carniolan specimens appear to closely resemble the British forms, as also do those from Frankfort, whilst those named *arbusculae*, from the Valais, are very little different, the male, perhaps, slightly darker, and the female thinner scaled. The reddest form is a German one (from Becker). The males and females of *L. rimicola* are practically alike and uniform in their coloration; both are of a reddish tinge with much more orange in the tint than occurs in the reddest *L. lanestris*. The basal mark is obsolete, the transverse line also (on both fore- and hindwings), and the central white spot is only weakly indicated. *L. catax* is much the finest species and the most specialised in the direction of sexual dimorphism, the females being almost of the same red tint as those of *L. rimicola*, but with the basal mark and the transverse line of the forewings indicated in orange, the central spot as conspicuous as in *L. lanestris*, although the transverse shade of the hindwing has disappeared. The male is of a rich orange tint from the transverse line to the base of the forewings, the thorax and abdomen also orange, the outer margin of the forewings of the same reddish colour as that of the female but paler, and the hindwings grey. A pair from Giessen (Frey coll.) are exceptionally fine, the red of the female quite bright, and the hindwings and outer margin of the forewings of the ♂ are tinged with pink. The anal tuft of *L. catax* is browner than that of *L. rimicola*, which is grey, but much less white than that of *L. lanestris*. One would suspect from the oval basal mark of *L. catax*, which is very like that of *Poecilocampa populi*, *Trichiura crataegi*, *Malacosoma castrensis*, &c., in general features, that this species exhibited, in its female form, the more ancestral characters of the genus. There can be no doubt about the specialisation of the male in this species. Standfuss thinks that *L. catax* and *L. rimicola*, both central European species, which appear as imagines in the autumn and pass the winter in the egg state, may have probably separated from the closely allied species which still hybernate as pupæ, and, by emerging at a different time of the year, have become isolated, and formed first of all permanent races, and later well-defined species. Ochsenheimer says that *L. catax* sometimes passes two or three years in the pupal stage.

Lachneis lanestris, Linné.

Synonymy.—Species: *Lanestris*, Linn., "Sys. Nat.," 10th ed., i., p. 499, no. 15 (1758); 12th ed., p. 815, no. 28 (1767); "Fauna Suec.," p. 292, no. 1105 (1761); Scop., "Ent. Carn.," p. 199, no. 499 (1763); Müll., "Faun. Frid.," p. 39, no. 352 (1764); "Zool. Dan. Prod.," p. 117, no. 1354 (1776); Fab., "Sys. Ent.," p. 566, no. 37 (1775); "Spec. Ins.," ii., p. 179, no. 53 (1781); "Mant.," ii., p. 113, no. 61 (1787); "Ent. Sys.," p. 429, no. 68 (1793); Wilkes, "Nat. Hist.," pl. liii (1773); Schiff., "Sys. Verz.," p. 57, L, no. 2 (1776); Fuess., "Mag.," i., p. 270 (1778); "Neu. Mag.," ii., p. 72 (1782); Göze, "Ent. Beit.," iii., p. 299, no. 28 (1779); Esp., "Schmett. Eur.," iii., pl. xvii., figs. 2-8, p. 93 (1783); View., "Tab. Verz.," i., p. 36, no. 14 (1789); Brahm, "Ins. Kal.," p. 288, no. 179; p. 544, no. 405 (1790); Bork., "Sys. Besch.," iii., p. 123, no. 33 (1790); "Rhein. Mag.," i., p. 366 (1793); Donov., "Nat. Hist. Brit. Ins.," vi., p. 73, pl. 210 (1797); Hb., "Eur. Schmett.," iii., p. 143, no. 3, pl. xxxviii., figs. 169, 170 (? 1800); "Larvæ Lep.," iii., Bomb. O, *b*, fig. 1*a* (?1803); Hb., "Verz.," p. 185 (? 1822); Schrk., "Fauna Boica," ii., Abth. 1, p. 278, no. 1463 (1801); Abth. 2, p. 154, no. 13 (1802); Latr., "Genera, &c.," iv., p. 218 (1809); Ochs., "Die Schmett.," iii., p. 289 (1810); Germ., "Prod. Sist. Bomb.," p. 16 (1811); Godt., "Hist. Nat.," iv., p. 108, pl. xi., figs. 1-2 (1822); Stphs., "Ill. Haust.," ii., p. 44, no. 45 (1828); "Cat. Brit. Ins.," p. 48 (1829); "List Br. An. Br. Mus.," v., 1st ed., p. 46 (1850); 2nd ed., p. 43 (1856); Curt., "Guide," p. 142 (1829); Meig., "Eur. Schmett.," ii., p. 199 (1830); Wood, "Ind. Ent.," no. 47 (1839); Bdv., "Gen. et Ind.," p. 69, no. 566 (1840); Dup., "Cat. Lép. Eur.," p. 76 (1844); Evers., "Faun. Volg.-Ural.," p. 155 (1844); H.-Sch., "Sys. Bearb.," ii., p. 108 (1847); Humph. and Westd., "Brit. Moths," 2nd ed., p. 52, pl. x., figs. 3-4 (1851); Frr., "Neu. Beit.," vi., p. 179 (1852); Sta., "Man.," i., p. 154 (1857); Hein., "Schmett. Deutsch.," p. 210 (1859); Humph., "Gen. Brit. Moths," p. 26 (1860); Rbr., "Cat. Lép. And.," p. 353 (1866); Snell., "De Vlind.," p. 188 (1867); Nolck., "Lep. Fn. Est.," p. 127 (1868); Newm., "Brit. Moths," p. 42 (1869); Wallgrn., "Skand. Het. Fjär.," (2), p. 84 (1869); Staud., "Cat.," p. 68 (1871); "Rom. Mém.," vi., p. 314 (1892); Bang-Haas, "Nat. Tids.," (3), ix., p. 412 (1874); Guén., "Lép. Eure-et-Loir," p. 80 (1875); Curò, "Bull. Soc. Ent. Ital.," viii., p. 149 (1876); Mill., "Iconog.," iii., p. 283 (1877); Lampa, "Ent. Tids.," vi., p. 41 (1885); Buckl., "Larvæ, &c.," iii., p. 78, pl. xlviii., fig. 1 (1889); Auriv., "Nord. Fjär.," p. 62 (1889); "Iris," vii., p. 145 (1894); Ström, "Danm. Somm.," p. 81 (1891); Kirby, "Cat.," p. 833 (1892); Reut., "Act. Soc. F. F. Fenn.," ix., p. 29 (1893); Carad., "Iris," viii., p. 91

(1895); Meyr., "Handbk.," p. 321 (1895); Tutt, "Brit. Moths," p. 59 (1896); "Proc. Sth. Lond. Ent. Soc.," pp. 1-11 (1898); Barr., "Lep. Brit.," iii., pp. 8, 9 (1896); Reutti, "Lep. Bad.," 2nd ed., p. 57 (1898); Dyar, "Can. Ent.," xxx., pp. 3, 6 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 71 (1898). *Lanestrus*, Haw., "Lep. Brit.," p. 124, no. 84 (1803).

Original description.—*Phalaena* (*Bombyx*) elinguis, alis reversis ferrugineis ; striga alba ; superioribus puncto basique albis. Habitat in *Tilia*, *Pruno spinosa*, *Salice*. Larva pilosa, nigra : segmento singulo punctis 3 albis inter maculas 2 rubras. Anus Phalænæ valde lanatus albidus (*Sys. Nat.*, xth ed., p. 499). To this description Linné adds: "Anus *Phalaenae* valde lanatus albidus, ac si esset *P. rubi* Mas. Alæ striga alba punctoque albo, insuper basi puncto albo" (*Sys. Nat.*, xiith ed., p. 815).

Imago.—Anterior wings rather thinly scaled, deep rust-red, with a slightly angulated white transverse line beyond the middle, a central white spot, and a white basal mark of varying size and shape (linear to oval) not quite reaching the costa, the outer margin of wing (beyond transverse line) grey. Posterior wings grey with a paler transverse median shade.

Sexual dimorphism.—♂. The wing expanse extends from 31·25mm.-36mm. The antennæ strongly pectinated, the wings rather more densely scaled, and with more grey scales on the outer margin than the female. ♀. 36·5mm.-45mm. The antennæ only finely serrated ; the wings more thinly scaled, usually rather redder (and less grey on the outer margin) than in the ♂ ; the anus with a large thick whitish-grey woolly tuft, from which the hairs are obtained with which the eggs are covered.

Gynandromorphism.—Gynandromorphous examples appear to be rare. The following are the only references we can discover :

α. Has the appearance of a small ♀ ; the anus decidedly ♀ but the antennæ ♂. Taken at large at Breslau (Wocke, *Entom. Miscell. Breslau*, 1874, p. 73).

β. A hermaphrodite of *Bombyx lanestris*, the abdomen of which was provided with a strong tuft of hairs, was put aside as a cripple till the breeding of a gynandromorphous *Saturnia pavonia*, caused closer attention to be given to it. It emerged in the autumn of 1893, from exchanged pupæ. Almost all the examples of this brood emerged as cripples (Caspari, *J.-B. Nass. Ver. Nat.*, xlviii., p. 178).

γ. Left side ♂, right side ♀, both as to wings and antennæ ; the right wings 20mm. in expanse, the left 16mm. ; the thorax and abdomen divided medially into a lighter ♂ and darker ♀ coloration ; abdomen ♀ in form. Bred. In coll. Wiskott (Wiskott, *Fistschrift Ver. Schles. Insectenkunde*, p. 28, pl. iii., fig. 12).

δ. Right side entirely ♂, left side ♀ ; right antenna pectinated, ♂, left antenna with short teeth, ♀. The right wings about 3mm. shorter and much more dusted with white than the left. Abdomen ♀ in form, carrying on anus the wool of the ♀. Bred by E. Maurer, Coburg (Maurer, *Insekten Börse*, 1895, p. 30).

ε. Left half ♀, right half ♂. In coll. Staudinger. Stdgr. *in litt.* (Schultz, *Illus. Wochen. Ent.*, ii., p. 413.

Variation.—The ground colour of this species extends from an almost complete ashy-grey to a rather bright rusty-red, various intermediate stages being frequently met with. (This has been noticed, *anteà*, p. 500). Specimens with the central spot absent (ab. *obsoleta*, n. ab.) are rarely met with. A very remarkable form is described by Edmunds as having "a large white diamond-shaped spot near the costa in the middle of the forewings. A specimen of this aberration was caught at rest at Worcester, February 6th, 1860 ; on the same day a similar one was bred, and on the following day another. The three moths vary but little in these spots and are almost destitute of any other markings." This might well be named ab. *quadrangulata*. It is figured by Barrett (*Brit. Lep.*, iii., pl. lxxxvii., fig. 3*b*). Oberthür notes that "the species appears to vary little in France, although in some examples the white spot of the forewings entirely disappears." Esper's figures (pl. xvii., figs. 2-3) are marvels of over-colouring, but fig. 4 is a remarkable female in which the bases of the right fore- and hindwing to the transverse band are brown, almost as in *Lasiocampa quercûs*, and the outer margins pale yellow to the grey transverse line, the brown extending into the outer marginal area towards the tip. On the left fore- and hindwing, the base of the forewing is brown, the hindwing entirely pale yellow. The various grey forms have been severally described as follows:

a. var. *arbusculae*, Freyer, "Neu. Beit.," vi., pp. 179-180, 186, pl. 590, fig. 2 (1852); Bisch., "J.-B. Nat. Ver. Augs.," xii., pp. 87 *et seq.*, pl., figs. *a-h* (1859); Staud., "Cat.," p. 68 (1871); Frey, "Lep. der Schweiz," p. 96 (1880); Fall., "Bull. Soc. Ent. Fr.," (6), x., p. xlvii (1890); Rühl, "Soc. Ent.," vii., pp. 140 *et seq.* (1892); Kirby, "Cat. Lep. Het.," p. 833 (1892).—In the above plate a larva is figured that is very closely allied to *B. lanestris*, and that I found in hundreds, and yet did not breed a single imago. I have already noticed the larva in the *Stett. Ent. Zeit.*, 1843, p. 165, and was, at that time, inclined to consider it a variety of *B. crataegi*. For years in succession I found from 100-300 specimens on the higher Bavarian Alps, in the early, middle, and full-grown stages, and even the eggs, which, as the figure shows, are enveloped in grey wool quite as in *lanestris*, but failed to breed any, although I obtained 20-25 cocoons. The larva in its earliest stages lives in nests quite like those of *B. everia* and *lanestris*. They are all dull black with fine hairs. After the third and fourth moult the characteristic white and orange spots appear, four on each segment, of which the front two are orange the others white. On the side, above the ochreous-yellow legs, runs a line consisting of white dots. The whole body is covered with thin, fine, reddish hairs. The head is black without any markings, and has not the bright yellow cross which the larva of *lanestris* has. I found almost all the larvæ on alpine species of willow and alder, never below 5000ft.-6000ft. elevation. They are fond of sunning themselves, and seem to prefer *Salix arbuscula*, but I have also found them on *Sorbus aria* and *Betula fructicosa*. The cocoon is like that of *lanestris*. The pupæ, which almost always dry up, also resemble those of that species. As already mentioned, I have not yet succeeded in making acquaintance with the imago (Freyer). After this was printed Freyer opened a cocoon which he had preserved for several years, and took therefrom a pupa containing a dried-up but perfectly formed male imago. This is noted as having "brown pectinated antennæ; the head and thorax dark grey; the forewings similar to those of *B. neogena*, but the colour dark ashy-grey (not reddish) with whitish nervures; at the base is a whitish spot similar to that in *B. lanestris*." A supplementary figure is given of this dried-up moth, which Freyer considered a new species. Bischoff, however, in 1859, described and figured (*Ber. Nat. Ver. Augsburg*, xii., p. 87 and plate) the variety in all its stages. He describes the imago as: "*Gastropacha arbusculae*, Frr. Alis supra subtusque rufo-brunneis, cilia elata albida, anticis lunula in disco maculaque alba ad basin. Ano griseo-lanato. Body and wings above and below reddish-brown; the wings with a dirty-white, zigzag band; the forewings with a white central lunule and a white basal patch; the fringes white at the tips of the wings, and chequered with white at the nervures; the anus thickly clothed with grey wool. The species is most closely allied to *G. lanestris*, but differs in the broader and differently-shaped zigzag band and the absence of any other grey spaces, as well as by the white apices of the wings, and the white dots at the end of the nervures." The localities given for this variety are—Austro-Hungary: Taufers, Innsbruck (Weiler). Germany: Silesia (Wocke). Italy: Alps—Valtellina (Curò). Scandinavia (Aurivillius). Switzerland; Balgrist nr. Zürich (Zeller-Dolder), Arolla, at 8000ft. (Chapman), Sils Maria (Hnatek), Simplon, Bérisal (Wackerzapp).

Weiler notes the form as occurring everywhere on the lower Alps at Taufers, also higher up the mountains where only occasional birch or sallow bushes are to be found. He further states that he found a larva in August, 1873, which pupated in the middle of September, the imago, a male, did not appear till the evening of March 22nd,

1878. He notes it as somewhat smaller than *L. lanestris*, the forewings shorter and broader in proportion, the hindwings more ample, the hair of the body black-brownish grey. The forewings are blackish-brown and whitish-grey mixed, the grey predominating, the blackish-brown colour being largely confined to the central area and to the margins of the white markings. The latter are much sharper than in the type, &c. Frey observes: "The larva lives on *Alnus viridis* and different species of *Salix*, in the Alps; the pupa may not disclose its imago for many years. There are fine examples in Zeller-Dolder's collection, which do not differ generally from the type." Wocke notes the Alpine form as occurring in the Silesian mountains. Curò observes that the larvæ feed also on *Vaccinium uliginosum*. Rühl reviews (*Soc. Ent.*, vi., pp. 140 *et seq.*) the history of *arbusculae* as follows: The larva was discovered by Freyer in July, 1842, who obtained at first only larvæ, and later cocoons, together with one single unemerged imago taken from the pupa, as a result of twelve years' effort, and an attempt to breed 10,000-12,000 larvæ. Bischoff was at last, in 1859, able to figure and describe (*J.-B. Nat. Ver. Augsburg*, xii., pp. 87 *et seq.*, figs. *a-h*) an imago of *arbusculae*, which had been bred by Hnatek, of Sils-Maria. Rühl goes on to say that he himself had for years found nests of larvæ of *arbusculae*, the latter usually feeding on *Vaccinium uliginosum*, but failed to breed them in the lowlands (although he transplanted the food-plant into his garden); single larvæ also were occasionally found on *Alnus* and dwarf sallow, but he got no cocoons until 1889, when he bought 22, and the next year ten others, and from these last reared at length a specimen of *arbusculae* in the spring of 1891. He discovered thousands of larvæ in 1892, and brought away about a hundred and obtained cocoons. The larvæ were never found below 6500ft., generally from 7000ft.-8000ft.; they are very fond of moisture, the nests usually being found close to the mountain streams that sprinkle the *Vaccinium* with their spray, yet in the lowlands they require to be kept very dry if they are to be reared with success, and the hotter the August sun the more rapidly they come to maturity. The larvæ will eat, sparingly, *Corylus*, *Salix fragilis*, *Sorbus*, *Rhamnus*, but invariably die on this diet, even if the food be changed two or three times a day. *Salix caprea* is the most successful substitute food-plant, and when sleeved thereon in the open the larvæ will sometimes reach the cocoon (but not the pupal) stage. The greatest care so far has resulted in failure. Chapman notes that *arbusculae* (as represented in Constant's collection) is a little larger than *L. lanestris*, the ♂s especially darker, and the markings in both sexes more pronounced, the lines being broader and whiter. Wackerzapp observes (*Stett. Ent. Zeit.*, li., p. 143) that the webs of larvæ, 1ft.-2ft. long, were found hanging from the birches on the Simplon, some of the webs containing as many as 80 larvæ which left their dwellings at night to feed, returning to them by day. The imagines emerged the following March (some not till the second year), and differed from the German examples in having a whitish dusting over the wings. He further notes (*loc. cit.*, p. 214) that at Bérisal, at the end of July, 1884, full-grown larvæ were to be found quite commonly away from their nests, and feeding on low plants with which they are not usually connected—*Cynanchum vincetoxicum*, &c. Standfuss observes that it appears to be a general thing for the pupæ of this variety to go over from four to six years before the emergence of the imago.

β. var. *aavasaksae*, Teich, "Stett. Ent. Zeit.," xlii., p. 187 (1881); xliii., p. 214 (1882); Lampa, "Ent. Tids.," vi., p. 41 (1885); Reut., "Medd. F.F.Fenn.," pp. 48-54 (1890); "Act. Soc. F.F.Fenn.," ix., p. 29 (1893).—In Aavasaksa (within the Polar circle in Russian Lapland) I found a nest of larvæ which reminded me of those of *L. lanestris*. On June 19th, 1879, they were still very small, blackish-grey, weakly haired, and ate the leaves of a dwarf species of sallow. After the first moult the conspicuous red-brown spots of *L. lanestris* were indistinctly surrounded with yellow, and on July 4th they moulted the last time. The ground-colour was then blackish-blue, the legs black, prolegs and claspers reddish; the lateral line and spiracles bright sulphur-yellow, almost golden-yellow; the hairs on the sides whitish, whilst on each segment, as in *L. lanestris*, were two spots with reddish-brown hairs, but these were edged by fine yellow squares not entirely closed; the inner edges of the squares right and left formed the double dorsal line, and the squares were connected with one another by yellow streaks parallel with the lateral line; the head was also marked with a yellow longitudinal line. The larvæ were full-fed July 17th, were 2-3 inches long, pupated, like *L. lanestris*, in oval, brown cocoons, amongst leaves and in moss. Kept in a warm room the moths were expected in the spring of 1880, but none emerged, yet the pupæ were all healthy with the exception of a few whose larvæ had spun their cocoons together in a "lumpy" mass and had perished. But on December 26th, 1880, four imagines emerged, one of which was crippled. Different as the larvæ were from those of *L. lanestris*, the moths show very little difference; they are more grey (as also are the body-hairs) which is a small matter in insects of northern origin. The curved stripe on all the wings is less sharply defined than in *L. lanestris*, only marked more distinctly by white dots on the nervures. The outer margin is (also on the hindwings) whitish-grey, especially in the ♂, and the fringes are (in the ♀ also on the hindwings) white-dotted. The costa of the forewings is, however, white—a character that I have never found in *L. lanestris*—and is especially strongly marked from the costal spot onwards. I am inclined, however, to look upon the insect as a var. of *L. lanestris*, and would propose for it the name of *aavasaksae* (Teich). Submitting these to Staudinger, they were referred hy him to *L. lanestris*. Teich further notes emergences from these pupæ in January, 1881, others in the middle of the summer, and yet others that were still (1882) lying over. Distribution.—Sweden: Jämtland (Aurivillius). Norway: Romsdalen Amt (Schöyen). Finland; Osterbötten (Lampa). Russia: Aavasaksa (Teich).

γ. var. *grisea*, n. ab. = var. (et ab.) *borealis*, Carad., "Iris," viii., p. 91 (1895).—An entirely dark grey, sharply-marked form of the male occurs as a rare aberration in Hungary. In Lapland and Siberia it would appear that this is the normal colour and it would be well to separate this dark grey form from the type as var. (et ab.) *borealis* (Caradja).

The northern grey form of the species had already been named *aavasaksae* by Teich, who notes it as having the white marks less sharply defined, and also notices the white costa, characters not mentioned by Caradja. If, as we suspect, the sharply-marked grey Hungarian form is distinct from the Siberian and Lapland *aavasaksae* which is "less sharply marked," Caradja's name *borealis* is an unfortunate title, which must of necessity sink as synonymous with *aavasaksae* (described from Lapland examples), whilst the "sharply-marked, entirely dark grey, Hungarian form" might be termed var. *grisea*. Staudinger describes this Hungarian form as "even more strikingly grey than the Amurland var. *senecta*" (see *posteà*).

δ. var. *senecta*, Graes., "Berl. Ent. Zeit.," xxxii., p. 126 (1888); Staud., "Rom. Mém.," vi., p. 314 (1892).—A nest of larvæ found at Chabarowka on *Pyrus* fed up readily on "Vogelbeeren" at Nicolajefsk. The larvæ were similar to the southern form found at Vienna. The greater part of the pupæ hybernated two winters. The moths are not so reddish-brown as European specimens but have a more slaty-grey colour, plentifully varied with white, and thereby they have a very strikingly different appearance from that of European specimens. This local Amurland form I name *senecta* (Graeser).

Staudinger writes (*Rom. Mém.*, vi., p. 314) that Dörries sent a ♂ from Bikin, with the reddish-brown tint of the typical German examples, and from Ussuri two males with slaty-grey forewings more or less mixed with light grey, similar to those that Graeser bred from Chabarowka. He adds that he has similar grey males from other localities—two from Irkutsk, two from Ural, and two from Hungary—the last* even more strikingly grey than the Amur specimens. A male from Lapland† has the same dark grey colour, but not more light grey dusting on the outer border of the forewings than have typical specimens. The ♀ belonging to the males from Ural and Hungary, are little (if any) different from the normal form. He further notes that he has also "a quite typical specimen from the Amur district, so that *senecta* cannot be indicated as a local form for the entire Amurland district and probably only occurs in certain localities. This grey form also occurs in Siberia, and the whole of south-eastern Europe. Many of my specimens, probably from Hungary, are intermediate between the extreme grey form and the type."

Egg-laying.*—The eggs are laid in large batches, round a twig in a long, close spiral, but placed regularly upon each other. They are thickly covered with a coating of dove-grey silk, the silk not only covering the eggs, but extending beyond them for some distance along the twig. The eggs are slightly attached to the twig by the point opposite the micropyle, the latter being at the free end, so that it appears as if the egg is really an "upright egg," *i.e.*, with the micropyle opposite the point of attachment, a form very unusual, not only among the Lachneids, but throughout the whole Sphingo-Micropterygid stirps. The fact is, the eggs are laid in true Lachneid fashion, especially the first ring, in which they are moderately horizontal in position, and must be considered as being laid upon each other, rather than attached to the twig round which they are placed. The silk covering the eggs appears to be of two different tints, white and black, hence its grey appearance in bulk. It is composed of short, wavy, fibrous masses. Newman says that some batches of eggs exhibit a corkscrew form, in others the rings are fused together, and the mass becomes amorphous. Lambillion notes the eggs as being laid from February 20th-March 10th (dependent on the weather) on young shoots of sloe in the Namur district. The eggs are reported by Perkins not to hatch simultaneously, but to continue to do so throughout May and June. Bower found a batch of ova laid on a birch branch in Bexley Woods on April 8th, 1871. Eggs hatched May 11th, 1890, at Mortimer (Holland), May 16th, 1890, and following days (Adkin).

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* Evidently this is ab. *grisea* (= ab. *borealis*, Carad., *in part*) (see *suprà*).

† Certainly referable to var. *aavasaksae*, Teich (*anteà*, p. 505).

* Reaumur wrote in 1736 (*Mém.*, ii., p. 107): "Les œufs étoient arrangés en spirale, autour d'une petite branche d'épine, comme ceux des bracelets, et enchâssés aussi dans une couche de gomme qui enveloppoit immédiatement la petite branche. Le ncm pourtant de bracelet ne convenoit pas à leur assemblage, parce qu'il occupoit une très-longue étendue de la branche; d'ailleurs ces œufs n'étoient visibles que quand on avoit enlevé les poils qui les cachoient. Ces poils étoient extrêmement fins, d'une très-jolie couleur de gris de fouris; ils n'étoient point couchés, comme le sont ceux des autres nids que nous avons décrits; ils étoient droits et comme flottans, quoiqu'ils fussent très-proches les uns des autres. Ils imitoient ce fin duvet dont est garni le corps de certains oiseaux, ou les poils fins qui se trouvent sur le castor et sur d'autres quadrupedes audessous des longs poils. Au reste, l'arrangement des poils, celui des œufs, celui même de la gomme dans laquelle sont enchâssés les œufs des bracelets, n'ont plus rien qui doive nous paroître difficile à exécuter par un papillon, dès que nous sçavons qu'il a un derrière qui peut faire tout ce que feroit, en pareil cas, une main adroite."

Ovum.—Under a low power, the egg looks as if streaked with fine dark lines (reminding one of the markings of a yellow-hammer's egg) but these markings, under a two-thirds lens, resolve themselves into silk fibres attached to the egg. The latter is roughly cylindrical, thickened and rounded towards the micropylar or outer end. It is pale milky white in colour, with an almost circular depression on the upper surface of the egg. The shell is smooth, somewhat glistening, with no trace of ribbing, but showing a very finely and minutely pitted surface under a two-thirds lens. The micropylar area is somewhat large in proportion to the transverse diameter of the egg, flattened, and very finely reticulated. The cells of the same size throughout except round the micropyle itself, where they are very much smaller and arranged in a stellate manner. The micropyle proper is very slightly depressed and is brown in colour.

Habits of larva.—Linné noticed the gregarious habits of the larvæ of this species, and wrote: "Larvæ cohabitant in societate sub tentoriis cellulosis, unde migrant pabulaturæ, redeuntque per foramina ramis parallela." Robson characterises it as being more gregarious than any other British species of Macro-Lepidoptera, and says that "the larvæ spin a web and live gregariously until full-grown, and cannot be removed from the web with any certainty of rearing them." This is hardly so, as they usually leave the nest some days before they are full-fed. The young larvæ spin a web wherever they go, but do not move further from their tent than is necessary to obtain food, although this may extend to a yard or more. They increase the size of their shelter as they spread themselves further for food, but always retire within their domicile when not feeding, and to change their skin. When full-fed they wander off alone, and spin their cocoons solitarily. Massey notices that the webs or nests vary in size, some are of the size of a cricket ball, others would fill a quart pot. The difference in size of the larvæ in the same web is remarkable, and is possibly due to overcrowding in the webs, the weaker ones suffering. The webs are generally placed near the top of a white-thorn hedge or blackthorn bush and are very conspicuous. The larvæ are very fond of basking in the sun. Riding observes that the larvæ denude the terminal shoots, and abandon the web about a week before they are full-fed. They stray from the nest as much as a distance of two yards at least—further if the supply of food be insufficient. They form bridges of silk between good feeding-grounds. so as to facilitate the return to the nest. They feed in the sunshine. The web of the nest is increased in size, more or less daily, by the formation of webs of tough silk spun between prominent extended projections. Hawes states that some of the nests contain more than 50 larvæ. Williams says that he found full-grown larvæ commonly, but singly, on hedges at Southend, these had evidently left the web, the usual practice with larvæ in their last instar. Merrin says that they remain gregarious until the change to the pupal stage, but this does not seem to be always so, many congeries dispersing directly after the last moult. Barrett says that the larvæ build a silken covering in which they live, leaving it to feed, and returning to it to rest. . . . They rest on the surface of the web in fine weather, basking in the sunshine, and crowd within it when the weather is cold or wet. Newman further notes that when quite full-fed the larva rests in a straight position, but on being annoyed raises the anterior extremity and tucks in the head, assuming a somewhat Sphinx-like attitude, and if the annoyance be continued this attitude is aggravated, and the larva finally falls from its food-plant forming a complete ring. Russell gives (*Ent. Rec.*, xi., pp. 283-284) a most interesting account of a nest of larvæ that he found in an exposed position on the branch of a small hawthorn tree at Polegate on May 21st, 1899. He says that "the web of the nest was compactly and evenly woven. It was about six inches in length, and was fastened to projecting thorns and to the end of the branch. Ingress to and egress from the interior was through one small opening only. A single larva was visible on the exterior, the remainder, afterwards ascertained to be about 200 in number, being snugly ensconced within. On returning home the following day the nest was fastened to the branch of a large hawthorn tree growing in the garden, and covered with a good sized gauze net, through an opening in the back of which the larvæ were afterwards supplied daily with increasing quantities of their food-plant. The larvæ when taken were three-quarters of an inch in length, and had apparently undergone at least one moult. Upon being placed upon the hawthorn tree they constructed another and a larger nest, enclosing the old within the new. The habits of the larvæ were most interesting to watch. Their mode of feeding was curious; they seemed to make short and hasty snatches at their food-plant, wasting a considerable portion of it in doing so. As far as one was able to observe they fed in the day time only, preferably in the early morning and in the late evening. Generally after a meal, at night time, and when very wet, they withdrew to the interior of the nest. It may have been a coincidence only, but whenever they so retired one of their number remained upon the exterior, a stationary sentinel over those within. In addition to constructing a fresh nest the larvæ wove lines of webbing along the bare branch and branchlets adjoining it, and when the sun shone they became most active, racing after one another along the webbing at a surprising rate. Occasionally first one and then another of them would take a hasty bite at a leaf of their food-plant, but so long as the sun was shining brilliantly upon them they seemed to prefer exercise to feeding. If disturbed at any time, they fell from where they were lodged to the bottom of the net. The larvæ moulted twice after I had them, the first moult taking place within ten days. They were then similar in appearance to the figures 1 and 1*a*, given in Buckler's *Larvae*, &c., though, of course, not so large. They again moulted about the middle of June, and after this, their final moult, they were most beautiful in appearance, and I deeply regretted my inability to paint a true picture of one of them. According to Newman the larvæ pupate at the end of June, but although quite one half of those I had were by this date fully two inches in length, and apparently full-grown, they showed no inclination to spin their cocoons, but continued to feed well until July 12th. They then commenced to pupate, and by July 20th, all of them, with the exception of three or four, had formed cocoons. These were constructed either within their nest or in a mixture of their own frass and dried pieces of wasted food-plant.

Larva.—The *newly hatched larva* has the head not especially wide, inclined to be tall, dead black, surface roughened, slightly notched at crown, with a few scattered, rather short, white hairs. Prothorax, with the scutellum fairly conspicuous, large, wider than the head, and following segments. The mesothorax rather less than prothorax, the remaining segments of the body fairly uniform in size. The segments rather distinctly separated; skin much wrinkled, in colour almost black; the tubercles rather tall and slender, the anterior trapezoidals rather larger than other tubercles; the posterior trapezoidals very small, hardly noticeable. The anteriors bear three (or four) long hairs, the posteriors two small ones. The lateral tubercles appear to be the supra-, sub- and postspiracular, and each of these seems to bear two hairs. The body hairs long (especially the dorsal), white and very slightly serrated; the longest hairs at least half the length of the larva. The anal segment is dull grey in colour, the anal claspers are spread widely; the prolegs and anal claspers light grey (Bacot, May 9th, 1897). *Adult larva:* The head is small, tending to be square or trapezoidal in outline; the surface dull, except the triangular clypeus which is shiny; colour black with a narrow white streak along the median suture. The body tapers slightly from the abdominal segments to the head, otherwise of fairly even thickness; the true legs black and shiny; the prolegs reddish; the body velvety black in colour, rather duller and with a bluish tint on the intersegmental membranes and ventral area. The head and body covered with numerous scattered fine, simple, tapering hairs of variable lengths, a few of those on head and prothorax black, the others bright brown in colour. On the dorsal area of each segment from the mesothorax to the 8th abdominal (inclusive) are situated two large patches of fine furry hairs, one on either side of the median line. These hairs look, to the naked eye, similar to the urticating hairs of *Lasiocampa quercûs*, being short, fairly closely set, and all of about the same length. There is a broken and irregular subdorsal white band with a well-marked short transverse band jutting from it at right angles towards the median line, and placed just behind the patch of fur-like hairs, there is, too, a less strongly developed similar transverse extension, rising from the summit of an upward crenulation of the band, and passing immediately in front of the fur-like patch. There are also disjointed remnants of a narrow, white, subspiracular band and of a narrow, double mediodorsal white streak. This last is represented by a pair of dots on the meso- and metathorax and a short pair of dashes on the anterior edge of the abdominal segments. Occasionally there is a second dash faintly marked on the posterior edge of the latter abdominal segments. What strikes one about the white markings is the tendency of the mediodorsal and subdorsal series to form a border (more or less complete) to the patches of short, fur-like hairs, thus throwing them into greater prominence. Between the meso- and metathorax, and between the metathorax and 1st abdominal segment is an extension backwards from near the junction of the posterior transverse dashes with the subdorsal band proper. This backward extension joins or nearly joins the front end of the subdorsal band on the following segment and there is no anterior transverse extension of the subdorsal band on the metathorax and the 1st abdominal. The short fur-like hairs under a $\frac{1}{4}$-inch objective, prove to be spindle-shaped needle-like hairs, very similar in general appearance to those of *Lasiocampa quercûs* and *Macrothylacia rubi*, but slightly different at base, and with minute serrations which are not found on those of *L. quercûs*. They are doubtless urticating hairs (Bacot). Newman (*Entom.*, vi., p. 265) describes the larva as follows: Head scarcely narrower than prothorax, subglobose; body almost uniformly cylindrical, covered with silky hairs. Colour of head almost black, of the body intense velvety black, having on each side a narrow interrupted yellow-white stripe, which, on each segment, emits a branch towards the dorsum at right angles with itself. On the 8th abdominal segment, these branches nearly, and sometimes quite, unite on the back, and midway between each two branches is another aborted branch, sometimes reduced to a mere spot. The shorter hairs on the dorsal surface are rich sienna-brown, very bright and vivid, and disposed in two longitudinal series of subquadrate and nearly contiguous patches; the longer hairs are mostly on the sides, paler and tipped with grey; the true legs black and glabrous, the ventral prolegs red, the anal prolegs pitchy-black. The ventral surface is smoke-coloured. Some years afterwards Newman (*British Moths*, p. 42) gave another description of the larva in which he states that "the larva is slightly hairy, has three white spots, and two red warts on the back of each segment, and with a pale grey line on each side." Comparing larvæ obtained in North Wales, with this description, Perkins observes that they have "no red warts on the back, have four, two, or no white spots, have a yellow line instead of the pale grey lateral stripe, interrupted at each segment where it turns at right angles halfway up the back and forms the border to a square velvety patch of short orange-brown hairs; the claspers coral-red." Buckler figures (*Larvae*, &c., pl. xlviii., fig. 1*a*) the larva before the first moult—with green ground colour, grey dorsum, and black subdorsal segmental patches. It is exceedingly different from the figures (1*b*, 1*c* and 1*d*) of the larvæ in their mature attire. In all the latter the ground colour is black with a slaty tinge, but the size of the subdorsal patches, the amount of yellow surrounding them, and the consequent variation in the quantity of the ground colour exposed are very noticeable. Barrett observes that the larvæ are not very variable, though the colour of the large subdorsal spots varies from yellowish-white to red.

Comparison of larvæ of L. var. arbusculæ and L. lanestris.—In the larva of *L.* var. *arbusculae* (from Arolla), the white bands of the larva of typical *L. lanestris* are broken up into spots; it has yellow instead of red prolegs, and a shiny instead of a dull head. The central suture of the head is dull-brown instead of white. Traces of the broken double mediodorsal line of *L. lanestris* are represented only by the anterior pair of spots on the meso- and metathoracic segments. The anterior and posterior extensions at right angles to the longitudinal subdorsal band are represented only by two disconnected spots, one before and one behind each patch of dorsal fur. The subdorsal band itself is also broken up into a series of disconnected white spots. [In spite of the form of the foregoing notes, which suggest that the larva of *L.* var. *arbusculae* is a direct derivative of the larva of *L. lanestris*, I am inclined to think that exactly the contrary is the fact, and that our larval form of *L. lanestris* has developed its still broken bands from the disconnected spots of the larva of *L.* var. *arbusculae*. The hairs and the short dorsal fur-like urticating hairs of the latter are exactly as in the larva of *L. lanestris*] (Bacot).

Pupation.—The cocoons are usually firmly fixed to twigs of whitethorn or blackthorn, sometimes two or three cocoons near together.

In a breeding-cage they are spun to twigs, in curled leaves, or in a corner of the cage, and sometimes seven or eight are spun together so firmly that they cannot be separated without injuring the cocoons (Massey). Greene notices that he once found two cocoons, in October, at roots of elm, no hawthorn being near at hand. Battley finds the cocoons among dead hawthorn leaves, and Robson says that the larvæ generally spin up among the rubbish about the bottom of a hedge. Lambillion observes that the cocoons are made up under moss or grass not far from the feeding-places of the larvæ; whilst Ridley says that they are sometimes made quite openly, and in winter may be found attached to stems of hawthorn.

Cocoon.—The larva spins a compact, oval, brown cocoon, about three-quarters of an inch long, and rather more than three-eighths broad. The inside of the cocoon is paler than the outside, and looks smooth to the naked eye, but it is really lined with yellowish silk which appears to be quite glossy under a lens. The silk forming the outer part of the cocoon is hardened with a paste composed of calcium oxalate, the silk comprising but a small part of the whole. The latter forms a very loose and open framework which is first constructed by the larva, and serves as a foundation for the oxalate of lime which the larva pours upon it. This latter is secreted by the Malpighian tubules of the larva, and appears to be poured from the anus. Hewett says: The lid of the cocoon is plainly visible long before the moth emerges, and chips off with quite a clean edge. The cocoon itself is made of two distinct layers, the outer hard and with air-holes, the inner soft, of the texture of very fine brown paper without any holes at all. The two separate pretty easily if a cocoon be pulled to pieces. Borkhausen says that the cocoon is like that of *L. everia*, but is not internally lined with hairs as in the latter, but with threads. To facilitate the emergence of the imago the cocoon is provided with a lid, and in the side it has a "Luftloch."

Double and composite cocoons.—Cocoons containing two (and more) pupæ are occasionally found in this species, *i.e.*, the cocoon has been spun in common by the larvæ, and utilised for pupation. Hoffmann (of Thurnau) in 1802, writes (*Naturforscher*, xxix., p. 230) that, on August 9th, 1799, he found a nest of 26 almost full-fed larvæ of *L. lanestris* on a birch in a wood on the mountains. They soon spun up, not one died, but fourteen made separate cocoons, six of the others spun up two by two in common cocoons, and six others three by three, so that they only made nineteen cocoons between them. Opening nearly all the double and triple cocoons, easily distinguishable by their larger size, he found that only one larva (one of a three) had failed to pupate. Not one emerged in 1800, but they were all quite healthy at the end of May. Russell observed that, of a large brood he reared, some spun double cocoons, whilst in other instances a general cocoon was formed by three or more of the larvæ. As imagines only emerged in one or two instances from these cocoons several were opened. The majority contained two dead larvæ, others three, and the largest as many as eleven, the larvæ having failed to complete their pupation. The formation of these cocoons certainly appears to have resulted from the overcrowding of the larvæ. Hervey records, in 1871, three or four instances in which two larvæ used the same cocoon with no partition inside. Hewett records, in 1890, an unusually large cocoon, containing two pupæ squeezed together and with no partition between them. Foddy mentions, in 1890, three cocoons with two pupæ in each. Pearson also records an instance of a cocoon with two pupæ. Vaughan found among many cocoons made by this species, two much larger than the rest, and each of these was found on being broken open to contain two dead larvæ. He further notes that Bond had observed a cocoon with three inmates. Thouless records two similar cocoons each containing two pupæ.

Variation in colour of cocoons.—Poulton found that the cocoons of this species were of various shades of colour, and supposed this to be due to the influence of the colour of the environment, among which the cocoons were spun, upon the larva, and he further assumed that the latter had the power of adjusting the colour of the cocoons to their environment as a means of concealment from their enemies. Newman reported that cocoons spun on white paper were creamy-white in colour, whilst those spun among leaves were dark brown in colour, the leaves becoming when dead of the same tint as the cocoon. From this also it was deduced that the dark brown colour was highly protective. It was, however, discovered that the normal brown colour of the cocoons of this species was due to a red-brown viscous fluid, which is voided on the silk by the spinning larva, and which becomes dark brown on exposure. This colour has, undoubtedly, a great protective value in nature, and pale cocoons are very rarely observed except when spun by larvæ reared under artificial conditions. The explanation of the coloration of these pale cocoons now became simple. It was observed that if a larva were disturbed just as it was about to spin, it voided the greater part of the red-brown fluid owing to the disturbance, and then, whatever the colour of the environment, the larva spun a pale cocoon, having already lost the colouring matter, with which it would, normally have stained the cocoon. It was also noticed that if larvæ were removed from their food and starved for three or four days previous to spinning, they also spun pale cocoons; and so, also, did larvæ whose constitutions had been undermined by parasites. Some of these pale cocoons were, indeed, quite white. Bateson considers that the colouring matter is probably a chlorophyll product, and this is the reason that the hue of the normally dark coloured cocoons, bears such a striking resemblance to decayed or decaying leaves. He further considers that it comes from the alimentary canal, but is not certain whether it be voided from the mouth or anus. It would appear, therefore, that the substance with which the silk is stained, is entirely different from that with which the cocoon is hardened. The variation in the colour of the cocoons extends from dark black-brown (the tint of black coffee), through dark brown, pale brown, cream-colour, to those that are absolutely white. The pale cocoons, as might be supposed are, as a rule, thin and papery, whilst the dark cocoons are stout, stiff and shiny. Russell notes of a batch of cocoons that he had from larvæ reared in confinement that the majority were of a whitish tint, a few were brownish, and one or two pale greenish.

Pupa.—The pupa is large for the size of the cocoon, the segments increasing in width from the head to the fourth abdominal. It is pale brown in colour, the ventral appendages and wings paler, and somewhat transparent. The dorsal area is rather darker, and there is a slender mediodorsal, blackish line. *Ventrally:* The head is prominent, the labrum, mandibles, labial palpi, and the maxillæ well-developed, and enclosed with the first and second pairs of legs by the antennæ, the tips of the third pair of legs only showing just beyond the apices of the wings. The antennæ reach nearly to the apices of the wings and enclose a comparatively large area (a character very noticeable in the pupæ of species belonging to this family). The glazed eye is almost of the same pale brown colour as the general hue of the pupa, and is very large and prominent. The wings are so transparent that the ventral portions of the first three abdominal segments are more or less visible. The sexual organs are very distinct, and there are marks on the venter of the abdominal segments 5-8, which suggest the position of the prolegs. *Dorsally:* The frontal part of the head with two well-defined prominences. The prothorax well-developed; the mesothorax large and prominent, the prothoracic spiracle low down (in contact with the antenna), black, ill-developed and inconspicuous; the metathorax not prominent, but well-developed laterally, where it gives rise to the posterior wings. The abdominal segments increase in size from the 1st to the 4th, and then decrease to the anal segment. *Laterally:* The abdominal spiracles are large, well-developed, with black centres and prominent red-brown rims, on abdominal segments 2-7, but aborted on 8 (and apparently also on 9). The cremastral area is very rounded, and smooth with the exception of a few stray black hairs. Borkhausen notes that the pupa is similar to that of *L. everia* and has, like that, two elevated knobs on the front segment.

Parasites.—Fifty per cent of the individuals in many broods appear to be attacked by dipterous and hymenopterous parasites. Mera exhibited, on March 15th, 1898, at the City of London Entomological Society, a cocoon of *L. lanestris*, in which he had found the larval skin, two pupa-cases of parasitic diptera, one large and one small, the dead imago that had emerged from the larger pupa, but which had not been able to escape from the compact walls of the cocoon, whilst the leg of a dipterous imago protruded from the smaller pupa, but there had been no room for its emergence. Species noted: *Eurylabus dirus*,* Grav. (Bignell), *Phaeogenes calopus*, Wesm. (Bignell), *Ophion obscurus* (Bairstow).

Food-plants.—*Tilia*, *Prunus spinosa*, *Salix* (Linné), whitethorn, bramble (Riding), plum (Foddy), elm (Raynor), ling (Wylie), birch (Bower), sallow (A. H. Jones), cherry, birch, willow (Kaltenbach), oak (Esper), fruit-trees (Dickore), apple (Burrows), plum (Miller), *Salix caprea* (Hering), *Alnus viridis* (Frey), *Vaccinium uliginosum*, *Corylus*, *Salix fragilis*, *Sorbus*, *Rhamnus* (Rühl), dwarf sallow (Teich), *Pyrus* (Graeser), apricot (Hoffmann).

Habits and Habitat.—The imago is rarely seen wild. The male is not attracted by light, but the female is now and again obtained near a batch of eggs on a hawthorn twig. Barrett notes that on one occasion he picked a hawthorn twig on which a batch of eggs had been laid and had carried the twig some distance before he observed that what he had taken for a dead leaf on the twig was the female (*vide, anteà*, pp. 446-447). Imagines frequently beaten out of small hedges and from tree-trunks in March and April in the Zürich district (Rühl). It

* Sauveur has (*Ann. Soc. Ent. Belg.*, v., p. 70) a brief note on the oviposition of *Eurylabus dirus* in the skin of *L. lanestris*.

appears to be an occasional habit for a preponderance of one sex to emerge from particular broods, but this may be due to the conditions of rearing them in confinement, the larvæ of one sex being killed off, yet this is not always so, for W. E. Nicholson records that, in a brood he once had, all the specimens that emerged one year were males, whilst those which emerged next year were females, and Wilson observes that of sixteen pupæ, he bred five females one year, all the rest going over. Standfuss gives (*Handbuch*, &c., p. 190) details of four years' results in breeding the species, in which the proportion of the sexes worked out as follows: 1889—89 ♂s, 81 ♀s; 1890—212 ♂s, 198 ♀s; 1891—128 ♂s, 119 ♀s; 1892—157♂s, 152 ♀s, *i.e.*, a total of 586 ♂s compared with 550 ♀s. The insect is in some years exceptionally abundant. Walker notes twenty nests in a mile by the roadsides at Pickering, in 1896 but states that, in spite of the abundance, the larvæ do no permanent damage. Harwood records thousands of larvæ in 1867, in the Colchester district. Barrett says that it is most plentiful in coast districts, but this is more than doubtful. Still records it from the moors in Devonshire, and Wylie on the heaths of Perthshire. Holland says the larvæ are locally common on hedges in Berks and Oxon, Vaughan in lanes in Essex, Christy on exposed parts of the downs at Emsworth. Bower observed it on rough ground near the sea at Eastbourne, Prout on hedges on marshy ground at Benfleet, and Chaney says that it is not uncommon in the woods at Chattenden. Very abundant in 1868, at Badyworth, in Somerset, one web was found on the top of a dwarf hawthorn hedge containing about 60 almost full-fed larvæ. At the bottom of the web was about a quart of frass. Most of the imagines from these emerged the following February, a very few went over until the next year (T. Briggs). Very irregular in appearance, sometimes 20 or 30 nests in the hedges round Hertford in one season (Stephens); on whitethorn hedges at Cambridge and Leamington, on blackthorn at Windermere, in woods on sallow, at Whitwell and Aylsham (Freeman); common on the exposed hawthorn hedges leading to the downs at Salisbury (Ridley); common near Bath, the larval nests conspicuous, and not unlike a wasp's nest at a distance (Greer); abundant on the hedgerows of whitethorn and blackthorn at Pickering, in July, 1897, there were nests almost every few yards along the roadsides (Ash); found on the hedges and commons in the Weald of Sussex (Nicholson); common on hawthorn hedges in Worcestershire (Rea); everywhere on hawthorn hedges in the Brighton district (Merrifield); on roadside hawthorn hedges at Aylesbury (Bayne); on a blackthorn hedge in the New Forest, June, 1897, we found a tough web about a quarter of a yard long, thick, white, and almost pear-shaped, with I should think hundreds of larvæ inside, the imagines emerged the following February (Cowl); prefers the cliff slopes between Southend and Benfleet, not so common inland (Whittle); larvæ very abundant on the stunted blackthorn bushes growing on the Magilligan sandhills in the Londonderry district (Campbell); very common in the larval stage on hawthorn hedges at Uriage, the larva full-fed at the end of June (Oberthür); egg-batches to be found on twigs of hawthorn, one such April 6th, 1899, at Warnant, on the Meuse (Lambillion); larvæ abundant on the Stepenitz turfmoor nr. Gnageland (Hering).

Pupal habits—Extended duration of pupal stage.—It is in the pupal stage that the habits of this species are the most remarkable.

Gascoyne records that on the morning of March 18th, 1860, he placed a box containing 300 pupæ on a chimney-piece, that felt warm to the hand; in three hours 49 males and 4 females emerged; moved the box back to cooler place in the evening; next morning no more had emerged, so moved box again to chimney-piece; in less than two hours 25 others, 14 males and 11 females, emerged. The power of existing for several years as pupa, and then successfully emerging, is perhaps more marked in this, than any other known species of lepidoptera. Thornewill, however, says that he can get the moths to emerge without trouble by putting the cage with the cocoons into the sun early in March, when they will swarm out like flies. He states that he once bred fifteen in half an hour. Miss Kimber says that the imagines usually emerge from 12.0-1.30 p.m. Hewett gives 4 p.m. Russell states that he placed the cocoons resulting from a large brood of 200 larvæ (*anteà*, p. 508) on moss, kept them in an unheated, well-aired room throughout the autumn and winter, occasionally damping them, and obtained: April 1st, 1899—14 ♂ s, 9 ♀ s; April 4th—15 ♂ s, 27 ♀ ; April 6th —7 ♂ s, 4 ♀ s; April 7th—11 ♂ s, 9 ♀ s; April 10th—8 ♂ s, 15 ♀ s; April 11th—3 ♂ s, 8 ♀ s. The imagines commenced to appear at 9 a.m., and continued to do so until 6 p.m., the majority emerging in the late afternoon. Of the 58 ♂ s and 72 ♀ s which emerged 2 ♂ s and 4 ♀ s only were crippled, but the hindwings of 5 per cent. of the ♂ s and 20 per cent. of the ♀ s were imperfectly formed. There are still remaining about 30 of the single and half a dozen of the composite cocoons, with pupæ, those of the former possibly going over to emerge another year, but it is doubtful whether the latter will do so. Woodforde states that he has obtained large numbers of emergences towards the end of Jauuary, after the pupæ had lain over two winters, by putting the box in which they were kept, with a glass over it, in the window in bright sunshine. The temperature in the box would then be between 90° F. and 100° F., and under these conditions they will emerge and buzz about like bees. Hoffmann (of Thurnau), in 1799 (*Naturforscher*, xxviii., pp. 87 *et seq.*), gave an account of his breeding *L. lanestris*, from a nest of 265 larvæ obtained June 18th, 1793. Of these he selected 125, and fed them on apricot leaves; before maturity 47 died, and the remainder spun up July 10th-14th. From February 1st-15th, 1794, 20 ♂ s and 29 ♀ s emerged, and of these 8 ♂ s and 14 ♀ s were crippled; in the first thirteen days all the males, but only a few females emerged, in the last two days the remainder of the females; after this, none appeared until November 12th when one ♀ , a cripple, emerged. In 1795, on March 1st, 3 ♂ s (one a cripple), and on March 12th, 1 ♀ emerged. In 1796, about the same time of year, a few more emerged. In 1797, on February 14th and February 25th, two males emerged; later in the same year he opened nearly all the remaining 21 cocoons; the greater part of the pupæ were dead, and dried up, some, however, were still healthy, and, on February 15th, 1798, 2 ♂ s emerged, on February 27th, 2 ♂ s, on March 3rd, 1 ♀ , the last three cripples, but very active. Two healthy pupæ were still going over. From pupæ received by us, in 1880, one emerged in 1881, another in 1882, two in 1883, and the remaining pupa opened in March, 1884, was found to contain a fully formed imago, which expanded its wings after being carefully removed from the pupa. Robson says that imagines from one brood he had, came out during four or five successive years on March 4th-5th. Hervey records that two specimens that pupated on July 8th, 1869, did not emerge until March 18th, 1874. Sladen observes that larvæ taken at Burghclere on June 23rd, 1879, produced imagines on March 6th, 1881, January 1st, 1882, March 3rd, 1883, and April 2nd, 1884. Slade reports that 100 pupæ were obtained from a nest of larvæ taken in 1869 at Buckingham, of these 15 emerged in February, 1870, 12 in February, 1871, a few in February, 1872, and a few in 1873. Larvæ obtained by Todd in 1866, produced about 100 pupæ ; of these the first moth emerged February 2nd, 1867, others following, in 1868, the next emergence was on February 20th, 1869, then on April 6th, 1869, whilst others remained in the pupal stage after this date. Adkin records that he fed up a brood of larvæ in 1891, there were no emergences in 1892, but about a half of the pupæ disclosed imagines in the early spring of 1893. Larvæ obtained August, 1896, at Poulton, several imagines emerged March 21st-April 25th, 1897, some lying over (Clutten); an imago emerged February, 1897, from an 1894 larva (Moss). Gribble notes that from a larva taken at Stokesley in 1895, a female emerged February 18th, 1898. Atmore observes that he has reared moths from four-year-old cocoons. Robson also notes that his brother at Stockton-on-Tees, reared a number, some of which emerged on almost the same day in February, over six or seven years. Baker says that he found the larvæ common at Chagford in 1887, these pupated in due course, and the imagines emerged over a period of four years. Speyer observes that from Waldeck larvæ which pupated in 1855, part of the imagines emerged March, 1856, two in 1857, and the last female in February, 1859. He further notes (*Stett. Ent. Zeit.*, xlix., p. 205) that to pass a second year in the pupal stage is quite an ordinary thing, also a third, once he knew of a fourth, but in June, 1882, two larvæ of this species pupated, the pupa from one of these larvæ, kept in an unheated room, produced an imago April 4th, 1887, whilst the other was still a pupa on July 16th, 1888, and then showed no sign of wing-development although living and quite healthy. It finally emerged on April 9th, 1889. The emergence of an imago after a pupal stage lasting five years is mentioned by Treitschke. Zeller, of Balgrist, records examples of *L.* var. *arbusculae* going over in the pupal stage for eight winters, and then emerging ; Standfuss also obtained several imagines of this form after a pupal stage extending over four and six winters. The cause of this delay in emergence is not known. It certainly is not lack of temperature at the right time, for of many pupæ subjected to identical conditions, some emerge, others go over. Edmunds records that in 1860, many pupæ kept in a warm room went over until another season, yet two kept in a cold cellar emerged on April 5th and 7th. Pierret considered that the delay was caused by the hardness of the cocoon of this species, which rendered it impenetrable to the vivifying action of the air, and asserted that those species which had exceptionally hard cocoons were those which remained longest in the pupal state (*Ann. Soc. Ent. France*, 1846, p. xl). The most remarkable factor in the case is that living organisms, whose tissues must perform at least some vital functions, can live such a long period of time without food and without apparently drawing on their own reserve material (if any) and ultimately produce a perfect insect of full size and colour, and differing in no way apparently from that which would have been produced had it emerged after only one winter's hybernation, instead of from two to seven years.

Time of appearance.—From February to April according to the season, yet many continental authorities make the speeies also emerge in the autumn.* *Larvae:* June 7th, 1860, from Taunton, others June 22nd, 1862, larvæ pupated July 5th-12th, emerged March, 1863 (Fenn); April 23rd, 1865, at Abbey Wood, June 6th, 1873, at Conway, June 17th, 1876, in New Forest (A. H. Jones); June 22nd-July 8th, 1868, at Badyworth (Briggs); larvæ hatched through May and June, 1873, at Ruabon, full-fed July 29th, 1873 (Perkins); larvæ October (very late), 1880, at Ely, emerged April 19th, 1881 (Durrant); June 16th, 1874, at Henley Road, June 18th, 1887, by side of river Kennet, June 9th, 1888, at Theale, June 22nd, 1889, at Henley, May 11th, 1890, at Mortimer, June 14th, 1891, at Aldermaston (Holland); nests of larvæ at Eastbourne, July 3rd-16th, 1876, at Canvey Island, June 28th, 1896 (Bower); June 20th, 1885, at Abbott's Wood (Hawes); June 1st-9th, 1886, at Barnwell Wold (Porritt); June 22nd, 1886, at Engleberg (Baker); July 18th, 1887, at Brentwood, June 14th, 1890, at Woodham Ferris, May 25th, 1893, at Benfleet, sleeved these larvæ on apple, there were very few deaths, and every pupa produced an imago the following spring (Burrows); June 11th, 1889, at Walton, May 25th, 1890, May 29th, 1892, at Benfleet, June 3rd, 1895, at Maldon, July 4th-11th, 1897, full-grown, at Southend, June 23rd, 1898, at Southend (Whittle); June 13th, 1889, May 23rd, 1892, May 9th, 1893, at Emsworth (Christy); June 14th, 1890, at Woodham Ferris,

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*We doubt almost the whole of these records—so evidently did Speyer (*Stett. Ent. Zeit.*, l., p. 141, li., p. 200), who only obtained imagines from February to April —yet they are so numerous that we add some of them, and would note that the record of Hoffmann *suprà*, and the statements of Fischer, Fritsch, and Schütze *posteà*, are apparently trustworthy, possibly more or less parallel with the specimen bred by Massey, December 20th, 1897, indoors. Berce writes: The imago emerges in September and October for the first time, in March, April, and May of the following year for the second time, at least round Paris, Bordeaux, Besançon, &c., yet according to Constant, Guillemot, and Peyerimhoff it has only one emergence, that of September, in the dept. Saone-et-Loire, Puy de Dôme, and in Alsace (*Schmetter.*, ii., p. 187). Borkhausen writes that the imagines usually emerge in October, but some pupæ hybernate and appear in the early spring (*Syst. Beschr.*, iii., p. 125). Caradja reports its occurrence in February, March, and September in the Haute-Garonne. Bruand says May and September in the Doubs dept. Donckier records that in Belgium this species is rare, occurring in October, although retarded examples do not appear until March and April. Schütze states that almost every brood in Upper Lusatia produces some autumnal examples. Nickerl gives from October until spring in Bohemia, whilst Fritsch records emergences on September 19th at Brünn, September 25th at Linz, March 1st-30th at Salzburg, March 20th-April 5th, 1874 (♀ abundant on latter date) at Freistadt. Fischer says that imagines appear in October at Wernigorode, from one brood an imago emerged the same autumn, the rest by degrees in the succeeding years, the last in the fifth year. Weiler observes that the species only occurs in Taufers every second year. On the other hand many continental authorities notice only the spring emergence, and these confirm our insular experience. Speyer insists strongly (*Stett. Ent. Zeit.*, l., p. 141) that the species only occurs in spring, and in Silesia it always emerges in February. Guénée gives February and March in the dept. Eure-et-Loir; Rössler says middle March in nature at Nassau, Speyer notes March at Waldeck. Oberthür gives February as the time of emergence from the Uriage larvæ, de Graslin says March for Château-du-Loir. Lambillion notes February 20th to March 10th, dependent on weather, in the Namur district, &c. Nolcken, too, observes that it only emerges in April and May in the Baltic provinces.

June 12th, 1892, at Panton, June 21st, 1894, at Baumber, June 16th, 1898, at Woodham Walter (Raynor); on blackthorn, at Eynsford, common, larvæ half-grown, June 30th, 1891 (R. Adkin); on whitethorn hedges on May 22nd, 1892, at Cambridge, on June 23rd, 1896, at Leamington, June 3rd, 1897, on blackthorn at Windermere, July 5th, 1897, on sallow at Whitwell, June 29th, 1898, at Aylsham (Freeman); June 8th, 1892, in Rufforth Lane, June 23rd, 1897, at Strensall, June 30th, 1897, near Elvington (Hewett); June 26th, 1893, at Birman Hill, Perth (Wylie); webs on June 5th, 1892, May 24th, 1893, near Exeter (Studd), June 23rd, 1894, at Polegate, April 19th, 1893, at Benfleet, May 19th-22nd, 1899, young larvæ in New Forest (Prout); June 15th, 1894, at Bath (Greer); June 25th, 1894, at Southend, June 17th, 1895, at Whitchurch (Thornewill); May 12th, 1895, at Pickering (Dennis); July 3rd, 1895, at Holt (Rea); July 13th, 1895, at Stokesley, June 20th, 1896, at Broughton (Lofthouse); May 25th, 1896, a large web in north-west Lancashire spun up July 10th-20th, pupæ left out of doors until February 17th, 1897, first emergence February 20th, continued until March 10th, 50 per cent going over, cage brought indoors again December 13th, 1897, first emergences, two ♂ and one ♀, took place December 20th (Massey); very small at Billesdon, May 2nd, 1896, half-grown on May 25th, 1896, at Yarmouth, Isle of Wight, June 14th, 1896, at Huntingdon, June 5th, 1897, at Yarmouth, Isle of Wight (Kaye); larvæ May 24th, 1896, at Aylesbury, the first emerged February 17th, 1897 (Bayne); larvæ June 8th and 18th, 1896, at Leigh, bred among others, one on April 24th, 1899, after two years in pupa, others April 7th and 15th, 1900, after three years in pupa (Mera); a small web end of May, 1897, at Buckerell, full-fed about July 9th, first emergence April 7th, 1898 (Riding); quite small larvæ June 11th, 1897, at Hailsham, imagines March 10th-18th, 1898 (P. Reid); June 14th, 1897, at Horsham (Image); July 7th-8th, 1897, at Pickering (Ash); larvæ July 9th, 1897, at Taunton, emerged March 16th-April 3rd, 1898 (Tetley); July, 1897, in St. Faith's district, Norwich (Thouless); May 21st, 1898, at Winchester (Holdaway); June 11th, 1898, at Hailsham (Sheldon); larvæ in May and June, 1898, at Hitchin, spun up in August, commenced to emerge March 11th, 1899 (Cottam); April, 1898, very small at Reading (Butler); young larvæ June 6th, 1898, at Taunton (Bartlett). *Imagines:* March 15th, 1859 (44 specimens emerged), February 6th, 1860, captured at rest, February 6th-April 7th, 1860, bred March 2nd-14th, 1861, at Worcester (Edmunds); March 18th-20th, 1860, at Newark (Gascoyne); April 12th, 1860, at Tilgate (Tugwell); March 4th-5th, for several years in succession (Robson); February 1st-April 5th, 1865 (72 specimens) from larvæ found May 18th, 1864 (A. H. Jones); March 28th, 1866, at Guestling (Bloomfield). Of 100 larvæ obtained in 1866, at Aldworth, the first emergence took place on February 2nd, 1867, others later in same year, of those that went over, the first appearance in 1868, was on February 20th, others still went over, and the first emergence in 1869 took place on April 6th, some went into a fourth year (Todd); February 22nd, 1869, at Glanville' s Wootton (Dale); March 1st-April 13th, 1878, 4 ♂s and 4 ♀s, February 14th-March 2nd, 1879, 6 ♂s and 3 ♀s, March 19th, 1881, 1 ♀, all from one brood, from Rugby (R. Adkin); March 12th, 1883, at Birmingham (Bath); March 27th, 1885, March 22nd, 1886, February 13th-March 9th, 1887, at Rainham (Burrows); March 23rd-April 3rd, 1886, from Frome and Nottingham larvæ, also on April 21st, 1887, and April 19th-May 20th, 1889 (four examples) from the same 1886 larvæ (Fenn); March 5th, 1891, at Winchester (Hewett); bred February 16th-19th, 1892, March 6th-16th, 1893, from Weston-on-Trent (Pearson); March 8th, 1893, at Farnboro' (Alderson); bred March 23rd, 1893, from Leigh, larvæ on May 29th, 1895, at Benfleet, gave imagines March 11th, 1896, larvæ June 23rd, 1896, at Southend, gave imagines February 28th-March 17th, 1897, larvæ June 23rd, 1897, pupated first week in July, gave imagines April 3rd-8th, 1898 (Whittle); March 17th, 1896, February 22nd, 1897, March 12th, 1897, March 12th-17th, 1898, nr. Leicester (Dixon); March 27th-April 5th, from two-year-old pupæ, larvæ from Magilligan, next year three from same brood between April 14th-25th (Kane); through April, 1897, from New Forest larvæ (B. Adkin); February 1st-March 20th, 1898, at Boxworth (Thornhill); February 20th-March 10th, 1897, and then from same brood, December 20th, 1897-January 11th, 1898 (Massey); March 17th-April 7th, 1898, from Carnforth, April 5th, 1898, after being two years in pupa, from Poulton, nr. Blackpool (Clutten); April 7th, 1898, at Buckerell, first emergences for the year (Riding); middle of January, 1898, at Gloucester (Merrin); February 10th-March 13th, 1899, from Hitchin (Burraud).

Localities.—Aberdeen: Pitcaple, introduced from Essex (Reid). Argyll: various places on the Firth of Clyde (Gray, *Nat.*, i., p. 84). Beds: Potton (Bond-Smith). Berks: local, and varying in abundance each year—Mortimer, Aldermaston, Theale, banks of the Kennet (Holland), Reading (Butler), Burghclere (Sladen). Bucks: Aylesbury (Bayne), Buckingham (Slade), Alton (Hervey), Halton (Stainton), Stoney Stratford (Thompson), Wavendon, nr. Newport Pagnel (Stainton). Cambridge: Cambridge and district (Moss), Whittlesford, Swaffham Prior (Balding), Bottisham (Jenyns), Ely (Durrant), Boxworth (Thornhill). Carnarvon: Conway (A. H. Jones). Cheshire: Wirral, nr. Hoylake (G. O. Day), Chester, West Kirby (Walker), Upton Valley (Brockholes), Tranmere, Prenton, Parkgate (Gardner), Birkenhead (Stainton). Cumberland: Keswick, rare (Beadle), Lake district, very abundant (Stainton). Denbigh: Ruabon (Perkins), Llanrwst (A. H. Jones), Colwyn Bay, abundant (Whittaker). Derby: Willington, Chellaston (Payne), Burton-on-Trent (Brown), Needwood Forest (Nowers), Derby (Pullen). Devon: Buckerell (Riding), Chagford, Dartmoor, nests of larvæ common (Baker), Seaton (Still), Braunton (Burrows), Barnstaple (Mathew), nr. Exeter, common (Studd), Teignmouth (Stainton). Dorset: banks of Stour (Fowler), Weymouth, some years common (Forsyth), Dorchester (Stainton), Glanville's Wootton (Dale). Durham: Hartlepool, uncertain, Stockton, Greatham (Robson), Darlington (Stainton), Horden (Bungay). Essex: Benfleet, Southend (Whittle), Colchester (Harwood), Hadleigh (Bacot), Leigh (Vaughan), Woodham Walter, E. Horndon, Maldon, Hazeleigh, Danbury, Purleigh (Raynor), Walton (Williams), Epping (Doubleday), Rainham, Brentwood, Wood ham Ferris (Burrows), Chelmsford (Miller), Canvey Island (Bower). Galway: Ardrahan (Curzon), nr. Galway common (Allen). Gloucester: general—Bristol district, &c. (Hudd), Gloucester, common (Marsden), Newnham, Upton, Mitcheldean (Lifton), Lower Guiting (Stainton), Barmwood (Merrin), Avonmouth (Griffiths). Hants: Isle of Wight—Nettlestone, Long Benton (Ingram), Yarmouth (Kaye), New Forest (B. Adkin), Bournemouth (Tutt coll.), Lockersley, Romsey (Burrows), Brockenhurst (Ogden), Emsworth (Christy), Winchester (Hewett), Fareham, Wickham (McArthur). Hereford: Leominster (Hutchinson), Tarrington (Wood), Hereford (Chapman). Herts: nr. Hertford (Stephens), Hitchin (Cottam), Hoddesdon (Horley), Tring (Prout). Hunts: Huntingdon (Glenny). Inverness: Ben Nevis (Weaver). Kent: Darenth Wood (Fenn), Dover (Tutt Coll.), Abbey Wood (A. H. Jones). Strood, Cuxton (Tutt), Chattenden (Chaney), Wateringbury (Fremlin), Bexley (Bower), Farnboro' (Alderson), Lyminge (Hills), Eynsford (R. Adkin). Kilkenny: nr. Kilkenny (Kane). Lancs: of frequent occurrence

(Ellis), Grange-over-Sands, Cartmel, Lancs. side of Lake Windermere (Massey), common all over the Fylde district from Preston to Fleetwood (Hodgkinson), Poulton, nr. Blackpool, Carnforth (Clutten), St. Anne's-on-Sea (Baxter), Clevelys nr. Rossall, very common (Moss), Arnside nr. Silverdale (Shuttleworth), between Grange and Carnforth (Mosley), Blackpool, Morecambe (Chappell). LEICESTER: common in the county—Aylestone, Loughborough, Quorn, Harborough, Knighton (Bouskell), Billesdon (Kaye), Swithland, Tilton, Belgrave, Leicester (Dixon). LINCOLN: Lincoln (Carr), Gainsborough (Tearle), Panton, Legsby, Newball, Baumber not uncommon (Raynor). LONDONDERRY: Derry, Magilligan (Campbell). MIDDLESEX: Mill Hill (South), Kingsbury (Godwin), Oxhey (Rowland-Brown). MONMOUTH: Abergavenny (Chapman). NORFOLK: common in mid-Norfolk, rare in west Norfolk—King's Lynn, &c. (Atmore), Norwich, St. Faith's dist. (Thouless), Whitwell, Aylsham (Freeman), Mundesley (Mousley), between Dereham and Foulsham, abundant (Norgate). NORTHAMPTON: Kettering (Trye), Barnwell Wold (Porritt). NORTHUMBERLAND: Twizell (*teste* Robson), Meldon Park (Finlay), Jesmond (Henderson), Newcastle (Maling). NOTTS: Newark (Gascoyne), Cotgrave, Bunny, Weston-on-Trent (Pearson), Nottingham (Fenn). OXON: Henley, Henley Road (Holland). PERTH: Perth, Birman Hill (Wylie). SHROPSHIRE: Whitchurch (Thornewill), Market Drayton (Woodforde). SOMERSET: generally distributed (Hudd), Frome (Fenn), Taunton (Rawlinson), Bath, very common (Greer), Castle Cary, common (Macmillan), Clevedon (Mason), Badyworth (Briggs). STAFFORD: between Newcastle and Market Drayton, Betton (Woodforde), Cannock, nr. Bamtwood (Freer), Loggerheads, nr. Ashley (Daltry). SUFFOLK: very common in the county (Bloomfield), Stowmarket (Stainton), Ipswich, Bentley (Burrows). SURREY: Aldworth (Todd), Box Hill, common (Colthrup). SUSSEX: generally distributed, sometimes common (Jenner), Weald district (Cooke), Lewes (Nicholson), Eastbourne (Bower), Hastings (A. H. Jones), nr. Goodwood (L. Newman), Tilgate (Tugwell), Abbott's Wood (Hawes), Polegate (Russell), Horsham (Image), Guestling, St. Leonards (Bloomfield), Hailsham (Sheldon), Brighton (Merrifield), Shoreham (McArthur). WARWICK: Birmingham (Bath), Leamington (Freeman), Wyre Forest (Abbott), Alcester (Bradley), Rugby (R. Adkin). WESTMORLAND: south of county—Witherslack, Levens (Massey), Windermere (Freeman). WILTS: Salisbury (Ridley), Calne, Bremhill (Eddrupp). WORCESTER: generally distributed throughout the county—Holt, &c. (Rea), Worcester, common (Hancock), Bockleton (Decie), Trench Woods (Wainwright), Cleeve Prior (Wynn), Wyre Forest (Abbott). YORKS: Pickering, abundant (Ash), Nunthorpe, Stokesley, Broughton-in-Cleveland (Lofthouse), Layersthorpe (Helstrip), Sheffield (Thomas), York, abundant (Walker), Askern (Mosley), Bramham (Smith), Easingwold (Tyers), Huddersfield (Inchbald), Ilkley (Birchall), Pontefract (Hartley), Richmond (Harris), Scarborough (Wilkinson), Thirsk (Grassham), Wakefield (Talbot), Wilstrop (Clarke), Rufforth Lane, nr. York, Strensall Common, Sandburn, Elvington (Hewett).

DISTRIBUTION.—ASIA: West and Central Asia to North Persia (Meyrick). AMURLAND (Staudinger). AUSTRO-HUNGARY: Tyrol, not common (Hinterwaldner), Taufers Valley, Innsbruck (Weiler), Bukovina, local and scarce (Hormuzaki), Pressburg (Rozsay), Bohemia, not common (Nickerl), Galicia, distributed (Garbowski), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Brünn (Müller), Freistadt, Linz, Salzburg (Fritsch), Carniola (Speyer), Lavantthal (Höfner), Golnitz (Hudák), Chemnitz (Pabst), Hungary, Kocsocz (Vángel), Epiries, common (Husz), Hermannstadt (Czekelius), Oetzthal (v. Gumppenberg). BELGIUM: Valley of Meuse, nr. Dinant, Valley of the Molignée nr. Warnant, &c. (Lambillion), nr. Liége (Selys). DENMARK: distributed, usually not rare (Bang-Haas). FINLAND: Karelia, Osterbötten (Lampa). FRANCE: throughout—Paris, Bordeaux, Besançon (Berce), Eure-et-Loir, Châteaudun (Guénée), Uriage (Oberthür), Château-du-Loir (de Graslin), Doubs (Bruand), Auvergne dist.—Mont Dore, Randan, St. Florent, Sologne, Nohant (Sand), Eure—Forêt de Beaumont-le-Roger (Védie), Aube (Jourdheuille), Haute-Garonne (Caradja), Thiers, Puy de Dôme, locally common (Guillemot), Morbihan (Griffith), Gironde (Trimoulet), Loire-Inférieure (Bonjour), Saone-et-Loire (Constant), Meuse, Moselle, Meurthe, Lozère, &c. (Speyer). GERMANY: generally distributed—Brunswick, Wolfenbüttel, Helmstedt, &c. (Heinemann), Silesia (Wocke), north-west Germany, almost everywhere (Jordan), Thuringia—Gotha, Siebler Woods, Berlach, Krahnberg, &c. (Knapp), Pomerania—on the Stepenitz turfmoor, nr. Gnageland (Hering), Rhine-Palatinate (Bertram), Würtemberg (Seyffler), Giessen (Dickore), Lower Elbe district (Zimmermann), Waldeck (Speyer), Erfurt (Keferstein), Zeitz-on-Elster (Wilde), Halle (Stange), Munich, common (Kranz), Rudolstadt (Meurer), Mecklenburg (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia (Schütze), Dresden, local (Steinert), Prussia—Königsberg, Pröbernau, common, Dantzig, Insterburg, Saalfeld, &c. (Schmidt), Upper Lusatia (Moeschler), Nassau, common (Rössler), Ratisbon (Schmid), Hartz dist. (Speyer), Coburg (Maurer), Dessau (Richter), Alsace (Peyerimhoff), Wernigorode (Fischer), Hanover, sometimes common (Glitz), Frankfort-on-Oder (Kretschmer), Baden, distributed (Reutti). ITALY: plains and valleys in the north, not common (Curò), Modena (Fiori), northern alps (Staudinger). NETHERLANDS: only in Gelderland, there rare (Snellen), Breda, rare (Heylaerts). ROUMANIA: widely distributed—Tultscha, Domhecken (Mann), Banat (Pavel). RUSSIA: Baltic provinces (Sintenis), Moscow dist. (Albrecht), Wolmar (Lutzau), Volga dist.—Kasan, Baschiria, not rare some years (Eversmann), Sarepta, not rare (Speyer), southern Lapland (Staudinger), southern Russia (Caradja). SCANDINAVIA: not rare to 62° N. lat. (Aurivillius), south-east and central Norway (Siebke), Dovrefjeld (Schöyen), Gothland (Zetterstedt), Skania, Helsingland (Lampa). SWITZERLAND: everywhere from Basle and Schaffhausen to Geneva, the Valais and eastwards to the Grisons (Frey), Valais, Visp Valley, S. Nicolas (Jordan), Engleberg (Baker), Zürich dist.—on the Zürichberg, the Uto, Höngg, Sonnenberg, on the Katzensee (Rühl), Weissenburg (Huguenin), Grisons (Killias), Simplon dist. (Wackerzapp). TURKEY: north-east Turkey (Staudinger), Gallipoli (Mathew). [See also var. *arbusculae*.]

Subfam.: MALACOSOMINAE.

Tribe: MALACOSOMIDI.

This is a very interesting tribe, comprising several closely allied species, so closely allied that they appear to form a single very natural genus, although Kirby has separated *castrensis* and the various offshoots of the dominant species, *neustria*, from the darker-maled species—*alpicola*, *franconica*, and *intermedia*. For ourselves we are convinced that they are much too closely allied for any real generic separation. The group forms the *Malacosomata* of Hübner, who, however, admitted (*Verz.*, p. 192) a very divergent species, *loti* (which was removed later by Rambur, into the genus *Diplura*), into the group.

Genus: MALACOSOMA, Hübner.

SYNONYMY.—Genus: *Malacosoma*, Hb., "Verz.," p. 192 (? 1822); Walk., "List Lep. Het.," vi., p. 1444 (1855); Kirby, "Cat.," p. 819 (1892); Auriv., "Nord. Fjär.," p. 61 (1889); "Iris," vii., p. 137 (1894); Tutt, "Proc. South Lond. Ent. Soc.," pp. 1-11 (1898); Dyar, "Can. Ent.," xxx., pp. 4, 6 (1898); "Ent. Rec.," xi., pp. 141, 142 (1899); Grote, "Illus. Zeits. für Ent.," iii., p. 70 (1898). *Bombyx*, Linn., "Sys. Nat.," 10th ed., i., p. 500 (1758); 12th ed., p. 818 (1767); "Fauna Suec.," p. 292 (1761); Hufn., "Berl. Mag.," ii., p. 402 (1766); Fab., "Sys. Ent.," p. 568 (1775); "Spec. Ins.," p. 181 (1781); "Mant.," ii., p. 115 (1787); "Ent. Sys.," iii., p. 432 (1793); Schiff., "Sys. Verz.," p. 57 (1776); Esp., "Schmett. Eur.," iii., p. 147 (1784); View., "Tab. Verz.," i., p. 37 (1789); Brahm, "Ins. Kal.," ii., p. 337 (1791); Bork., "Sys. Besch.," iii., p. 107 (1790); "Rhein. Mag.," i., p. 369 (1793); Hb., "Eur. Schmett.," iii., p. 145 (? 1800); Schrk., "Fauna Boica," ii., Abth. 1, p. 279 (1801); Haw., "Lep. Brit.," p. 128 (1803); Godt., "Hist. Nat.," iv., pp. 142, 376 (1822); Zett., "Ins. Lapp.," p. 926 (1840); Bdv., "Gen. et Ind.," p. 69 (1840); Boh., "Vet. Ak. Handl.," 1848, p. 133 (1848); Snell., "De Vlind.," p. 189 (1867); Nolck., "Lep. Fn. Estl.," p. 127 (1868); Staud., "Cat.," 2nd ed., p. 68 (1871); "Hor. Soc. Ent. Ross.," xiv., p. 356 (1877); "Stett. Ent. Zeit.," xlviii., p. 98 (1887); "Rom. Mém. Lép.," vi., p. 314 (1892); Newm., "Brit. Moths," p. 42 (1869); Mill., "Cat. Lép. Alp.-Mar.," p. 57, *note* (1871); p. 192 (1875); "Iconog.," iii., pl. 134 (1877); Christ., "Hor. Soc. Ent. Ross.," x., p. 36 (1873); Curò, "Bull. Soc. Ent. Ital.," viii., p. 149 (1876); Oberth., "Etudes d'Ent.," iii., p. 44 (1878); vi., p. 75 (1881); xiii., p. 29 (1890); Frey, "Lep. der Schweiz," p. 95 (1880); Standf., "Stett. Ent. Zeit.," xlv., p. 193 (1884); Lampa, "Ent. Tids.," vi., p. 41 (1885); Rühl, "Soc. Ent.," v., p. 170 (1891); Carad., "Iris," viii., p. 90 (1895); Reutti, "Lep. Bad.," 2nd ed., p. 57 (1898). *Phalaena*, Scop., "Ent. Carn.," p. 199 (1763); Fuessly, "Verz.," p. 34 (1775); "Neu. Mag.," ii., p. 335 (1785); iii., pp. 148, 157 (1786); Göze, "Ent. Beit.," iii., (2), p. 317 (1781); Geoff., "Fourc. Ent. Paris," ii., p. 262 (1785). *Lasiocampa*, Schrk., "Fauna Boica," ii., Abth. 2, p. 155 (1802); Latr., "Genera," iv., p. 218 (1809); Germ., "Prod. Sist. Bomb.," p. 48 (1811); Meig., "Eur. Schmett.," ii., p. 206 (1830). *Trichoda*, Hb., "Tentamen," p. 1 (1806). *Gastro-*

pacha, Ochs., "Die Schmett.," iii., p. 294 (1810); H.-Sch., "Sys. Bearb.," ii., p. 101 (1847); Hein., "Schmett. Deutsch.," p. 201 (1859). *Clisiocampa*, Curt., "Brit. Ent.," expl. pl. 229 (1828); "Guide," p. 142 (1829); Stphs., "Illus. Haust.," ii., p. 49 (1828); "Cat. Brit. Ins.," p. 48 (1829); "List Br. An. Br. Mus.," v., 1st ed., p. 47 (1850); 2nd ed., p. 43 (1856); Wood, "Ind. Ent.," no. 51 (1839); Dup., "Cat. Lép. Eur.," p. 75 (1844); Humph. and Westd., "Brit. Moths," 2nd ed., p. 54 (1851); Walk., "List Lep. Het.," vi., p. 1485 (1855); Sta., "Man.," i., p. 156 (1857); Humph., "Gen. Brit. Moths," p. 26 (1860); Rbr., "Cat. Lép. And.," p. 346 (1866); Wallgrn., "Skand. Het.," ii., p. 72 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 411 (1874); Guén., "Lép. Eure-et-Loir," p. 81 (1875); Kirby, "Eur. Butts.," &c., p. 131 (1880); "Cat.," p. 839 (1892); "Handbook," &c., iv., p. 123 (1897)," Buckl., "Larvæ," etc., iii., pl. 1 (1889); Auriv., "Nord. Fjär.," p. 62 (1889); Ström, "Danm. Somm.," p. 83 (1891); Hamps., "Fauna of India," i., p. 417 (1892); Meyr., "Handbook," p. 322 (1895); Tutt, "Brit. Moths," p. 59 (1896); Barr., "Lep. Brit.," iii., p. 13 (1896); Dyar, "Can. Ent.," xxx., p. 6 (1898). *Cliseocampa*, H.-Sch., "Samm. Auss. Schmett.," p. 9 (1856).

Hübner's diagnosis of the genus (*Verzeichniss*, p. 192) reads as follows:

6. Verein, Coitus 6. Malacosomaten, *Malacosomata*.—Die Schwingen mit zwei fast geraden Linien gezeichnet; die Senken zeichenlos; beyderley fast bunt gefränzt—*Malacosoma loti*, Ochs., *castrensis*, Linn., *neustria*, Linn., *disstria* (*neustria*, Abb., *Lep.*), *franconica*, Schiff.

Trichoda, Hb., *Tent.*, p. 1 (1806), would of course be the proper generic name for this group, were it not that the name was preoccupied. This being so *Malacosoma* appears to be the oldest appellation available. Aurivillius observes that, with the exception of *loti*, the species included by Hübner in *Malacosoma* are very closely related, and cannot be generically separated, and adds: "If it were possible I would gladly use the hitherto little known name of *Malacosoma* for *loti*, and Curtis' name, *Clisiocampa*, for *neustria*, but as Hübner's diagnosis—'the forewings marked with two nearly straight lines, the hindwings without markings, both pairs of wings with somewhat chequered fringes'—really only applies to *neustria* and *castrensis*, it appears to me to be impossible to declare *loti* to be its type. We are, therefore, unfortunately obliged to sink *Clisiocampa* before *Malacosoma*. It matters nothing that Walker and Kirby have applied the name only to *franconica*, *intermedia* and *alpicola*, since these species cannot be separated generically from *neustria*." Walker practically fixed *franconica* as the type of the genus in 1855, by isolating it in this genus, and Kirby, in 1892, followed this view by pointing out *franconica* as the type. This action appears to render nugatory that of Aurivillius, who, in 1894, indicated *neustria* as the type. Aurivillius (*Iris*, viii., p. 137) gives the following as the chief characters of the genus:

Imago: Eyes naked or hairy; palpi medium or rather small, distinct, projecting obliquely, or almost hanging, shaggily haired; forehead without protuberance; wing-margins entire, with short, entire fringes; forewings with costa straight nearly to the apex, hind margin short, weakly arched, the outer margin more or less strongly arched, the hinder angle broadly rounded off; hindwings with costa "ventricose" at base, then straight or weakly arched, the outer margin moderately arched; legs, femora, and tibiæ with long hairs; tarsi with appressed scales or on the outer side of the first joint hairy (*neustria*); front tibiæ unarmed; middle and hind tibiæ with tiny terminal spurs; ♂ antennæ with long pectinations; ♀ antennæ with moderate (*neustria*) or short pectinations. Larva: The larvæ are cylindrical, with thin and soft hairs, without distinct warts and without "felt-hairs." Pupa: The pupæ are clothed with short soft hairs; they are rather slender, and posteriorly produced into a thick, blunt conical cremaster; rest in a soft, thin cocoon mixed with yellow dust.

Malacosoma is a very natural genus, and *M. neustria*, if one may judge from the distribution of the normal form and the large number of closely allied species directly evolved therefrom, is the predominant species. We suspect, however, that *M. neustria* and its very closest allies are the most newly developed forms, whilst the polymorphic *M. castrensis* appears to be, in some respects, the more ancestral. The imago of the latter species shows the generalised basal oval mark, commencing on the costa of the forewings and curving round to the thorax, although occasional specimens have this mark developed into a well-defined, moderately straight basal line, reaching to the inner margin as in *M. neustria* and its offshoots. (*M. azteca* from Vera Cruz has also the curved basal line.) The sexual dimorphism of the species of this genus is most marked, and the dark rust-red or red-brown unicolorous females of *M. neustria*, *M. castrensis*, *M. alpicola* and *M. franconica* are so similar, that it is somewhat difficult to refer certain individuals to their proper species, and one is inclined to suspect this female type to be the ancestral form of the genus. *M. alpicola* and *M. franconica* are both evidently specialised offshoots of *M. castrensis*, *M. alpicola* having a similar curved generalised basal mark on the forewings, whilst in *M. franconica* it appears to cross to the inner margin although it is frequently lost before reaching the edge of the wing. This character of *franconica* is maintained in hybrid *castrensis* × *franconica* bred by Standfuss, in which particular the examples follow *franconica* and not *castrensis*. A fine dark male of *M. castrensis* in the British Museum coll. (Frey coll.) gives an excellent clue as to the line taken in the specialisation of the dark coloration of *alpicola* and *franconica*, for the olive-brown shading that largely covers its wing is not at all unlike the final tint reached in these species. *M. alpicola* and *M. franconica* are very closely allied, but *M. alpicola* is much more densely scaled in both sexes, the male is darker, the transverse line better developed, the basal line somewhat curved, the hindwings also densely scaled, and with a pale shade—all characters that place it near *M. castrensis*. The male of *M. franconica* is almost transparent over the greater part of the area of the wings, the fasciæ are almost obsolete, the outer fascia commences nearer the apex, the nervures are darker, and the transverse shade of the hindwings is lost in the transparency of the discal area, whilst the males of both species retain the chequered fringe of *M. castrensis*. The females of both are unicolorous, those of *alpicola* more dense, and vary from orange-red to deep red-brown (rarely with indistinct markings traceable), whilst those of *franconica* are more uniformly tinted in rust-brown, much more translucent, and thinly scaled. In most respects both species much more nearly resemble *M. castrensis* than *M. neustria*, although all are really very close.

The "*neustria*" group is an exceedingly interesting one, the species with sufficient similarity to make any but an expert doubt their specific distinctness. Thus *M. californica* has a fine brick-red male, with yellowish base and a yellow outer transverse line edging the median band, the female being yellowish; *M. americana* males are of a deep red-brown colour with grey transverse lines, and those of *M. disstria* of a brighter red, with a fairly defined but only slightly darker median band (in some cases unicolorous). *M. azteca* (from Mexico) is another well-defined, dull, grey-brown species that might easily be considered a strong local race of *M. neustria*, except for the direction of the basal line, and apparently with a common ochreous aberration. The Japanese *M. testacea* is by common consent now considered to be specifically identical with *M. neustria.*

Having already noted the chief points of difference between *M. castrensis* and the allied *M. alpicola* and *M. franconica,* we may now mention the hybrids that Standfuss has obtained between the three species, *castrensis, franconica,* and *neustria.* A pair of the crosses between *franconica* and *castrensis* are in the British Museum coll. The ♂ shows in the deepening ground colour, the darker nervures, the direction of the transverse lines, and in the thinning of the scaling in the median areas of the wings, an approach to *franconica.* On the other hand, the distinctly denser scaling (compared with *franconica*) is unquestionably derived from *castrensis.* The female also exhibits distinct intermediate characters—the large more elongated forewings and the smooth unicolorous appearance of the wings suggest *franconica,* whilst the barely traceable central band and the dense scaling are indicative of *castrensis.* Standfuss' interesting account of breeding these and other hybrids reads (*Stett. Ent. Zeit.*, xlv., pp. 193, 194) as follows :—

(1) *Malacosoma neustria* ♂ and *franconica* ♀.—In the Roman Campagna larvæ of *M. franconica* are exceedingly common. In 1884, from June 10th onwards, many females of this species emerged, and as *M. neustria* males were coming in hundreds to light, endeavours to pair the two species were made and were successful in a number of cases. Copulation lasted at most from 5-15 minutes, and the females immediately sought with the ovipositor a suitable place on a dry twig on which to oviposit. Thus far all the females acted similarly, but then differences occurred. Four fertilised females, having apparently obtained a good position, vainly endeavoured to deposit their eggs, and fell to the ground without laying a single one, and died in from three to four hours ; it was assumed, as this never happened when the ♀ of *franconica* was very large, or the ♂ of *neustria* very small, that this was due to the unsuitability of the organs of copulation and that the ♂ sexual organ of *neustria* was ordinarily too long. In other cases the fertilised females laid all their eggs quite normally, properly arranged. An intermediate condition was noticed in some instances, *viz.*, that the female, after copulation, laid no eggs or at most 6-12, then left the twig and commenced to "call" again vigorously ; after copulating a second time the ♀ then laid, so far as could be judged, all her eggs. The eggs laid by these females (whether paired once or twice) were all fertile, as proved by an examination in September, when they were found to contain living larvæ. It appears as if these species cannot lay infertile eggs. Five batches of from 400-600 eggs each were laid. Of these, in spite of the eggs containing living larvæ in September, the following numbers only hatched—0, 15, 23, 65, 151. Most of the larvæ failed to escape from the egg-shells, and even of those that did, several died without even commencing to feed. Only a dozen larvæ reached full-growth, but these all produced well-developed moths. The larvæ varied remarkably, and represented almost all transitions from *neustria* to *franconica,* yet the imagines are all essentially alike.

a. hybr. *caradjae*, Stdfss., "Handbuch, &c.," p. 62, pl. iii., fig. 3 (1896).—Wing expanse 26mm.-28mm., intermediate between *neustria* and *franconica.* The forewings dark brown throughout except that the median band is bordered on both sides with a yellow line scarcely 1mm. in width; on the brown hindwings there is sometimes a paler median line indicated; on the underside of both wings, however, a light central band is always traceable. The wings are not so transparent as in *franconica*, but more so than in *neustria*, especially the forewings. The thorax and body are brownish-yellow, the former always of a lighter tone of colour than the latter. On the hindwings, on nervures 3 and 4, the fringes, which are yellow in *franconica*, are brown as in *neustria*. One is reminded most of *franconica* by the contrast of the colour of the wings on the one hand and the thorax and abdomen on the other, and the perceptibly transparent wings. The points that most remind one of *neustria* are the distinct yellow border of the central band of the forewings and the dark fringes on nervures 3 and 4 of hindwings (Standfuss).

(2) *Malacosoma neustria* ♂ × *castrensis* ♀.—At the same time as the former experiments in crossing *neustria* and *franconica* were being carried out, *M. castrensis* var. *veneta* was emerging, and *neustria* ♂ s were paired with ♀ s of the latter. The same three points as to egg-laying noted under *neustria* × *franconica* were observed, *viz.*, some of the ♀ s were unable to discharge their eggs and died, others laid their full quantity of eggs at once, whilst others did so after a second pairing. Of these, four batches were obtained, and the larvæ developed much more favourably. Each of the four batches numbered from 400-600 eggs, the numbers of larvæ emerging being respectively 120, 143, 161, 204. The larvæ at first seemed to feed well, but gradually after the first, second, and especially the third, moults, died off, so that finally only a dozen hybrids emerged, curiously enough all females—or, to speak more correctly, a form with the external appearance of ♀ s. Some of these hybrids were crippled, and the body of one on being opened was found to contain the rudiments of an ovipositor and an extraordinarily developed mass of fat (a quite unusual occurrence in Lachneid females). This form is noted as follows:—

β. hybr. *schaufussi*, Stdfss., "Handbuch, &c.," p. 63, pl. iii., fig. 4 (1896).—The markings of the hybrid *neustria* × *castrensis* are intermediate between those of the two species, the inner transverse line making a small pointed angle into the median band (more rarely a small curve) just before reaching the costal margin. This is the only point, perhaps, worth noticing, for the females of *neustria* and *castrensis* scarcely differ at all in wing form, and the only constant difference appears to be in the boundary lines of the median band; in *castrensis* the inner line makes a considerable bend into the band before the costa, in *neustria* this is absent (Standfuss).

(3) *Malacosoma franconica* ♂ × *castrensis* ♀ and the reciprocal cross *M. castrensis* ♂ × *franconica* ♀.—These reciprocal crosses were obtained by both Standfuss and Penzig. In neither of these crosses did the ♀ s die without egg-laying as a result of the pairing, although unfortunately after living some time several of the ♀ s laid no eggs. Two necklets of eggs were obtained of *castrensis* × *franconica*, from which 70 and 92 larvæ were obtained, but they all died without eating anything except the eggshells. Of *franconica* × *castrensis* a batch of 400 eggs produced 120 larvæ, of which only three reached maturity, and of these only one pupated, which yielded a crippled ♀. This is described as follows:—

γ. hybr. *penzigi*, *n. hybr.*—The central band always wanting in *franconica* was here weakly indicated, but of the form of wing the crippling prevents anything to be said. The ovipositor also was in this extremely ill-developed and the fat-body prominent (Standfuss).

Selmons records (*Soc. Ent.*, January, 1894) that he obtained a pairing between *M. alpicola* ♂ and *M. castrensis* ♀. Only three eggs were laid and these infertile. He also obtained seven pairings between ♂ *M. castrensis* and ♀ *M. alpicola*, and four of the females deposited a large number of eggs, all of which proved infertile.

The natural history of the Malacosomas is exceedingly interesting. The *eggs* are laid closely upon each other round and round a twig in a very close spiral, with the micropylar ends free, *i.e.*, those opposite the apparent point of attachment to the twig (*vide, anteà*, p. 435), the whole embedded in a thick liquid gum. The batch of eggs thus forms a sort of necklet, which can readily be slipped off the twig when it contracts on drying. Concerning the source of this gum (in *M. neustria*), Reaumur writes (*Mém.*, ii., p. 97): "J'en ai ouvert pour voir si je trouverois dans leur corps le réservoir de cette gomme brune qu'elles employent en si grande quantité; je n'ai pû la méconnoître, je l'ai trouvée dans cette vessie double, ou plutôt ces deux vessies que nous avons dit avoir communication avec l'anus. Ces réservoirs sont bien plus grands dans notre papillon, que dans d'autres papillons qui le surpassent considérablement en grandeur. Avant qu'il ait commencé à faire ses œufs, ces réservoirs sont remplis d'une matiere trop épaisse pour que le nom de liqueur lui convienne, elle a la consistance d'une bouillie — et sa couleur est très-brune; en un mot, il est visible que ces vessies sont remplies de la gomme fondue dont le nid doit être construit, de celle dans laquelle les œufs doivent être enchâssés. L'usage de ces vessies bien connu, nous apprend que les vessies semblablement placées qu' on trouve à tant d'autres papillons, fournissent la liqueur qui humecte leurs œufs lorsqu'ils sont près de sortir, et qui les attache contre les corps sur lesquels ils sont déposés. Mais la quantité de la liqueur contenue dans ces réservoirs ne doit pas être sensible, lorsqu'il n'en faut fournir que pour humecter légèrement les œufs." The *larvae* live gregariously and form large silken nests on the branches of various plants, a habit that has given rise to the popular American name of "tent" caterpillars for these larvæ, although the North American species, *disstria*, *erosa*, and *thoracica* are said to be tentless. Dyar divides (*Can. Ent.*, xxv., p. 37) the larvæ of the North American species of this genus into two groups: (1) The species whose larvæ do not spin a nest—*M. disstria, M. erosa, M. thoracica.* (2) Those that do spin a nest—including all the remaining species. The larvæ of the first group rest in companies on the trunk without covering, those of the second, with the possible exceptions of *M. constricta* and *M. incurva*, are all nest-spinning, their webs being formed in the forks of the smaller branches or twigs. The "Eastern region," from the eastern slope of the Rockies to the Atlantic, has two species, one belonging to each group, *viz.*, *disstria* and *americana*. The "Pacific north-west," from the Cascade Mountains to the Pacific, has also two, one to each group, *viz.*, *erosa* and *pluvialis*, but the latter, which takes the place of *americana*, is not its representative, as *erosa* is of *disstria*. The "Central arid region" has but one species, unless *incurva*, described from Arizona, be found throughout the range of *fragilis*. *M. fragilis* is the only species not a tree-feeder, and this habit has evidently been induced by the absence of deciduous trees in its habitat. California has five endemic species, unless it be that *thoracica* is the same as *erosa* of Oregon. Rivers' description of the former recalls the latter most vividly, but he makes no mention of the broad subdorsal blue band so distinct in the larva of *erosa*. Grote says (*Ent. Rec.*, vi., p. 112) that, as species are now understood, it is clearly an impossibility, to consider some of the American Malacosomas distinct species, since the names can only be applied with certainty to the larvæ and bred moths. He illustrates his contention by means of *M. californica*, which inhabits the coast region of California and the Pacific north-west, and which, he states, is made into three species by Dyar on larval peculiarities, *viz.* :—

(1) A dorsal pale line, sometimes obsolete:
  Lateral blue region heavily shaded .. .. .. *ambisimilis.*
  Lateral region with no blue shade .. .. .. *californica.*
(2) A dorsal row of elliptical blue spots.. .. .. .. *pluvialis.*

We are not in a position to question the specific identity or distinctness of these insects, but we mention the subject here because of the importance of fully allowing for larval variation, which is somewhat extensive in this and allied genera. The solitary habit appears to be adopted by the larvæ of all the species in the last stadium. The European species that feed on low plants, *M. castrensis*, *M. alpicola*, &c., still keep up the gregarious habit, and construct silken streets. On the high Alps, that form the habitat of the latter species, at from 6000ft.-7000ft. elevation, the silken paths may be observed in the grass, the dewdrops on them glittering in the sun, and by following them up one readily finds the community, for although living solitarily in their last instar they rarely spread to the extent that the tree- and shrub-feeding species appear to do. It is very interesting to watch the movement of the full-grown larva of *M. alpicola*, for it alternately hides and exposes a narrow zone between the segments, the anterior segment sliding backwards over it, and this small portion is bounded on each side by rows of minute glistening white points at the bottom of fine sulci. The *newly hatched larva* shows many generalised characters, i much larger than ii, the latter bearing as a rule only two small chitinous-based setæ, iii forms a single-haired chitinous-based tubercle, whilst iv and v are represented by a double generalised tubercle bearing two setæ; the hairs are usually serrated, the head blackish and shiny. The principal characters of the Malacosomid *larva* (specially noted from *M. alpicola*), are: The head only just less than the prothorax, covered with short hairs, an aggregation of minute black spots on the head, some variation in the number of ocelli (of which there are six normally, but may be only four); the marked spinneret; the prolegs consist of two large basal rings of soft tissue, and then a long extensile segment carrying a row of about 24 strong brown hooks; the development of the prothoracic "ear-tubercles;" the longitudinal disposition of the lines. The larva is clothed with hairs but not sufficiently dense to obscure the tint of the larval skin which gives the larva its colour, and it appears impossible to trace the tubercles in a full-grown larva. There is a moderately well-developed marginal flange which, at the anterior portion of each segment, rises considerably above the level of the spiracles. The anal plate is well-defined (blue in *alpicola*). The Malacosomid *cocoon* is thin and papery in texture, usually well intermixed with yellow particles of aragonite, secreted by the Malpighian tubules and plastered on the inside of the walls, badly fed or starved larvæ spinning white cocoons without the characteristic colouring matter distributed through them. This material gives a peculiar appearance to the pupa, for the fine yellow powder appears to be loosened by the movement of the pupa, and to be spread over the latter, collecting, however, more thickly where the hairs are strongest and most numerous. This appearance is only to be equalled by that of certain

Eutrichid pupæ. The chief characters of the *pupa* (taken from *M. alpicola*) are as follows: ♂. The surface of the skin appears to be covered with fine raised points. The mouth-parts consist of a labrum, mandibles (on the outer edge of the labrum), a wide labium and labial palpi, which are median to the maxillæ. The central pair of the structures below the mouth-parts, appears to be the femora of the first pair of legs, whilst outside these are the first pair, arranged in the usual form, a narrow strip between these and the terminal half of antenna is all that appears of the second leg, except the tarsal tips that project just beyond the antennæ. The third pair of legs does not appear to be visible; the antennæ are very large, and form an abrupt bend round the tip of the first legs. The face-parts are produced on either side much below the mandibles, and hang down like lappets, whilst the glazed eye is barely visible against the antennæ; a few hairs are situated on the vertex of the head and another little brush above the labrum. The wings reach almost to the end of the 4th abdominal segment, there is a distinct Poulton's line, and the hindwing is almost entirely covered by the upper. The prothoracic spiracle forms a rather long slit in the usual position, those on the 1st and 2nd abdominals are covered by the wings, the rest are oval wrinkled depressions without obvious lumina, that on the 8th is of course aborted. The narrowing of the abdominal segments from the 6th abdominal to anus, and the narrowness of the 6th and 7th segments ventrally, throw the three terminal segments forwards and give them a peculiar appearance for Lachneid pupæ. The pupa is covered densely with fine short brown hairs, more abundant dorsally than ventrally, but quite wanting on the appendage-covers and the ventral aspect of the last three segments. The anus is marked by two large rounded projections with a deep sulcus between them, which is placed quite ventrally, whilst beyond it is a large rounded cremastral boss covered with stouter hairs than those on the dorsum of the rest of the pupa. The dorsal head-piece is well-developed, roughly triangular (as also is the prothorax), the dorsal head-piece and prothorax forming the front of the pupa, the head being ventral. ♀. The female pupa agrees generally with that of the male, but the angle that the three terminal segments form with the rest of the pupa is much less obvious, whilst the genital organs are represented by a median sulcus on the 8th abdominal ventrally, and two small tubercles at its posterior margin, the anterior margin of the 9th segment having a similar sulcus and two tuburcles. The cremastral boss is much less fully rounded than in the male; the glazed eye is better seen. The second pair of legs is more fully exhibited, whilst the antennæ hardly reach down as far as the first pair of legs; the wings reach to about the middle of the 4th abdominal segment, exposing the leg-scars of that segment, whilst the spiracles form a distinct sulcus with a raised margin, the whole placed in a slight hollow. The *imagines* present many points of interest—the great difference in the sexes, the almost polymorphic variation of certain of the species, the abundance of certain of them at light, and the peculiar habits which, in spite of the great abundance of some of the species, lead us to confess that we have rarely seen them wild (except at light). Light has a fatal attraction for many of the species—*M. neustria* occurs sometimes in hundreds at the lamps on Wicken Fen. Slingerland records (*Can. Ent.*, xxv., pp. 81-2) the capture of 513 males and 88 females of *M.*

americana at the "trap lanterns" of the Cornell Agricultural Experiment Station, between June 17th and July 18th, 1889, whilst Dyar notes (*Psyche*, 1891, p. 126) the capture of 2416 specimens of the same species, in five visits, paid between June 14th and July 9th, 1891, to the electric light globes at Poughkeepsie, N.Y. Standfuss observes (*Handbuch*, &c., p. 119) that *M. castrensis*, *M. neustria*, and *M. franconica* each lay from 400-600 eggs. He further notes that in 1884 he reared 405 examples of *M. castrensis*, of which 207 were males, and 198 females. When the latter species was abundant on the Essex marshes in 1896, Whittle bred a large number, the females being as $3\frac{1}{2}:1$ compared with the males. Of 70 bred in 1890, the females outnumbered the males by more than four to one.

Our two British species have an almost Palæarctic distribution, *M. castrensis* extending into central Asia and Amurland, whilst *M. neustria*, in a form scarcely distinguishable from our own examples, abounds in Japan and China, and the slight modifications that it has undergone in North America, afford excellent material for study; yet the distribution of both these species within the limits of the British Islands is at present totally inexplicable. Why *M. castrensis*, that extends well into Scandinavia and Finland, should be restricted in Britain to the flooded marshes around the mouths of the Thames and Medway, where it is in amazing abundance in some seasons, is quite incomprehensible, nor does Chapman's explanation (*Ent. Rec.*, xi., p. 62) that it appears to require flooded areas, help us much when we consider its habitats in other parts of its range. Still more remarkable is the sudden failure of *M. neustria* in our northern English counties, and its entire absence in Scotland, for it swarms in countless numbers in many seasons in certain places in the counties which practically form its northern limits—Carnarvon, Denbigh, Leicester and Lincoln. These are matters that still require to be elucidated by the British lepidopterist.

The genus *Malacosoma* is essentially Palæarctic and Nearctic. The only species outside these areas would appear to be *indica* from the East Indies, and *bilineata* (doubtfully a *Malacosoma*) from Senegambia. The following list of species in the genus has been taken from the works of Kirby and Dyar:

M. alpicola, Staud.	Alps of C. Europe.
M. ? flavomarginata, Pouj.	Mou-Pin.
M. castrensis, Linn.	Europe, N. and W. Asia.
M. intermedia, Mill.	South France.
M. franconica, Esp.	S. Europe and W. Asia.
M. neustria, Linn.	Europe to Japan.
M. testacea, Motsch.	Japan.
M. luteus, Oberth.	Algeria.
M. indica, Walk.	East Indies.
M. americana, Fab.	Florida to Canada.
M. fragilis, Stretch	Rockies—Central arid region of Colorado.
M. pluvialis, Dyar	The Pacific North-west.
M. ambisimilis, Dyar	California and Colorado.
M. californica, Pack.	California (coast).
M. constricta, Stretch	California (hills).
M. strigosa, Stretch	Yosemite Valley.
M. erosa, Stretch	The Pacific North-west.
M. thoracica, Stretch	California and Colorada.
M. incurva, H.-Edw.	Arizona.
M. disstria, Hb.	Mississippi valley to Atlantic.
M. mus, Neum.	S.-W. Utah, Mexico.

M. azteca, Neum... .. .. .. Mexico.
M. ? bilineata, Mab. .. .. .. Senegambia.
M. ? subfasciata, Klug .. .. .. Alexandria.

MALACOSOMA CASTRENSIS, Linné.

SYNONYMY.—Species: *Castrensis*, Linn., "Sys. Nat.," 10th ed., p. 500, no. 20 (1758); 12th ed., p. 818, no. 36 (1767); Hufn., "Berl. Mag.," ii., p. 402, no. 10, p. 433 (1766); Fuessly, "Verz.," p. 34 (1775); "Neu. Mag.," ii., p. 335, no. 147 (1785); iii., pp. 148, 157 (1786); Fab., "Sys. Ent.," p. 568, no. 43 (1775); "Sp. Ins.," p. 181, no. 59 (1781); "Mant.," ii., p. 115, no. 71 (1787); "Ent. Sys.," iii., p. 432, no. 80 (1793); Schiff., "Sys. Verz.," p. 57 (1776); Göze, "Beit.," p. 317 (1781); Esp., "Schmett. Eur.," iii., p. 147, pl. xxviii., figs. 1-7 (1784); Vill., "Linn. Ent.," p. 134 (1789); View., "Tab. Verz.," i., p. 37 (1789); Bork., "Sys. Besch.," iii., p. 107, no. 29 (1790); "Rhein. Mag.," i., p. 369, no. 227 (1793); Brahm, "Ins. Kal.," p. 337 (1791); Hb., "Eur. Schmett.," iii., p. 145, pl. xl., figs. 177, 178 (? 1800); "Larvæ Lep.," iii., Bomb. Q. a.b. figs. *2a-b* (? 1805); Schrk., "Fauna Boica," ii., Abth. 1, p. 279, no. 1466 (1801); Abth. 2, p. 155, no. 16 (1802); Latr., "Genera, &c.," p. 219 (1809); Ochs., "Die Schmett.," iii., p. 294 (1810); Godt., "Hist. Nat.," iv., pp. 142, 376, pl. xiii., figs. 5-6 (1822); Curt., "Brit. Ent.," v., expl. pl. 229 (1828); "Guide," p. 142 (1829); Stphs., "Illus. Haust.," ii., p. 48 (1828); "Cat. Brit. Ins.," p. 48 (1829); "List Br. An. Br. Mus.," v., 1st ed., p. 47 (1850); 2nd ed., p. 44 (1856); Meig., "Eur. Schmett.," ii., p. 206 (1830); Wood, "Ind. Ent.," no. 51 (1839); Bdv., "Gen. et Ind.," p. 69, no. 564 (1840); Zett., "Ins. Lapp.," p. 926 (1840); Dup., "Cat. Lép. Eur.," p. 75 (1844); H.-Sch., "Sys. Bearb.," ii., p. 105 (1847); Humph. and Westd., "Brit. Moths," 2nd ed., p. 54, pl. x., figs. 9-10 (1851); Frr., "Neu. Beit.," i., p. 100., pl. 1 (1833); Sta., "Man.," i., p. 156 (1857); Hein., "Schmett. Deutsch.," p. 209 (1859); Humph., "Gen. Brit. Moths," p. 26 (1860); Rbr., "Cat. Lép. And.," p. 346 (1866); Snell., "De Vlinders," p. 189 (1867); Nolck., "Lep. Fn. Est.," p. 127 (1868); Wallgrn., "Skand. Het.," ii., p. 80 (1869); Newm., "Brit. Moths," p. 42 (1869); Staud., "Cat.," p. 68 (1871); "Hor. Soc. Ent. Ross.," xiv., p. 356 (1877); "Iris," v., p. 352 (1892); Chris., "Hor. Soc. Ent. Ross.," x., p. 36 (1873); Bang-Haas, "Nat. Tids.," (3), ix., p. 411 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 192 (1875); Curò, "Bull. Soc. Ent. Ital.," viii., p. 149 (1876); Frey, "Lep. der Schweiz," p. 95 (1880); Lampa, "Ent. Tids.," vi., p. 41 (1885); Buckl., "Larvæ, &c.," iii., pl. l., figs. 1, 1*a*, 1*b*, 1*c* (1888); Auriv., "Nord. Fjär.," p. 62 (1889); "Iris," vii., p. 139 (1894); Kirby, "Cat.," p. 838 (1892); Carad., "Iris," viii., p. 90 (1895); Meyr., "Handbook," p. 322 (1895); Tutt, "Brit. Moths," p. 59 (1896); "Proc. Sth. Lond. Ent. Soc.," pp. 1-11 (1898); Barr., "Brit. Lep.," iii., p. 17 (1896); Dyar, "Can. Ent.," xxx., pp. 4, 6 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 70 (1898); Reutti, "Lep. Baden," 2nd ed., p. 57 (1898). *Neustria* var. β, Linn., "Faun. Suec.," p. 292, no 1102 β (1761). *Castrensus*, Haw., "Lep. Brit.," p. 128, no. 86 (1803).

ORIGINAL DESCRIPTION.—*Phalaena* (*Bombyx*) elinguis, alis reversis griseis: strigis duabus pallidis; subtus unica. ["Fn. Suec.," 831; Frisch, "Ins.," 10, t. 8; Roes., "Ins.," 4, t. 14; De Geer, "Ins.," 1, t. 13, figs. 4-6.] Habitat in *Salicibus*, *Pilosella*, *Jacea*, *Alchemilla*, *Euphorbia*, polyphaga, pascitur sub tela, gregaria, migratque sæpius novo tentorio; ova, more præcedentis (*neustria*), in annulos conferta circum arborum ramulos. Larva pilosa, maculata (Linné, *Syst. Nat.*, xth ed., p. 500). To this Linné adds: "Fn. Suec.," ii., no. 1102. He also modifies his description of the habits omitting "arborum," so that the eggs are laid "in annulos conferta circum ramulos," and says, "Haec frequens in Suecia, duplici colore occurrit, eadem tamen, diversa a præcedenti, cum illa arborea, hæc terrestris. Larva pilosa, subcærulea lineis utrinque 2 lateralibus ferrugineis approximatis et dorsali 1 utrinque, lata nigro maculata; abdomen albo utroque maculatum; caput cinereum. Alarum fasciæ duæ, absque puncto" (*Syst. Nat.*, xiith ed., p. 819).

IMAGO.—Anterior wings pale ochreous with a brownish transverse basal streak that fails to reach the inner margin, but curves round to the thorax, a second transverse line just outside the centre, and beyond this a transverse submarginal shade; cilia with two dark patches on outer margin. Posterior wings unicolorous reddish- or coppery-brown, a faint median transverse shade; cilia pale.

Sexual dimorphism.—The males differ entirely from the females in their smaller size, averaging 28mm.-34·4mm. against 35mm.-40mm., their strongly pectinated antennæ, the squarer-shaped wings, the character of the transverse markings which usually form dark lines in the males, and pale fasciæ in the females, as well as in the generally paler ground coloration. The small robust build of the males denotes a rapid flying habit, which appears quite impossible to the larger, rounder-winged females with their heavy egg-filled abdomina.

Gynandromorphism.—Several gynandromorphous examples appear to have been described. The following are those we have discovered:

α. A specimen with the left half having the appearance of a pale male, the right half that of a dark female; the division of colour on the thorax very apparent. The upper part of abdomen of the same colour as is usual in female specimens, but beneath it is longitudinally divided into dark and light, as also are the legs (Ingall, *Entom.*, xxviii., p. 42).

β. A specimen in which neither side is definitely male nor female, in general, the male sex predominates; head pale yellow; left side a ♂ antenna and ♀ wings, right side a ♀ antenna and ♂ wings. The collar yellow-haired, on the right side mixed with brown; the thorax yellow-haired, on the left side and to a limited extent in the centre, with the brownish hairs of the ♀. The right hindwing in form and colour ♂. The right forewing male in colour, but very slightly larger, the base and costa with brown scaling, similar to the brown colour of the ♀ body. The left wings ♀, but not quite fully developed. In the Berlin Museum coll. From Kirstein's coll. Probably bred (Schultz, *Illus. Wochenschrift für Ent.*, i., p. 381).

γ. I have in my collection a hermaphrodite *Bombyx castrensis*, bred by me in July, 1829. Having reared the caterpillar with a number of others of the two sexes, . . . I was surprised to find this individual presenting distinctly the two sexes [Duval, *Ann. Mag. Nat. Hist.*, iv., p. 150 (1831)]. A figure of the specimen is given which shows the right antenna, and the right pair of wings distinctly male, the left antenna and left pair of wings as distinctly female. The abdomen in the drawing (fig. 26) looks entirely female, although the thorax is clearly bisected by a line separating two quite differently coloured halves.

δ. A gynandromorphous example of *M. castrensis* var. *veneta*. The left side ♂, right side ♀, in marking, colour, and size of wings. as well as in the antennæ. Body male in form. Right wings 18mm., left wings 15mm. Bred by Standfuss at Monte Rotondo, near Rome, in 1882, now in Wiskott's coll. (Schultz, *Illus. Wochenschrift für Ent.*, i., p. 382, ii., p. 413).

ε. Left side ♀, right ♂. On the upper and under side the characters of the two sexes sharply separated. The left female wing considerably larger than the right male wing, being 15mm. and 11mm. respectively. The colour-distinction on the thorax and abdomen, both on upper and under side, very distinctly contrasted, divided exactly in the middle from the forehead to the end of abdomen. Legs on the right side bright ochreous-yellow, on the left side brown. Antenna on right side ♂, bright ochreous-yellow, on the left side ♀, reddish-brown. The genital organs, also distinctly equally halved, with very prominent light-coloured anal tuft on the right side. Bred in Berlin. In coll. Wiskott, Breslau (Wiskott, *Festschrift Verein Schles. Insectenkunde*, p. 28, pl. iii., fig. 12).

ξ. Incomplete. According to the form of the wings, ♂. The colouring ♂ and ♀ mixed. The abdomen in form and size ♀, with rough and bristling anal tuft on right hand side, the hairs on the left side lying smooth and flat, the two sides differently coloured. The same colour difference also on the underside. Legs on the left side brown, on the right side bright ochreous-yellow. Antennæ right ♂, left ♀, in colour and form. Bred in Pesth. In coll. Wiskott, Breslau (Wiskott, *Festschrift Verein Schles. Insectenkunde*, p. 28).

η-ι. Three further gynandromorphous specimens of this species are noted as being in the collection of Staudinger. No description is given (Schultz, *Illus. Wochenschrift für Ent.*, ii., p. 399).

The following specimens have also been recorded as gynandromorphous:

κ. An apparently ♀ specimen, but with the left hindwing shaped like that of a male. Exhibited by Bond at the meeting of the Entom. Society of London, November, 1871.

λ. An apparently ♀ specimen, with the right hindwing marked and banded as in the forewing. Exhibited by Bond at the meeting of the Entom. Society of London, November, 1871.

We have recently been able to examine these specimens which are now in Webb's collection. Our notes read as follows:

(1) ♀. With the left wings both somewhat of the male form, but probably merely due to crippling, and not to gynandromorphism.

(2) ♀. Of the buff type, with two yellow bands distinctly developed on the right hindwing as well as on the forewings.

Nothing whatever in these suggests gynandromorphism except the wing-shape of 1 and the extra line on the hindwing of 2, but the latter is of the female forewing type of marking, and not of the male. A third example in the collection has been hinted as possibly gynandromorphous. Of this we note:

(3) ♀. Almost unicolorous, the right forewing short and square, might be looked upon as more of the shape of the ♂ wing; appears to us simply a crippled ♀ wing that has by chance got this shape.

Variation.—The sexes have been shown to be very dissimilar, and their variation takes somewhat different lines, yet the most extreme forms—unicolorous yellow-ochreous, on the one hand, and unicolorous red-brown, on the other—are similar in both sexes. In England, the principal forms of the male are as follows:

(1) Forewings very pale ochreous with almost (or quite) obsolete transverse lines, no dark patches in cilia; the hindwings also greyish-ochreous (not at all dark coppery as in 2 and 3) = ab. *pallida*, n. ab.

(2) Forewings quite yellow, with indistinct lines and markings; hindwings normal coppery-brown = ab. *obsoleta*, n. ab.

(3) Forewings pale yellow-ochreous in colour with the curved basal line, the median transverse line and the submarginal shade distinctly marked in brown, with two brown patches on the outer margin in the cilia, the margin at apex also darker; the hindwings coppery-brown, with (or without) a trace of the transverse band, and the fringes pale. This may be looked upon as the typical British male form = *castrensis*.

(4) Forewings yellowish-brown, with darker lines, the hindwings also coppery; distinctly intermediate between 3 and 5 = ab. *intermedia*, n. ab.

(5) Forewings brown in colour, approaching the coppery-brown hue of the hindwings, the lines still darker = ab. *brunnea*, n. ab.

(6) Fore- and hindwings unicolorous, red- or coppery-brown, without any (or very faint) transverse lines = ab. *hilleri*, Stdfss.

The transverse lines on the forewings of the males are sometimes very distinctly separate, sometimes more than a third of the wing apart, at others almost touching, frequently united by a short oblique shade from the median line to the curve of the basal line, the submarginal shade also may be quite absent, or may form a strongly developed line, there is sometimes, also, a small, but distinct, dark costal basal patch. One meets occasionally with very small aberrations of the male, measuring from 20mm.-25mm. (= ab. *minor*, n. ab.). Agassiz records one measuring 23mm. from the Grisons. The females are less strikingly variable than the males, although there are some remarkably good forms developed. Linné's original description with "two pale fasciæ" evidently refers to the commonest female form, although it would be difficult by any stretch of the imagination to call the colour of any of our examples "grey," and hence one is at a loss as to which form Linné really described. Our commonest form may perhaps be described as reddish-grey or fawn-colour, with transverse yellow fasciæ, replacing the normally dark transverse lines in the male. The hindwings may have a faint transverse shade, although this is frequently absent. The best marked British female forms are :

(1) Forewings entirely yellow-ochreous with little trace of paler lines; hindwings also yellow-ochreous = ab. *taraxacoides*, Bell.

(2) Fore- and hindwings fawn colour, with two distinct transverse yellow fasciæ; forewings with the basal area also yellow, leaving the median band and outer margin of the redder ground colour = ab. *virgata*, n. ab.

(3) Fore- and hindwings fawn colour, the forewings with two distinct transverse yellow fasciæ = ? *castrensis*, Linn.

(4) Fore- and hindwings unicolorous fawn colour = ab. *unicolor*, n. ab.

(5) Forewings red-brown, with markings as in 2 = ab. *rufo-virgata*, n. ab.

(6) Forewings red-brown, with markings as in 3 = ab. *bifasciata*, n. ab.

(7) Forewings red-brown, with little trace of the yellow transverse fasciæ = ab. *veneta*, Stdfss.

(8) Fore- and hindwings unicolorous red-brown = ab. *hilleri*, Stdfss.

A peculiar modification of 2 often occurs in some ♀s, in which the lower part of the median transverse band of the forewings is also suffused with yellow, making it, as it were, nearer to 1 (as a yellow form), although with the hindwings darker as in 2. We observed in Webb's collection, three very remarkable females: (1) An exceedingly deep red-brown, almost like the deepest fox-coloured *M. neustria*, but with the ordinary pale fasciæ. (2) A peculiar example, of a tint between yellow and red-brown, both shades as it were to be seen equally developed; the fasciæ practically obsolete. (3) An example of an unicolorous pale livid buff. Stephens states that scarcely two specimens of this inconstant species are precisely similar, they vary so greatly. Bacot observes that 77 specimens—44 females and 33 males—bred from one batch of larvæ in 1899, show great variation in size and colour. The colour of the males extends from creamy-yellow to dark amber on the forewings—intermediate shades being present; the hindwings show a less range, but all the pale forms exhibit a tendency to develop remnants of a pale transverse median shade which is entirely absent on those of the dark forms; 15 males may be described as pale, 11 as dark, one is unicolorous ochreous, having almost obsolete markings on the forewings; the rest are ill-developed or cripples. Of the females, 24 have well-marked pale transverse bands across the forewings, in 16 these are more or less obsolete; most of the latter are dark forms, whilst the banded ones show a gradation from dark to a pale ground colour. These obsolete-banded forms rarely have any transverse band across the hindwings, although the well-banded forms generally show traces of this marking. Whittle says that of 70 specimens reared in 1890, 59 were males, and 14 females; of these 52 males were typical, three pale ochreous, with transverse lines only faintly visible, three brownish and one unicolorous deep reddish-brown. Of the females one was ochreous, the rest brownish. In 1897, Whittle bred a pale male with approximating transverse lines, and another male of an uniform red-brown colour, without transverse lines, the larvæ of both from Great Wakering marshes. Of the general variation of the species he observes: "I possess specimens of the male which show a range of coloration extending from pale ochreous to deep red-brown; of these some are well-marked, others but faintly, whilst yet others are perfectly concolorous (either pale ochreous or deep reddish-brown) without a trace of markings. The wing-space enclosed by the first and second transverse lines varies considerably—in some the lines are very closely approximate. The third transverse line or submarginal band may be continuous or broken, faint, a mere shadow, or non-existent. The pale ochreous unicolorous form of the female is much less frequently met with than the corresponding form of the male." Barker records a pale ochreous unicolorous male. There is, however, a form of the male already noted (*ante*, p. 523) in which the forewings are distinctly marked with olive-brown, whilst Barrett mentions a specimen with forewings entirely olive-brown in tint, without transverse lines, and another smoky-brown (especially the hindwings). Oberthür says that the male varies little in France and this chiefly in the character of the transverse median band of the forewing; this band is more or less brown, contracted, but is extended on the inner margin of the wing owing to its inner edge being bent round towards the wing-base. He adds, however, that he has English examples (from the "Howard Vaughan" coll.) which are very like *americana*, Harris, others unicolorous pale, and dark brown; also females with the disc of the upper wing clear yellow. None of these aberrations appear to have been found in France, the species being, like many other lepidoptera, more variable in England than in France. Nolcken states that the species shows great variation in size and colour, in the Baltic provinces, whilst Romanoff also observes that in Transcaucasia, the imagines are very variable. Staudinger notes that in the Caraman district the imagines are somewhat smaller and paler than German examples.

The already described forms of this species are:

a. ab. *taraxacoides*, Bell., "Ann. Soc. Ent. Fr.," p. 102, pl. iv., fig. 1, ♀ (1851); Staud., "Cat.," p. 68 (1871); Kirby, "Cat.," p. 839 (1892); Reutti, "Lep. Bad.," 2nd ed., p. 57 (1898).—The more or less dark ferruginous colour, which is usually found in ♀ s of this species, is replaced by a very pale yellow-ochreous tint, with which the forewings are uniformly coloured above and below. The head, antennæ, corselet, abdomen, and legs partake of this same colour. The two bent lines on the upper side of the forewings, and that on the upper side of the hindwings have disappeared almost entirely, and it is necessary to examine the insect with care to observe even a trace of them. Although I have reared a great number of *castrensis* each year, I never before obtained a similar aberration, but this year two emerged at an interval of three or four days. The cause is quite inexplicable, as the larvæ were fed with others, and kept throughout with others at the same time, in the same place, &c. One is tempted to consider it to be due to disease, which often produces albinic specimens in lepidoptera. It has not been observed in other collections, and is called *taraxacoides*, because of its similarity to *taraxaci* (Bellier de la Chavignerie).

The colour of the figure in the British Museum copy of the *Annals* has so changed that the originalt int is quite unrecognisable. Staudinger diagnoses it as "al. concolor. stramineis," and Oberthür observes that only two females of the ab. *taraxacoides*, were taken by Bellier de la Chavignerie, and these were bred from larvæ found near Paris. This form is occasionally bred in England, and Reutti records one from Stöckhert.

β. var. (et ab.) *veneta*, Standf., "Stett. Ent. Zeit.," xlv., pp. 193-194 (1884); Kirby, "Cat.," p. 839 (1892); Auriv., "Iris," vii., p. 139 (1894).— ♂. Alis anticis et brunneo-fasciatis et late brunneo-marginatis; antennis, capite, thorace, corpore brunneis. Exp. alar. 29mm.-36mm. ♀. Supra subtusque brunnea, solo fascia media anguste flavo-marginata. Exp. alar. 42mm.-46mm., 12 ♂, 8 ♀. Patria: Italia septentrionalis, litus venetum. The size of the male of var. *veneta* (29mm.-36mm.) exceeds that of the type (26mm.-30mm.) and has a dark brown median transverse band, and is also broadly dark brown on the outer margin; the head, antennæ, thorax and abdomen are brown, only rarely mixed with yellow; the hindwings deep brown. The females agree with the males; the body and wings above and beneath deep brown, only the median band of the forewings is narrowly margined with yellow; they run from 42mm.-46mm., whilst the type only measures 34mm.-39mm. (Standfuss).

Standfuss received from Penzig, June 9th, 1882, 50 pupæ collected in the neighbourhood of Venice, imagines from which commenced to emerge the day he received them. They were evidently a form of *M. castrensis* but differed greatly from the type in size and colour, and also varied so much *inter se* that he considered it advisable to describe the two forms *veneta* and *hilleri*.

γ. var. (et ab.) *hilleri*, Standf., "Stett. Ent. Zeit.," xlv., pp. 193-194 (1884); Kirby, "Cat.," p. 839 (1892); Auriv., "Iris," vii., p. 139 (1894).—*Bombyx* var. *veneta*, ab. *hilleri*, mihi. Aberratio utriusque sexus unicolor brunnea. Exp. alar. ut in varietate *veneta*. 5 ♂, 4 ♀. Patria: Italia septentrionalis, litus venetum (Standfuss).

Among the var. *veneta* bred by Standfuss (*suprà*) nine examples (5 ♂s and 4 ♀s) agree with the rest in size, but are throughout of an unicolorous brown, without the least trace of yellow above or below. These he names after Hiller, of Brieg. He observes that *veneta* and *hilleri* are to be looked upon as seashore forms whose larvæ feed exclusively on almost all kinds of salt-marsh plants, chiefly *Triglochin maritimum* and species of *Salicornia*. On the other side of the Adriatic, he adds, *M. castrensis* is not rare, but is of the same size and colour as the ordinary German form.

δ. var. *kirghisica*, Staud., "Stett. Ent. Zeit.," xl., p. 318 (1879); Rom., "Mem.," ii., p. 12 (1885); Auriv., "Iris," vii., pp. 137, 139 (1894).—A number of bred *B. castrensis* sent by Henke are so different from the Central European form that they should be distinguished as a local race. The specimens are much paler, the males with much weaker brown bands on the forewings, and with a pale whitish transverse band on the hindwings. The females are not brown with yellow transverse bands on the forewings, but have yellow forewings with indistinct brown bands and markings. Some intermediates leading up to the type are present (Staudinger). DISTIBUTION.—TRANSCAUCASIA: Helenendorf (Romanoff). TURKESTAN: Saisan (Staudinger), Askhabad, Nuchar, common (Christoph).

EGG-LAYING.—The eggs are laid in true Malacosomid form, but appear somewhat irregular, and at different levels owing to the irregularity of the surface of the twig on which the batch examined is laid. They are placed in a close spiral, the first row laid rather flatly, the succeeding rows almost uprightly, but all united in a bracelet by a thick gum, scarcely attached to the twig and laid in reality lengthwise upon one another. They are never superimposed, which, indeed, would be fatal to the lower stratum owing to the thickness of the gum in which they are embedded. Walker observes that the eggs are laid round a culm of grass, or stalk of *Artemisia*, just as those of *M. neustria* are laid around a twig of some shrub; the selected position is such that the plants on which the eggs are laid are often covered by the spring tides; the batches of eggs, therefore, are often broken off and drifted away, and have several times been found in tidal refuse when hunting for beetles. As they have an efficient "waterproof varnish," it is easy to see how readily the species may be dispersed along the shore. Newman says that the egg mass is about an inch in length, the eggs embedded in a most tenacious glue which is not soluble in water; they form a compact cylinder, the axis of which is the flowering stem of some grass that is easily withdrawn when shrunk by desiccation, each egg-mass contains about 600 eggs. Hellins observes that the eggs hatch in March and April. A batch in our possession hatched on May 12th, 1896, but there is great difference in this respect.

Ovum.—The eggs are so pressed on each other and embedded in stiff gum that the shape is somewhat obscured. Each egg appears to be of the typical Lachneid form, the micropylar end placed outwards, the nadir towards the culm or stem round which the batch appears to be laid. It is flattened, and has a very large and distinct depression occupying about two-thirds of what is really the upper surface. It forms a rough oval in longitudinal section, with both ends broadly rounded but rather wider at the micropylar end. The egg is whitish in colour, opaque, shiny (with a varnished appearance), shaded with dark sepia longitudinally, the eggshell being covered with minute roughened points. The micropylar end of the egg consists of a raised white convex surface, sculptured with an undefined labyrinth of very slightly raised ridges and containing in its centre the true micropyle, a minute, cone-like point, rising from a shallow depression composed of very minute cells, placed quite centrally in the convex surface.

Comparison of eggs of M. castrensis and M. neustria.—The egg of *M. castrensis* is like a pulled fig in shape, 1·1mm. in length, ·8mm. in width, ·6mm. in thickness, greyish-white in colour, darker where the cement is thicker; it tapers from the micropylar end to the base, the width and thickness at base being about ·6mm. and ·5mm. respectively. The shell has an opaque porcellanus appearance, and under a 1″ objective a minute surface network may be distinguished. The egg of *M. neustria* is very similar in shape, but with a tendency (not constant) to have a raised micropylar area; it is 1·2mm. in length, ·7mm-·8mm. in width, and ·6mm. in thickness. The eggs are so firmly cemented, however, in this species that it is almost impossible to detach single eggs without breaking them. The shell of the egg of *M. neustria* appears to be double and much thicker than that of *M. castrensis*. The micropylar area of *M. neustria* is black, forming a noticeable dot in the centre of the end at which it is placed. In the egg of *M. castrensis* the micropylar area is not coloured, but there is a slight dimple where it occurs (Bacot).

Habits of larva.—The eggs hatch in May, and the larvæ are gregarious until the penultimate moult; but there is great difference in the hatching period and the date at which the larvæ are full-fed, young larvæ in their webs, and adult larvæ, often being found on the same ground at the same time. They feed in the web they make on *Statice limonium*, *Artemisia maritima*, and other plants, but as the web becomes larger they spread it to the short herbage on which they also feed, and leave a trail (where they have eaten the plants) covered with web. These may be found early in June on the mudflats of the Kent, Suffolk, and Essex coasts, and are then some three or four inches wide and one or two yards in length. The larvæ themselves, although brightly coloured, are not at all conspicuous at a little distance, and are best found by following up one of their webs. Bacot says that a nest made by the larvæ when only a few days old is almost spherical, an inch or less in diameter, the whole not unlike a nest of young spiders in general appearance. The larvæ are exceedingly easy to rear on sallow and knot-grass, if kept in a well-ventilated frame, where they can get full advantage of the sun, warmth and fresh air being very essential to development. The larvæ must have plenty of room when pupating, otherwise they spin the cocoons on one another, and thus many are prevented from escaping when the imaginal stage has been reached. Newman observes that the web constructed by the young larvæ is thinner and less opaque than that of *M. neustria*, and is generally placed very near the ground. Linné noticed their gregarious habits, and says: "Polyphaga, pascitur sub tela, gregaria, migratque sæpius novo tentorio; ova, more præcedentis, in annulos conferta circum ramulos. Hæc frequens in Suecia, duplici colore occurrit, eadem tamen, diversaa præcedenti (*neûstria*), cum illa arborea, hæc terrestris" (*Syst. Nat.*, xiith ed., p. 818). After they leave the web they do not wander far, so that when a full-fed larva is found others are sure to be close by (J. J. Walker). Jones observes that on June 30th, 1871, the larvæ were in hundreds on Higham marshes, and were not at all confined to the sea-wall, but occurred for a mile inland; they were equally common on the Gravesend marshes near the sea-wall. He noticed that at 10 a.m. the larvæ occurred only sparingly, but as noon approached they became more abundant, crawling up from their retreats to sun themselves upon the branches of their food. After 1 p.m. they again became much scarcer, retiring to the roots of their food-plant. In confinement the larvæ should be put in the sun. Whittle notes that the food-plants and the larvæ themselves must often be submerged. He says that the larvæ love the sunshine, but the evening is the great feeding-time, and then they may be found freely enough on almost anything that grows on the salt marshes. Wright observes that the half-grown larvæ rest side by side, in masses, on the sea-plantain and other plants, all with their heads towards the sun, basking in the warmth, and are so sensitive that, on the least disturbance, or on the approach of an intruder, every head would instantly be raised and thrown back. James says that in June, 1881, the larvæ were in large numbers, feeding on dried seaweed on the seashore, at Bawdsey Ferry, near Felixstowe, and were distributed over a long ridge of the seaweed that had been washed up by some extraordinary high tide, at some yards above high-water mark. Two of the larvæ found had spun up in the mouths of large whelk-shells, and the specimens bred from these are still in his collection. Ingall notes that on July 5th, 1856, the larvæ were in immense abundance near Queenborough, chiefly full-fed. They were crawling about in such profusion that he could scarcely walk without treading upon them. Lambert writes that the larvæ may be taken from July 15th to the end of the month, are rarely to be found except when the sun is shining and the weather warm, when they may be seen feeding on the young tops and unexpanded blossoms of *Artemisia maritima*; he notices that the larvæ have a habit when feeding, of occasionally jerking the head and fore legs from side to side as if annoyed by insects, although such was not the fact. Newman states that when full-fed, the larva rests in a nearly straight position, is very easily shaken off, generally falling on its back, when it immediately turns over and begins to crawl, never feigning death nor rolling into a ring. Harwood notes that the full-fed larvæ generally hide themselves very effectually during the heat of the day, and come out to feed in the evening, when numbers may be found crawling and feeding, where one might have searched in vain a few hours previously; sometimes they are to be found in the earlier part of the day, whilst the young broods may be found on their webs at all times. Boisduval notes (*Bull. Soc. Ent. France*, 1851, p. lxl) the damage done by the larvæ of this species in Poitiers.

Larva.—The *newly hatched larva* (May 13th, 1896) has a very large black and shiny head, which forms roughly a tall trapezoid in shape, with scattered hairs over it. The body is dark brown in colour, and tapers gradually towards the anus. The scutellum smooth. The ear-like tubercles on the 1st thoracic segment strongly developed, and also the hairs arising from them. The dorsal tubercles form chitinous warts, are arranged in trapezoidal form, and bear minutely thorny or serrated hairs. Of these i is, however, much larger than ii, and carries four or more large hairs, ii bearing only two smaller ones, iii is a single-haired chitinous-based generalised tubercle, iv and v being represented by a double generalised tubercle bearing two hairs. In the *second instar*, the larva still has a shiny, black head, covered with pale hairs; the ocelli somewhat prominent, and black in colour; the apex of the head is divided by a central suture. The skin of the body is blackish-grey, with pale, greyish-white, mediodorsal, subdorsal and supraspiracular lines, and faint subspiracular line. The prothoracic tubercles bear rather long black hairs, those on the mesothorax, metathorax and abdominal segments carrying very long red-brown hairs; the hairs on the dorsum stand upright, those on the supra- and subspiracular tubercles curve downwards and completely cover the spiracles. The skin is also covered with small warts, which bear shorter black hairs. The dorsal tubercles themselves consist of two large tubercles on each segment, one on each side of the pale mediodorsal line. These appear to be placed about midway between the front and back edges of the segment, to be composed of a raised wart, and to give rise to four long, radiating, stiff, red-brown hairs. The small hairs on the body surface come from minute scattered skin warts. The intersegmental membrane is blackish-grey, smooth, without hairs, and is conspicuous when the larva walks. The supraspiracular tubercles are very similar to the dorsal, and the hairs are given off in a very similar radiating manner, but they turn downwards at their ends. There is a pale subspiracular flange, broken at the segmental incisions. The true legs are shiny, black; the prolegs are blackish-grey with pale tips, and black hooks, those on the anal prolegs being particularly well-developed. The 8th and 9th, abdominal segments are rather swollen dorsally, but not distinctly humped as is the larva of *M. neustria* of the same age. The anal segment is rough, black, and without hairs. The *more adult larva* is characterised by the markings being arranged, as it were, in longitudinal lines, running from the prothorax to the anal segment. In the *third* and *fourth instars*, the anterior trapezoidals are well-developed, and bear six or seven hairs stouter than the secondary hairs which rise from the skin surface. These longer hairs are still covered with minute serrations. Bacot describes the *adult larva* (from blown example) as follows: Head rounded, not large, surface dull, crown black, face and cheeks dull silvery-blue, lines of median and clypeal sutures white; a thick covering of fine bright brown hairs, a few scattered dark ones (these hairs greatly soften the colour effects and give the blue coloration the appearance of a bloom). Body with dorsal area velvety-black, mottled with narrow longitudinal broken streaks of bright red; a narrow, much interrupted, blue, median line is traceable, strongest on thoracic and hindmost abdominal segments; a broad, but broken, and interrupted, blue, subdorsal band present; immediately beneath this is a narrow, irregular and broken, red band, narrowly bordered with the black ground colour; below this the lateral area to base of prolegs is blue, with a narrow interrupted streak composed of a mottling of black, red, and white just beneath the spiracles; the ventral area is velvety-black much blotched on either side of median line, and towards the posterior and anterior edges of the segments, with white or cream colour, and a slight amount of blue. The bases of prolegs mottled black and yellowish-white, the lower portion blue; the foot is disc-like with a row of 24-26 hooks on its inner edge. The true legs black with white ring at base. The larva is covered with a fairly thick coat of fine soft hairs of various lengths, rising more or less vertically on the dorsal area, but tending to be collected into downward sweeping tufts laterally; the bright blue subdorsal and lateral bands are thus rendered more prominent, being less obscured by hairs than the remainder of the body. The hairs on the thoracic segments rather stronger than on the abdominal segments. Many hair-bases and the skin area immediately surrounding them are black on the blue and white parts of the larva, and to a less extent on the red also. It is this black spotting that gives the blue areas a dull appearance; the blue is particularly strongly and brightly marked on the intersegmental areas, where there are no hairs. Before full growth is reached (? penultimate skin) the blue bands and areas are less strongly developed, and the red is relatively stronger; the blue subdorsal band, in some not quite full-grown larvæ, consists for the most part of a strong intersegmental spot on each segment, and another in the same horizontal plane at about the middle of the segment. Linné described the larva as "Pilosa, subcærulea lineis utrinque 2 lateralibus ferrugineis approximatis et dorsali 1 utrinque, lata, nigro-maculata. Abdomen albo utroque maculatum. Caput cinereum" (*Syst. Nat.*, 12th ed., pp. 818-819). Curtis says: "Many coloured; an indistinct whitish dorsal line, then a broad orange-brown stripe, in which, on each side of the 3rd, 4th, 5th and 12th segments is a black spot; the hairs all golden-brown, and longer than in the larva of *M. neustria*." Newman writes: "The head is of almost the same width as the 2nd segment; the body is of nearly uniform substance throughout, the back being rather convex, and having the divisions of the segments distinctly marked, the sides being dilated, and the dilated portions being broken up into wart-like lobes by transverse folding; the belly is rather flattened, the claspers rather long, but remarkably small at the extremities; the head and body are clothed with silky hairs of various lengths, but nowhere sufficiently abundant to completely conceal the skin; the colour of the head is bluish-grey, minutely dotted with black; that of the body is rich, velvety, purplish-brown, with an interrupted and irregular medio-dorsal series of small and amorphous blue-grey spots, and two lateral stripes on each side of the same colour, the upper of these being the most perfect, and the lower containing the black spiracles; the space between these two stripes contains a series of linear orange spots, one on each segment; the ventral area black, freckled with white; all the hairs are bright ferruginous."

Variation of larva.—Walker writes: "The adult larvæ vary considerably in the amount of the leaden-blue markings, which are more strongly developed in those larvæ that produce males. The whitish dorsal stripe is also much more distinct in some examples than in others, and here again the male larvæ have it the more distinctly marked. The fulvous hairs are also denser on the male larvæ." Whittle says: "One often sees larvæ approaching those figured by Buckler (*Larvae*, pl. l) in which the orange dorsal and the blue lateral streaks have increased at the expense of the usual dark coloration." Buckler figures (*Larvae*, &c., pl. l., figs. 1, 1*a*, 1*b*) three different forms of the full-grown larva :

(1) The dorsal area red-brown, with a darker median line, below this is a paler reddish, subdorsal, longitudinal line, directly below this is another longitudinal line, alternately marked transversely with blue and black, beneath this again is a bright yellow supraspiracular line, a blue-grey spiracular, and an orange subspiracular line; the yellow spiracular line is continued as a frontal line across the prothorax and shows up distinctly the bluish-grey head (fig. 1).

(2) The dorsal area brown, with a bluish-grey median longitudinal line, a yellow subdorsal, beneath which is another longitudinal line marked alternately with blue and black transversely, below this is the yellowish supraspiracular line and a blue-grey spiracular; the yellow spiracular line is also continued frontally across the prothorax; the head is bluish-grey (fig. 1*a*).

(3) The dorsal area blackish-grey, the mediodorsal line broken up into blue spots on abdominal segments 1-8; the subdorsal orange line, continuous over the thoracic and 1st and 2nd abdominal segments, is also broken up into spots on segments 3-8, and placed on same subsegments as the blue spots of the mediodorsal line; this is followed by a continuous bright blue longitudinal line; beneath this is a yellow supraspiracular, darkened at the segmental incisions, and below this is a continuous blue spiracular line, separated from the greyer ventral area by a fine black one (fig. 1*b*).

Romanoff observes that the larvæ of the Transcaucasian *castrensis* differ from those of central Europe, being "greyish-blue in colour, with only two very narrow bands of reddish-tawny on the back." He further notes that the larvæ found in Persia present the same differences.

Pupation.—The cocoon is spun up among the food-plants, or in the low herbage near. Jones found cocoons by searching among the long grass growing near the top of the sea-wall below Gravesend, many, however, were empty, the pupæ having been extracted by birds. Zeller found cocoons spun up among the leaves of an *Artemisia*, on June 16th, 1869, at Meseritz, in Posen.

Cocoon.—The cocoon consists of a large quantity of loose, flossy white silk, outside, and a more closely woven cocoon, of a pale yellow colour, within. The latter is about one and a half inches long and half an inch wide. It is somewhat pointed at both ends, more so at the bottom than at the top, but the latter is rather more loosely woven. The yellow inner cocoon has a felted appearance, is thin, and coated inside with yellow particles of aragonite, which are freely sprinkled on the pupa. Newman says that the cocoon is rather tough, oblong, of fine pale-coloured silk, interspersed with a powder much resembling flower of sulphur.

Compound cocoons.—On several occasions three or four larvæ united in making a large cocoon, in which the pupæ were found without any separating partitions (on the other hand some of the larvæ are very lazy in constructing a cocoon, and become pupæ without making one at all) (Fisher).

Pupa.—The pupa is remarkable for the contrast in colour between the pale reddish-grey mouth-parts, and the surrounding shiny black maxillæ, maxillary palpi, legs, wings and thorax. It is rather more than seven-eighths of an inch in length; is widest (three-eighths of an inch) at the 4th and 5th abdominal segments, narrowing rapidly to a blunt point formed by the 9th and 10th abdominal segments. *Ventrally:* The dorsal head-piece well-developed, but ventral; the mouth-parts are pale reddish-grey, with bright orange labial palpi (?); the maxillæ short, the first pair of legs extending beyond the maxillæ, and the second pair beyond the first; these are shiny black in colour, and are partly enclosed between the antennæ, which, however, terminate at about two-thirds along the costa of the wing, measured from the base; the first pair of legs ends medially on the same level as the tips of the antennæ, the second pair extending some distance beyond the antennæ. The antenna ends in a point, is strongly ribbed longitudinally down its centre, and closely segmented transversely. The wings are rounded at the apices, are short compared with their width, with distinct neuration extending to Poulton's line, which is well marked. The 4th, 5th, 6th and 7th abdominal segments have each two marked scars (in the position of the larval prolegs); these segments are also covered thickly with short yellow and brown bristles. The genital organs are well marked, a linear depression being placed medially on both the 8th and 9th abdominal segments; the anus is very prominent on the 10th abdominal, and the cremaster forms a rounded flap which extends far beyond the anus, posteriorly, and is thickly covered with red-brown bristles. *Dorsally:* The prothorax is rounded frontally and covered with short red-brown bristles; the mesothorax is swollen, has a fine raised, shiny, mediodorsal line, is sparingly sprinkled with red-brown bristles, is dull blackish in colour (as is also the whole of the dorsum), giving rise on either side to the forewings; the metathorax is narrow and ill-developed, even the sides whence the hindwings originate being ill-developed, the latter disappearing at once beneath the forewings; the prothoracic spiracle forms a longitudinal slit, placed in the segmental incision between the pro- and mesothorax, and in contact with the antenna; the 1st, 2nd and 3rd abdominal segments narrow, but each increases in width from the 1st to the 6th, whilst those following the 6th contract to the cremaster, which is long, blunt and rounded; all the abdominal segments are sprinkled with short stiff bristles, and these hold a thick covering of loose larval hairs which entirely cover the abdominal segments dorsally, and less so the sides and venter. *Laterally:* The rounded front of the prothorax thickly covered with brown bristles; the glazed eye, very distinct, forming an open lunule, extending from the mouth to the base of the antenna; the shoulder of the forewing swollen; the spiracles on the 2nd, 3rd, 4th, 5th, 6th and 7th abdominal segments consist of a raised, brown, roughly oval lip, placed towards the middle of each segment; the segments are well drawn within each other, so that, although there is free movement between abdominal segments 4-5, 5-6, 6-7, the intersegmental membrane is not visible. The most remarkable features of the pupa are: (1) The yellow appearance of the abdominal segments. (2) The thick covering of loose red-brown (larval or cocoon) hairs over the greater part of the pupa. (3) The narrowing of the abdominal segments to a point. (4) The extension of the cremaster beyond the anus [Description made on July 16th, 1897, from a pupa received from Mr. Whittle]. The pupa is black, dull-looking, the cuticle transversely striated, thinly clothed with short ferruginous hairs, which are most abundant at the anal extremity, the latter prolonged but blunt (Newman).

Comparison of pupæ of M. castrensis and M. neustria.—The pupæ of *M. castrensis* are rather browner than those of *M. neustria*, some variation would, however, seem to exist as one male pupa is quite red-brown, while those of another male and a female are of a dark mahogany tint, almost, but not quite, black in the case of that of the female. The hairs on the pupæ of *castrensis* appear browner and more numerous, but the former difference may be more or less due to the browner colour of the pupal envelope. The pupa of *M. neustria* is longer, thinner, and tapers more gradually to the anus; that of *M. castrensis* is shorter, and tapers much more sharply from abdominal segments 6-8 than is the case in *M. neustria*. The mouth-parts, too, in *M. castrensis*, shade more gradually into the surrounding parts as regards colour; in *M. neustria*, the transition from coal-black leg- and eye-sheaths, &c., to the pale brown of the mouth-parts is quite sudden and abrupt (differences in degree are observable in this respect in the pupæ of *M. castrensis*, but the contrast in all the pupæ of *M. neustria* examined, is distinctly marked) (Bacot).

Parasites.—In ordinary seasons it seldom happens that parasites are bred from the larvæ, but in 1893 many larvæ were destroyed by them (Whittle). *Telenomus phalaenarum* has been bred from this species (Goeze).

Food-plants.—Almost polyphagous. In the Isle of Sheppey the favourite food is *Statice limonium*, then *Artemisia maritima*, but also found on coarse salt-marsh grasses, *Plantago maritima*, &c. (Walker), *Atriplex portulacoides*, *A. littoralis*, *Suaeda maritima*, coarse grasses, rose, birch (Whittle), *Plantago lanceolata*, *Daucus carota* (Curtis), chrysanthemums (Vaughan), *Polygonum aviculare* (A. H. Jones), southernwood (preferred when dipped in salt water), cherry leaves (eaten voraciously when dipped in salt water) (Ingall), *Pilosella*, *Jacea*, *Alchemilla*, *Euphorbia* (Linné), *Centaurea jacea*, *Euphorbia esula*, *E. cyparissias*, *Geranium*, *Hieracium pilosella*, young birch shoots (Borkhausen), *Artemisia campestris* (Teich), *Athamantha oreoselinum* (Zeller), *Helianthemum vulgare* (Selys), *Erica*, *Leontodon*, *Calluna*, &c. (Caradja), *Campanula*, &c. (Rössler), young shoots of *Betula alba* (Garbowski), apple, pear, poplar, plum, blackthorn (preferably sprinkled with salt water) (Newman), plum, oak (Ingall), *Erodium* (Millière), sallow, knot-grass, plantain, willow (Bacot), *Armeria maritima*, *Silene maritima*, *Inula crithmoides* (Harwood).

Habits and Habitat.—The habits of the imagines are practically unknown, but Button observes that they emerge in the afternoon, and should be secured before dark, or they will batter themselves to pieces. The moth is rarely seen wild, almost all our cabinet specimens having been bred from captured larvæ. Walker took a female in Sheerness, in July, 1868, on a wall opposite a lamp post, probably attracted by the light. Jones captured a female near Gravesend. Button notes (*Ent.*, 1868, p. 129) an example at Gravesend attracted by the lamp when sugaring on the marshes, and Millière obtained a female when resting on a stalk of *Lavandula officinalis*, on the Pic de l'Aigle. It may have been merely a fortuitous coincidence, but

Whittle notes that whilst breeding these moths, three males emerged on July 21st, 1897, and were found resting on two cocoons, which afterwards (on July 26th and 27th) produced two females. In England the species is excessively local, being practically confined to the saltings of the Thames and Medway, and the marshes for some distance along the Essex and Suffolk coasts. One suspects its possible occurrence also on the salt marshes of the south coast, since it occurs on the opposite side of the English Channel. In Denmark, too, it is, as with us, a coast species. In the Netherlands it is confined to heaths, and Richter observes that it inhabits similar districts in Dessau, but Selys de Longchamps notes it as occurring in the large woods of Belgium, and Speyer says that in the north and north-eastern parts of its range it prefers sandy districts and heaths. Zeller says that it occurs everywhere on the low sandy hills around Meseritz, in Posen. At Abruzzi, in the Roman Campagna, Calberla records it as exceedingly abundant at 1500m. elevation, whilst in Asia, in the Kentei mountains, Staudinger says it is common in the elevated meadows; in Nassau, Rössler observes that it is confined to warm high-lying places, and Eversmann says that it is distributed over the Caspian littoral; Guénée gives "collines et lieux calcaires" in the Eure-et-Loir, whilst Dupont captures it "sur un coteau calcaire," near Pont de l'Arche. On the salt marshes of the Medway and Thames the larvæ are sometimes in extraordinary abundance, near Leigh, in Essex, Vaughan notes them as exceptionally abundant in 1871 and 1874, whilst Jones says that in 1871, in a field on Cliffe marshes, in which the grass had been cut, and where there was no trace of sea-wormwood, the larvæ could have been collected in thousands. Yet in the same year, at Queenborough (*Ent. Mo. Mag.*, viii., p. 185), Walker says that he could only find a few starved and stunted larvæ, although they are usually very abundant in the locality. Whittle observes that he suspected that the great floods of November, 1897, would have seriously affected the distribution of the species at Great Wakering, but it was as abundant as ever in 1898, and he saw few larvæ away from the well-known stretch of marsh. Kerry notes that near Harwich the species occurs on the "bentlings," where the eggs must frequently be under water, and Mera found it on the sea-wall at Bawdsey. We have already noted (*anteà*, p. 537) the great abundance in which Ingall found it in 1856, at Queenborough, and he states that the larvæ seem to revel in the moist places overgrown with grass, *Artemisia*, *Statice*, and other salt-marsh plants. Harwood notes the larvæ as especially common some seasons along the bases of the sea-wall of the north Essex coast, and says that this is to be accounted for by the eggs being laid round the stems of grass and other plants, which, when they become sere and brittle, are frequently broken off and borne by the incoming tide towards the sea-wall, where they may often be detected. In a favourable season the larvæ are to be found in amazing numbers, often within a very limited space. In confinement they require an abundant and perfectly fresh supply of food if they are to be reared successfully. The eggs will endure immersion in sea-water for a considerable time without injury; they must be regularly covered by the high tides in their natural haunts in Britain, as also to a less extent must the larvæ, for all that I have ever seen have been between the sea-wall and the sea. The larvæ appear to be rarely ichneumoned, but once they have pupated the sea-birds prey on them, although the cocoons are usually cleverly hidden in the low herbage.

Time of appearance.—The imago is generally bred from the middle of July until the third week in August, although Walker notes that in confinement the bulk of the specimens appear during the third week of July. In July, in Belgium (Selys); in June and July, in Transcaucasia (Romanoff); in France, in July and August (Oberthür), but Guénée gives May and June for the Eure-et-Loir district, although Dupont took it at Pont de l'Arche on July 10th, 1892, whilst Sand mentions June 28th-July 15th, for the Auvergne district, and Millière August 2nd, 1875, on the Pic de l'Aigle. Fritsch gives it as appearing in the Vienna district from June 26th-July 28th, and Jordan took it in the first week in July, 1878, in the Visp valley, Frey gives July and August, for Switzerland, Caradja says that the larvæ occur in May and June and the imagines in July and August, in Roumania, and Reutti gives exactly the same dates for Baden. Staudinger notes that in the Caraman district the earliest emergence took place on July 6th, but specimens continued to appear until August 8th, 1875, whilst in the Kentei mountains the larvæ were very abundant at the commencement of July. Ingall notes that the bulk of the emergences in 1856, took place between July 30th and August 3rd, although some imagines appeared in September. Whittle observes that in 1889, larvæ were taken at Shoeburyness until July 30th, in 1890 none were seen after July 19th, in 1893, larvæ were found almost fully grown by June 2nd, although broods of young larvæ were still common; broods of quite young larvæ were taken on June 14th, in 1897. In 1893, larvæ in the second stadium, were found near Southend, as early as April 17th, by Battley. The best time to obtain the larvæ varies with the season. Larvæ were first found in England at the beginning of May, 1827, in an island on the Essex coast, called New England, and others occurred in the beginning of July, 1828; these latter larvæ pupated about the middle of July, the pupæ producing imagines between August 10th-22nd (Parsons *teste* Curtis); June 6th and July 23rd-30th, 1842, large numbers of larvæ in the Isle of Sheppey, from which 60 ♂s and 35 ♀s were bred, as well as a gynandromorphous example on August 7th, larvæ again taken at Queenborough, July 11th-12th, 1845, commenced to spin up July 17th, although others were still feeding on July 31st; from July 3rd-5th, 1856, at Queenborough, the larvæ were in amazing numbers, principally full-fed, they were crawling in such profusion that one could scarcely walk without treading on them, by July 12th, they were spinning up fast, and 200 had already pupated, and imagines emerged from July 30th-August 17th, altogether some 340 were set—114 males, and 225 females (Ingall); some six dozen larvæ found near Gravesend, in June, 1860 (Fisher); larvæ near Gravesend, July 13th, 1866 (Miller); July 13th, 1866, larvæ at Gravesend, imagines bred August 7th-9th, 1890, others bred August 19th-29th, 1891, July 28th-August 14th, 1892, all from Leigh (Fenn); larvæ already separated on May 29th, 1869, and full-grown, sitting upon the weeds, on June 19th, at Meseritz, in Posen (Zeller); larvæ on July 10th, 1869, were found in various stages of growth below Gravesend, some quite small, others full-fed, on June 3rd, 1871, hundreds in a field in Cliffe marshes (A. H. Jones); larvæ full-fed July 1st, 1871, on Gravesend salt-marshes, on May 20th, 1892, near Southend, three nests of small larvæ were found, and on June 17th, 1894, the larvæ were common, some quite small others two-thirds grown (Bower); July 8th and 12th, 1879, at Queenborough, nearly or quite full-fed, in 1896 the larvæ were in extraordinary abundance on Chetney marshes, on May 21st, there were broods at intervals of every two or three yards, from newly-hatched larvæ up to those in the penultimate moult, whilst stragglers continued to occur until July 16th, when some were obtained at Elmley, in 1897 a few belated larvæ were found close to Sheerness in the middle of July (J. J. Walker); many nests of young larvæ at St. Osyth, May 19th-21st, 1888 (Harwood); larvæ June 9th, 1888, exceedingly abundant and varied much in size, at Shoeburyness (Adkin); larvæ June 13th-July 24th, 1889, produced imagines July 28th-August 15th, 1889, larvæ June 29th-30th, 1890, imagines July 28th-August 5th, 1890, larvæ June 14th-July 12th, 1891, imagines July 25th-July 30th, 1891, larvæ June 17th-July 3rd, 1892, imagines July 26th-August 1st, 1892, larvæ June 2nd-12th, 1893, imagines July 9th-16th, 1893, larvæ June 9th-27th, 1895, imagines July 21st-31st, 1895, larvæ June 13th, 1896, imagines July 12th-21st, 1896, larvæ June 12th-19th, 1897, imagines July 15th-26th, 1897, larvæ July 23rd-27th, 1898, imagines August 24th, 1898, all from Great Wakering salt-marshes (Whittle); larvæ July 11th, 1891, on the sea-wall at Bawdsey, also on June 16th-20th, 1890, July 24th-27th, 1891, July 9th, 1892, and June 13th-30th, 1896, on the Essex marshes (Mera); June 19th, 1892, the larvæ in thousands on the salt-marshes at Shoeburyness, some extremely small, others larger, in companies, in such abundance that it was difficult to avoid treading on them (Wright); bred July 11th-20th, 1893, larvæ from Essex coast (Bankes); larvæ at Clacton-on-Sea, produced imagines August 2nd, 1898 (Pickett); larvæ June 23rd, 1898, from Shoeburyness, produced imagines August 1st-17th (P. Reid), larvæ from Isle of Sheppey produced imagines July 25th-30th, 1899 (Thornhill).

LOCALITIES.—ESSEX: saltmarshes between the mouths of the rivers Colne and Stour—St. Osyth (Harwood), Leigh (Vaughan), Clacton (Pickett), Canvey, Wakering Marsh, Shoeburyness to Haven Gore (Whittle), Southend (Battley), Mersea, nr. Colchester (Laver), nr. Harwich (Kerry), nr. Crowstone (Burrows), Fobbing Marsh (Auld), Leigh (Fenn). KENT: Herne Bay (Daltry), nr. Rochester (Edwards), Higham and Gravesend marshes (A. H. Jones), St. Mary's Creek, Chatham, Cliffe, Queenborough (Chaney), banks of Medway (Wright), banks of Thames below Erith (Stainton), Chetney Marshes, Elmley, Sheerness (Walker), Isle of Sheppey (Ingall), nr. Port Victoria (Bacot). SUFFOLK: Aldeburgh (Crutwell), Bawdsey (Mera), the Haven at Thorpe, Aldborough (Hele), Bawdsey Ferry, nr. Felixstowe (James). [The following records require confirmation:—DEVON: mouth of the Exe (Leach *teste* Stephens). HERTS: East Barnet (Gillum *teste* Gibbs, *Ent. Rec.*, v., p. 158). IRELAND (Ball, never since confirmed, *vide* Birchall, *Ent. Mo. Mag.*, x., p. 153). WORCESTER (Smith, *Substitute*, p. 184). YORKS: York, in salt-marshes (Meyrick). Of these the Devon locality is a very probable one. Meyrick's record is very remarkable.]

DISTRIBUTION.—ASIA: Altai Mountains, Kentei Mountains, North Persia (Staudinger), Kouldja (Alpheraky), Achalzak (Christoph). ASIA MINOR: Amasia, Tokat, Brussa (Speyer), Caraman (Staudinger). PERSIA (Romanoff). TURKESTAN (Erschoff). AUSTRO-HUNGARY: Brünn (Schneider), Galicia (Garbowski), Linz, Vienna (Fritsch), Buda (Speyer), Epiries, not rare (Husz), Hungary—Kocsocz (Vángel), Tyrol, very rare (Hinterwaldner), Upper Carinthia, in Salzburg (Nickerl), Fiume (Mann), Bucovina (Caradja). BELGIUM: everywhere on heaths (Heylaerts), rare in the country—Calmpthout (Lambillion). CORSICA: rare (Curò). DENMARK: generally distributed in coast districts (Bang-Haas). FRANCE: not rare, but only common in central France—at Paris, Fontainebleau, &c. (Berce), rather rare in north France—Eure, Pont de l'Arche (Dupont), Vernet-les-Bains, Cauterets (Oberthür), Alpes-Maritimes—Pic de l'Aigle (Millière), Poitiers (Boisduval), Evreux (Bellier de la Chavignerie), Eure-et-Loir, Châteaudun (Guénée), Château-du-Loir (de Graslin), Indre, Cher, Sologne, Auvergne (Sand), Aube (Jourdheuille), Haute-Garonne — Bouconne, Lardennes, Encausse (Caradja), Puy-de-Dôme (Guillemot), Morbihan (Griffith), Gironde—Facture, St. Médard, Cestas (Trimoulet), Saone-et-Loire, Autun, rare, Chalon, common (Constant). Finland: southern districts, Osterbötten (Lampa). Germany: north-west Germany—Hanau, Elberfeld, Quedlinburg, Osnabrück, Hamburg, Eutin, &c. (Jordan), local in the middle Rhine district and south Germany—Holstein, Lüneburg, Frankfort-on-Oder, Berlin, Kemberg, Mannsfeld, Mayence (Speyer), south-west Germany local—Giessen, Grünberg, Laubach, &c. (Koch), Silesia (Assmann), Pomerania—Garz (Hering), on the Dänholm at Stralsund (Plötz), Spires (Linz), Würtemberg—Ober-Schwaben (Seyffler), Ratisbon to Grünberg (Hoffmann), Giessen (Dickore), Lower Elbe dist. —Sachsenwald, Hamburg (Zimmermann), Posen—Meseritz (Zeller), Halle, Dessau (Stange), Hesse—the Wetterau, &c. (Glaser), Mecklenburg—Sulz, Neustrelitz, Waren (Schmidt), Bremen (Rehberg), Pressburg (Rozsay), Prussia—Dantzig, Insterburg, Eilegenburg, Wittemberg (Schmid), Upper Lusatia (Moeschler), Görlitz (Hirté), Nassau—Mombach, Lorch, Bad Schwalbach (Rössler), Dessau, not rare (Richter), Eutin (Dahl), Baden—Waldshut, Karlsruhe, Mannheim, Schwetzingen, Heidelberg, near Wertheim, very common (Reutti). Italy: north and central Italy (Curò), Roman Campagna—Abruzzi, very common at 1500m. elevation (Calberla), Modena—Montegibbio (Fiori). Malta: Civita Vecchia (Garde). Netherlands: everywhere on heaths—Breda, &c. (Heylaerts). Roumania: Grumazesti, Tultscha (Caradja), near Turn Severin (Haberhauer). Russia: Livonia (Teich), Baltic Provinces—generally distributed, Schleck, Kokenhusen, Pichtendahl (Nolcken), Moscow dist. (Albrecht), Wolmar (Lutzau), Volga dist.—prov. of Orenburg, Baschkiria, Caspian littoral (Eversmann), St. Petersburg (Erschoff), southern Russia (Möschler). Transcaucasia: distributed—Tiflis, Borjom, Lagodekhi, Manglis, Eldar, Istissou, Kasikoparan, Derbent, Delijan, Helenendorf (Romanoff). Scandinavia: common in south Sweden, but rarer farther north—extends to Upland, Westmanland and S. Finland, in Norway only in Smaalenene (Aurivillius), Scania, Blekinge, East Gothland, Sköfde in West Gothland (Wallengren), Lapland, very rare (Zetterstedt). Spain: Teruel—Griegos, Alcala de la Selva (Zapater and Korb). Switzerland: local and apparently absent in northern Switzerland, limits of flight about 4000ft. (Frey), Tarasp (Killias), Basle (Knecht), Jura—St. Blaise-Neuveville (Couleru), Mont Salève, nr. Geneva (Frey), several places in the Valais—Bergell, Vieschwald, Brieg, Berne (Meisoner), Visp Valley, Saas Valley (Jordan), Grisons (Agassiz). Turkey (Speyer), Varna (Lederer).

Malacosoma neustria, Linné.

Synonymy.—Species: *Neustria*, Linn., "Sys. Nat.," 10th ed., p. 500, no. 19 (1758); 12th ed., p. 818, no. 34 (1767): "Fauna Suec.," 2nd ed., p. 292, no. 1102 (1761); Müll., "Faun. Frid.," p. 39, no. 350 (1764); "Zool. Dan. Prod.," p. 118, no. 1358 (1776); Hufn., "Berl. Mag.," ii., p. 402, no. 11 (1766); Fuessly, "Verz.," p. 34 (1775); "Neu. Mag.," ii., p. 60 (1785); iii., pp. 148, 152 (1786); Fab., "Sys. Ent.," p. 567, no. 42 (1775); "Sp. Ins.," ii., p. 180, no. 58 (1781); "Mant.," ii., p. 114, no. 70 (1787); "Ent. Syst.," iii., p. 432, no. 79 (1793); Wilkes, "Nat. Hist.," pl. xlv (1773); Schiff., "Sys. Verz.," p. 57 (1776); Göze, "Ent. Beit.," p. 315 (1781); Esp., "Schmett. Eur.," iii., p. 143, pl. xxvii., figs. 1-7 (1784); Vill., "Linn. Ent.," pp. 133, 134 (1789); View., "Tab. Verz.," i., p. 37 (1789); Rossi, "Fauna Etrus.," p. 170 (1790); Bork., "Sys. Besch.," iii., p. 103, no. 28 (1790); "Rhein. Mag.," i., p. 368 (1793); Brahm, "Ins. Kal.," ii., p. 341 (1791); Donov., "Nat. Hist.," iii., p. 61, pl. xcv (1794); Hb., "Eur. Schmett.," iii., p. 144, pl. xl., figs. 179-180 (? 1800); "Larvæ Lep.," iii., Q. a.b. figs. 1*a-c* (? 1803); "Verz.," p. 192 (? 1822); Schrk., "Fauna Boica," ii., Abth. 1, p. 279, no. 1465 (1801); Abth. 2, p. 155, no. 15 (1802); Latr., "Genera, &c.," iv., p. 219 (1809); Ochs., "Die Schmett.," iii., p. 296 (1810); Germ., "Prod. Sist. Bomb.," p. 48 (1811); Godt., "Hist. Nat.," iv., p. 137, pl. xiii., figs. 3-4 (1822); Curt., "Brit. Ent.," expl. pl. 229 (1828); "Guide," p. 142 (1829); Stphs., "Ill. Haust.," ii., p. 49 (1828); "Cat. Brit. Ins.," p. 48 (1829); "List. Br. An. Br. Mus.," v., 1st ed., p. 47 (1850); 2nd ed., p. 44 (1856); Meig., "Eur. Schmett.," ii., p. 207 (1830); Wood, "Ind. Ent.," no. 50 (1839); Zett., "Ins. Lapp.," p. 926 (1840); Bdv., "Gen. et Ind.," p. 69, no. 563 (1840); Dup., "Cat. Lép. Eur.," p. 75 (1844); H.-Sch., "Sys. Bearb.," ii., p. 105 (1847); "Samm. auss. Schmett.," p. 9 (1856); Humph.

and Westd., "Brit. Moths," 2nd ed., i., p. 55, pl. x., figs. 11-12 (1851); Sta., "Man.," i., p. 156 (1857); Hein., "Schmett. Deutsch.," p. 208 (1859); Humph., "Gen. Brit. Moths," p. 25 (1860); Rbr., "Cat. Lép. And.," p. 349 (1866); Snell., "De Vlind.," p. 190 (1867); Nolck., "Lep. Fn. Est.," p. 127 (1868); Wallgrn., "Skand. Het.," ii., p. 75 (1869); Newm., "Brit. Moths," p. 42 (1869); Staud., "Cat.," p. 68 (1871); "Hor. Soc. Ent. Ross.," xiv., p. 356 (1877); "Rom. Mém. Lép.," vi., p. 314 (1892); Bang-Haas, "Nat. Tids.," (3), ix., p. 411 (1874); Guén., "Lép. Eure-et-Loir," p. 21 (1875); Mill., "Cat. Lép. Alp.-Mar.," p. 142 (1875); Curò, "Bull. Soc. Ent. It.," viii., p. 149 (1876); Kirby, "Eur. Butts. and Moths," p. 131 (1880); "Cat.," p. 839 (1892); "Handbook, &c.," iv., p. 124 (1897); Frey, "Lep. der Schweiz," p. 95 (1880); Oberth., "Etudes, &c.," v., p. 38 (1880); Lampa, "Ent. Tids.," vi., p. 41 (1885); Buckl., "Larvæ, &c.," iii., p. 78, pl. L., figs. 2-2*a* (1889); Auriv., "Nord. Fjär.," p. 62 (1889); "Iris," vii., p. 139 (1894); Rühl, "Soc. Ent.," v., p. 170 (1891); Ström, "Danm. Somm.," p. 83 (1891); Carad., "Iris," viii., p. 91 (1895); Meyr., "Handbook, &c.," p. 323 (1895); Tutt, "Brit. Moths," p. 58 (1896); "Proc. Sth. Lond. Ent. Soc.," pp. 1-11 (1898); Barr., "Lep. Brit.," iii., p. 13 (1896); Schröder, "Ill. Woch. Ent.," ii., pp. 673-8 (1897); Dyar, "Can. Ent.," xxx., pp. 4, 6 (1898); Grote, "Illus. Zeits. für Ent.," iii., p. 70 (1898); Reutti, "Lep. Bad.," 2nd ed., p. 57 (1898). *Pyri*, Scop., "Ent. Carn.," p. 199 (1763). *Annularis*, Geoff., "Fourc. Ent. Paris.," ii., p. 262, no. 16 (with ref. to *Hist. des Ins.*, ii., p. 114, no. 16) (1785). *Quercûs*, Esp., "Schmett. Eur.," pl. lxxxv (contd. pl. vi), fig. 3, Forts. p. 55 (1790). *Vulgaris*, Bkh., "Rhein. Mag.," i., p. 368, no. 226 *b* (1793). *Neustrius*, Haw., "Lep. Brit.," p. 129 (1803). *Bilineatus*, Haw., "Lep. Brit.," p. 130 (1803).

Original description.—*Phalaena* (*Bombyx*) elinguis, alis reversis flavescentibus: fascia grisea sesquialtera; subtus unica [Goed., "Ins.," i., t. 10; List., "Goed.," t. 89; Blank., "Ins.," 48, t. 8, figs. i-m; Rai, "Ins.," 213; Mer., "Eur.," i., t. 33?; Alb., "Ins.," 19, f. 27; Frisch, "Ins.," i., t. 2; Reaum., "Ins.," 2, t. 4, figs. 1-11; Roes., "Ins.," i., phal. 2, t. 6; Wilk., "Pap.," 21, t. 3, a. 10. Habitat in arboribus et herbis, polyphaga. Larva subpilosa, lineis albis rubris cæruleis. Verruca supra anum; hinc diversa a sequenti, cui maxime affinis statura et natura (Linné, *Syst. Nat.*, xth ed., p. 500). In the xiith ed., Linné leaves out the words "et herbis" in his account of the habitat, and adds: "Alarum strigæ duæ absque puncto" (*Syst. Nat.*, xiith ed., p. 818).

Imago.—Anterior wings from ochreous-yellow to deep red-brown, with two transverse strigæ from costa to inner margin, one before and one beyond the middle of the wing, the median area sometimes darker; cilia chequered with dark patches. The posterior wings of the same colour as the forewings, sometimes with faint median shade; cilia almost uniform.

Sexual dimorphism.—Several males measured varied between 31·25mm. and 37·5mm., and several females between 33mm. and 50mm., although these are not by any means extreme examples in either direction. The male is, on the whole, much smaller than the female, shorter and squarer-winged (due to the wings being shorter than, and yet almost as wide as, those of female), the male with comparatively slender, the female with large heavy, abdomen, the antennæ of the male strongly pectinated. The forewings of the male have a dark apical and two other lower dark patches in cilia, leaving three pale patches in the fringe, in the female these are less strongly marked. The hindwings with more markedly uniformly coloured cilia in the female; the hind margin also often distinctly sinuate in the latter sex.

Gynandromorphism.—Only two records of gynandromorphism in this species have come under our notice. These are:

α. On August 1st, 1882, I bred from larvæ a hermaphrodite example of *B. neustria*, ♂ on the left side, ♀ on the right, the last especially well developed; the left antenna is pectinated, the right filiform; the abdominal extremity terminated by two orifices. The specimen is also remarkable for its coloration, the male side being yellow, the other brown. The two colours are distinctly separated by a longitudinal line that divides the body into two parts so exactly that the head partakes of both colours (Buchillot, *Feuilles des Jeunes Naturalistes*, xii., p. 146).

β. The left side ♀, the right side ♂. In Staudinger's collection. Communicated *in litt.* (Schultz, *Illus. Wohenschrift für Ent.*, ii., p. 399).

Variation.—The British imagines of this species vary, in both sexes, from pale yellow-ochreous to deep rust-red, the forewings with two oblique lines, or with a dark median band, or unicolorous. Of course, many intermediate stages of colour and markings will be discovered if a large number of specimens be examined, but the greater number will be found to be included within the limits of the following table:

Ground colour pale ochreous.

(1) Pale ochreous, the forewings with two distinct transverse strigæ = ab. *quercûs*, Esp. (= ab. *quercina*, Selys).

(2) Pale ochreous, the forewings with the two transverse strigæ united = ab. *ochracea-confluens*, n. ab.

(3) Pale ochreous, the forewings with the space between the two transverse strigæ darker, and forming a median band = ab. *annularis*, Geoff.

(4) Pale ochreous, the forewings with a median band broken centrally = ab. *ochracea-fracta*, n. ab.

(5) Pale ochreous, the forewings with the lines and markings obsolete = ab. *ochracea-unicolor*, n. ab.

Ground colour yellow or buff.

(1) Yellow or buff, the forewings with two distinct transverse strigæ = *neustria*, Linn. (= *bilineatus*, Haw.).

(2) Yellow or buff, the forewings with the two transverse strigæ united = ab. *confluens*, Selys.

(3) Yellow or buff, the forewings with the space between the two transverse strigæ darker, and forming a median band = ab. *virgata*, n. ab.

(4) Yellow or buff, the forewings with the median band broken centrally = ab. *fracta*, n. ab.

(5) Yellow or buff, the forewings with the lines and markings obsolete = ab. *unicolor*, n. ab.

Ground colour pale fawn.

(1) Pale fawn, the forewings with two distinct transverse strigæ = ab. *cervina*, n. ab.

(2) Pale fawn, the forewings with the two transverse strigæ united = ab. *cervina-confluens*, n. ab.

(3) Pale fawn, the forewings with the space between the two strigæ darker, and forming a median band = ab. *cervina-virgata*, n. ab. (= *neustrius*, Haw.)

(4) Pale fawn, the forewings with the median band broken centrally = ab. *cervina-fracta*, n. ab.

(5) Pale fawn, the forewings with the lines and markings obsolete = ab. *cervina-unicolor*, n. ab.

Ground colour reddish-ochreous.

(1) Reddish-ochreous, the forewings with two distinct transverse strigæ (often paler than ground colour) = ab. *vulgaris*, Bork.

(2) Reddish-ochreous, the forewings with the two transverse strigæ united = ab. *rufescens-confluens*, n. ab.

(3) Reddish-ochreous, the forewings with the space between the two transverse strigæ forming a median band = ab. *rufescens-virgata*, n. ab.

(4) Reddish-ochreous, the forewings with the median band broken centrally = ab. *rufescens-fracta*, n. ab.

(5) Reddish-ochreous, the forewings with the lines and markings obsolete = ab. *rufescens-unicolor*, n. ab. (=? *unicolor*, Cyrilli).

Ground colour rust-red or red-brown.

(1) Deep rust-red or red-brown, the forewings with two distinct transverse strigæ (usually paler than the ground colour) = ab. *pyri*, Scop.

(2) Deep rust-red or red-brown, the forewings with the two transverse strigæ united = ab. *rufa-confluens*, n. ab.

(3) Deep rust-red or red-brown, the forewings with the space between the two strigæ forming a median band = ab. *rufa-virgata*, n. ab.

(4) Deep rust-red or red-brown, the forewings with the median band broken centrally = ab. *rufa-fracta*, n. ab.

(5) Deep rust-red or red-brown, the forewings with the lines and markings obsolete = ab. *rufa-unicolor*, n. ab.

It may be here observed that the transverse strigæ are, in reality, double, an inner darker line with an outer paler edge. In the pale specimens the dark line is conspicuous, in the dark specimens the pale border. Although the specimens produced from a single batch of eggs may differ considerably from each other, yet, as a general rule, the majority of the individuals of a brood are very similar to each other. Dollman observes that a brood of larvæ obtained at Angmering, on May 23rd, 1896, produced imagines from June 27th onwards, that varied from yellow-ochreous to chocolate, with simple lines crossing the wings or with a band between the same. Hills notes that the batches from Folkestone Warren appear to have a preponderance of reddish-ochreous forms, whilst large broods that we have bred from Farnboro' (Kent), have been entirely fawn-coloured. The very darkest rust-red examples we have seen have come from Milford Haven and Clevedon, others almost equally dark having been taken in Wicken Fen with pale yellow-ochreous forms. Barrett says that the darker examples are more common northward and in the eastern counties. Pearson notes that at Lincoln the specimens varied from light ochreous to dark ochreous-brown, that they were of a brick-red tint at Chilwell, whilst at Wannock they were all light ochreous in colour. Raynor observes that those from Toft are dark rufous in colour, whilst from Beeston he bred a small pale form. Grover notes the imagines as variable at Guildford, where, however, brown males are scarce, whilst Riding records that those bred from larvæ obtained at New Quay are mostly red-brown, only a few being yellowish-brown, Bouskell, too, notes a dark form without bands in both sexes at Quorn, and our general conclusions, based on a number of similar records, lead us to suppose that whilst particular districts produce a majority of a special form, the greater number of our darkest English specimens come from the more western localities. We have, in our collection, an absolutely white example (ab. *alba*, n. ab.) which was in the "Coverdale collection," without data, when we purchased the latter, and of which, therefore, we have no further information or knowledge. Outside England the same uncertainty prevails. Luff states that of three examples bred from Herm, one was yellow and two brown, Agassiz says that the form at Aix-les-Bains is deep brown, at Bourg d'Oisans we found the prevailing tint to be yellow. Borkhausen observes that aberrations are not infrequent in Germany, and that one specimen is rarely quite like another, some aberrations have the ground colour red-brown as in male *Pachygastria trifolii*, with the transverse lines pale yellow; he further adds that he has an example with one of the transverse lines partly absent, whilst Esper figures one with only one line. Zetterstedt says that in Lapland one finds entirely pale specimens with two fuscous strigæ, as well as dark unicolorous reddish-ochreous examples. Caradja observes that both brown and yellow forms occur in Roumania and the surrounding countries, whilst Oberthür remarks that all the specimens from the Isle of Askold are of a pale chamois-yellow, the form taken in Brittany being, on the contrary, of a very deep reddish-brown, although from Pavia, in Italy, he has specimens of the same type of coloration as those from Askold. Leech observes that the examples from Kiukiang are identical with European individuals. Graeser says that in Amurland all the males seen were of the pale clay-yellow colour, and that he never saw a brown male like those common in Europe, whilst Staudinger observes that specimens from China are like those from Amurland. Fletcher, however, who saw the species in amazing numbers at Kormiloff (*vide, posteà*, pp. 552-553) says that the males vary from pale whitish-ochreous to dark chocolate red-brown, and from specimens with well-defined fasciæ to those almost unicolorous; he further observes the great difference in size that is exhibited by various individuals. There is often considerable variation in the width of the space between the two transverse lines (sometimes filled in to form a band). Simes records an aberration in which the transverse lines are confluent on one side only. Studd observes that specimens bred from Tiverton show great variation in the width of the bands of the forewings, some being reduced to mere blotches on the costal and inner margins. Fologne figures (*Ann. Soc. Ent. Belg.*, vii., pl. iii., fig. 3) a female with the median band starting from the costa, arrested at the middle of the wing, making a triangular blotch, similar forms, he says, were bred in both sexes. Barrett also observes that similar aberrations occur in both sexes, with the two transverse lines coalescing, leaving an upper and lower blotch; further, that some specimens of rich brown colour have the two lines white, and the central band dusted with the same. In almost every really good collection one finds several interesting examples of this species. In looking through Webb's collection, chiefly of picked specimens, we noted that of the yellow examples most of the females are of a distinctly warm yellow, and not pale ochreous in tint, and one finds banded individuals very frequent in the members of this group, as well as in the rather more definite buff-coloured examples. Some of the buff females are distinctly suffused with red, and are, in a few instances, quite rosy tinged. Some of the fawn-coloured examples tend to become ruddy with a distinctly pink band (of which one female has the latter broken). It is also noticeable that when the transverse lines unite in the reddest examples they tend to form a pale median fascia, such as one occasionally sees in parallel aberrations of *Macrothylacia rubi*. The red-brown ♂ examples from the "Hopley collection" are very striking* and remind one much of the American *M. americana*, they have very distinctly marked cilia, chequered with white and red-brown; the transverse lines of the forewings whitish, the central area strongly sprinkled with white scales, the inner line curving round to the thorax, sometimes without reaching the inner margin (just as in *M. castrensis*), this peculiarity (in *M. neustria*) is due to the fact that the basal portion of the inner margin is strongly grey, as is the central area, and continuous with the latter. Another example from the "Hopley collection," evidently of the same type (possibly of the same batch) is intermediate, presenting

* It may be remarked that Oberthür notes (*anteà*, p. 534) certain *M. castrensis* as being similar to *M. americana*. One suspects this form is the "rich brown" variety referred to by Barrett (*suprà*).

all the peculiarities of colour of the two examples just noticed, but the inner line though curved basally, distinctly reaches, as in typical *M. neustria*, the inner margin. There are some specimens (♂ and ♀) from the "Frey coll." in the British Museum collection that are distinctly brown rather than red-brown. None of the examples that we have examined, however, would appear to approach that which Frings describes from the Bonner district of Switzerland, which he says is pale yellow in colour, but with the outer half of the forewings deep red-brown, and with no transverse lines. Gadge exhibited at the meeting of the South London Entomological Society, September 28th, 1899, a specimen with three wings, there being no trace of the left forewing. The original diagnoses of the described forms appear to be as follows:

α. ab. *quercûs*, Esp., "Schmett. Eur.," Forts. p. 35, pl. lxxxv (contd. pl. vi), fig. 3 (1790).—Alis reversis pallide ochraceis, strigis duabus arcuatis transversis, rufis. The normal form is of a reddish-ochreous tint with a broad dark band. In this aberration the ground colour is pale yellowish, the area in the usual position of the band is of the same tint as the rest of the wing, but there are two reddish-brown transverse lines (Esper). This is evidently the same as ab. *quercina*, Selys, "Ann. Soc. Ent. Belg.," i., p. 55 (1857).—The four wings pale yellow, the anteriors with two dark brown transverse lines (Selys).

Borkhausen compares (*Rhein. Mag.*, i., pp. 368, 369) this form with the reddish-ochreous specimens which he terms *vulgaris*, describing var. *quercûs* as: "Alis reversis flavis; fascia sesquialtera rufa, subtus unica. Esp., Forts. tab. lxxxv., fig. 3." He then states that he found this latter "on oak and birch, but is still doubtful whether it is a distinct species, for in the females he has found the most gentle gradations between the two forms, although the extremes are constantly different from each other, and the fringes are as chequered in his examples of var. *quercûs* as in the common *neustria*. He comments on Esper's statement that the larva has not such fine blue stripes in ab. *quercûs*, and that it is shorter than that of the common *neustria*, but considers that the two forms should be bred from the egg before *quercûs* is given specific rank.

β. ab. *bilineatus*, Haw., "Lep. Brit.," (1), p. 130 (1803) = *neustria*, Linné.—*Bombyx bilineatus* (The striped Tree Lackey). Omnino lutescens, alis anticis strigis duabus cervinis. . . . Expansio alarum mar. 1 unc. 6 lin. Mas simillimus præcedenti (*neustrius*), magnitudine et statura; colore tantum differt. Antennæ griseæ. Thorax flavescens. Abdomen flavo-grisescens. Alæ omnes flavescentes, subinde tinctura grisea; anticæ strigis duabus gracilibus pallide cervinis (nec medio saturatiores strigis 2 flavescentibus ut in præcedente) ciliis cervinis flavisque (Haworth). This evidently agrees with the Linnean type.

γ. ab. *confluens*, Selys, "Ann. Soc. Ent. Belg.," i., p. 56 (1857).—The two transverse lines of the forewings confluent medially (Fologne has an example in which the band is incomplete) (Selys).

δ. ab. *annularis*, Geoff., "Fourc. Ent. Paris.," ii., p. 262, no. 16 (1785).—*Phalaena annularis*. La Livrée. Long. 8 lign. *Phalaena* pecticornis elinguis, alis deflexis pallidis, fasciâ alarum transversali saturatiore. Loc: Larva truncos arborum habitat, abundans (Geoffroy).

ε. ab. *cervina-virgata*, n. ab. = *neustrius*, Haw., "Lep. Brit.," p. 129 (1803).—*Bombyx neustrius* (The barred Tree Lackey). Thorace alisque griseis, fascia saturatiore media, utrinque striga pallida terminata. . . . Expansio alarum mar. 1 unc. 5 lin., fem. 1 unc. 9 lin. Imago simillima præcedenti (*castrensus*) magnitudine et statura, sed vero differt. Maris thorax cervinus nec flavescens. Alæ minus lutescentes. Femina mare pallidior nec saturatior et saturate cervina ut in præcedente (Haworth).

ξ. ab. *vulgaris*, Bork., "Rhein. Mag.," i., pp. 368, 369 (1793).—*Phalaena Bombyx neustria vulgaris*. Alis reversis rufo-ochraceis, fascia pallidiore flavescente sesquialtero, subtus unica. Linn., no. 35. Esp., tab. xxvii., figs. 1-7. Common everywhere—unfortunately! (Borkhausen).

η. ?ab. *unicolor*, Cyr., "Entom. Neap.," p. 3, pl. iii., fig. 6 (1787).—*Bombyx* *unicolor*. Alis reversis ex luteo-ferrugineis, unicoloribus. Habitat in Japygia D. Mann. Descr: Magnitudo media. Antennæ setaceæ breves. Thorax pilosus. Alæ omnes integerrimæ, ex luteo-ferrugineæ.

Prout says: The figure may very well represent the unicolorous ♀ of *M. neustria*. Schläger refers it to *M. franconica*, but Werneburg (ii., p. 152) says the insect appears to him to be too stoutly built and the wings too broad for the latter, and he suspects that Cyrilli had an unicolorous ♀ *M. neustria* before him. He further suggests that it may even be the same example that Fabricius later described as *ferruginea*, for Fabricius received his example from Italy, from Signor Allioni.

θ. ab. *pyri*, Scop., "Ent. Carn.," p. 199 (1763).—*Phalaena pyri*. Long. lin. 7½, lat. 5. Cinnanomaea (*sic*); dorso tomentoso; alis anticis supra strigis duabus pallidioribus, posticis subtus limbo pallidiore. In *Pyro* reperta larva, ejusque foliis enutrita, ut et foliis *Populi albae*. Antennæ alis concolores. Dorsum denso villo tomentosum, nec tamen cristatum. Alæ deflexæ; anticæ striis binis paleaceis, quarum postica margini externo parallela, margo idem lineolis binis albis notatus. Sub his alis strigæ nullæ. Larva superne nigra; linea dorsali et laterali glaucis, quibus adjacet linea alia fulva; capite glauco; punctis duobus nigris. Folliculus duplex, albus, tenuis, oblongus (Scopoli).

ι. var. *parallela*, Stdgr., "Stett. Ent. Zeit.," xlviii., p. 98 (1887); Kirby, "Cat.," p. 839 (1892); Auriv., "Iris," vii., p. 139 (1894).—The central Asiatic form differs from the European specimens not very strikingly, but yet constantly enough to be quoted as a local form. I possess a male and two females found at Samarkand from middle to end of June, a worn male caught June 18th at Namangan, and two apparently bred pairs from Issyk-Kul. I also refer to this form two pairs from north Persia. The males of this form are all more or less dark brown, an unusual colour for the species in Europe. The females are yellowish, with darker central bands on forewings, as is common in European specimens, but the two north Persian ♀ s are similarly coloured to the dull brown males with yellow transverse lines. On the other hand, the hindwings of all the ♀ s are more or less brown. The most striking feature of this variety is, however, the form of the two (light or brown) transverse lines of the forewings, which enclose a central band; the two lines are almost parallel, being externally somewhat convex, a character not exhibited by any example of my long series of this insect from districts extending from Andalusia to the Amur district. Alpheraky has already noted a male from the Kuldja district as small and entirely dark brown (Staudinger).

Alpheraky notes (*Rom. Mém.*, vi., pp. 16-17) the capture of a single male on the banks of the Khardjitaï in Ordos, on August 19th, 1884, the wings uniform pale yellowish-grey, the two median lines, scarcely wavy, are almost parallel and very widely separated. It is thus, he says, a form which, except in its pale colour, appears to come near var. *parallela*, Staud., and is at any rate very different from the European specimens with which he has been able to compare it.

κ. var *testacea*, Motsch., "Et. Ent.," ix., p. 32 (1860); Leech, "Proc. Zool. Soc. Lond.," 1888, p. 627; Kirby, "Cat. Lep.," p. 839 (1892).—*Clisiocampa testacea*, Motsch., figura *C. neustriae*, sed minor, dilutior, alis anticis apice longioribus, angulis magis prominulis, margine postico vix arcuatis. Exp. al. 10 lin. (Motschulsky). Localities: Nagahama, Nagasaki, Gensan (Leech), Yokohama, Oiwaki (Pryer), Kiukiang (Pratt), Corea, Kobé, Kormiloff, Port Lazaref (Fletcher).

Leech unites *testacea* with *neustria*, and states that he took specimens at Nagasaki in June, and at Gensan in July. These, with a number from Pryer's collection, make up a good series, exhibiting much variation, but nothing calling for special notice. Fletcher adds that he found the insect just emerging at Kobé on June 11th, 1897; the cocoons very common, made up under the eaves or on the walls of houses. Afterwards abundant at Gensan, in Corea, on July 8th-9th, but at Kormiloff, from July 13th-24th, in incredible abundance, coming to the upper-deck (electric) lights literally in thousands—forty and fifty around one lamp was nothing unusual, and in the morning they were swept up in heaps on the deck and thrown overboard. He states that he has never seen a moth in such numbers, they were simply everywhere. Their flight is swift but jerky, and the moth buzzes about with the abdomen turned up. It darts at the light, then drops to the deck where it buzzes helplessly round and round in a circle. This habit is fatal on a wet night as they then get their wings spoilt and clogged by buzzing on the wet deck. The female flies more slowly, and settles oftener. The variation in the size of individuals of the sexes is very great. Reference has already been made to the wide range in its coloration (*anteà*, p. 550). Fletcher further notes that, at Port Lazaref, in October, 1897, the eggs (arranged in the usual bracelet fashion around a twig) and empty cocoons were very common.

Egg-laying.—The well known eggs of this moth are arranged in a close spiral, round a twig, in contact with each other, and really laid upon each other, rather than upon the twig, so that although the micropylar axis is vertical to the twig, and one gets an idea that the eggs are upright, yet they are really flat eggs, with the micropylar axis horizontal. That each egg is laid upon another, and not upon the twig, is shown when the twig shrinks, for the eggs then come off *en masse*. The first row of eggs laid is really almost horizontally placed, the succeeding ring being laid thereon. The eggs are embedded in a thick liquid gum, which cements them into a bracelet-like ring, leaving, however, the micropyles of the eggs from which the larvæ make their escape free. We have already noted (*anteà*, p. 526) Reaumur's account of the glands in which this gum is secreted. Moncreaff states that on the lower part of the abdomen of the female of *M. neustria* are two pear-shaped glands filled with liquid gum, and as each egg passes these it becomes coated with the cement, which, on exposure to the atmosphere, quickly hardens. It is insoluble in water, and so tenacious that pieces of cardboard secured together by it cannot be separated without tearing. Newman says the cement is not disintegrated by wet, but retains the eggshells *in situ* for many years. Reaumur gives (*Mém.*, ii., p. 95) a most graphic account of these egg-bracelets. He writes: "Ces nids d'œufs entourent un jet de poirier, de pommier, de pêcher, de prunier, comme les bagues ordinaires entourent les doigts, ou comme les bracelets entourent les bras. Ils ressemblent tout-à-fait aux bracelets de grains d'émail; chaque œuf tient ici lieu d'un de ces grains. Il entre depuis 200 jusqu'a 350 œufs dans chaque bracelet. On ne voit que leur partie supérieure dont le contour est rond et blanc; le milieu est plus brun; la sommité est toujours marquée par un point noir. Ces grains ou œufs, qui se touchent seulement par quelques endroits de leur contour, et qui sont pressés les uns contre les autres, laissent nécessairement entre eux des espaces qui sont remplis par une espece de gomme brune, dure et cassante. La largeur du bracelet est formée par 14 à 15 rangs, et jusqu'à 17 rangs d'œufs. Ils ne sont pas placés précisément sur la circonférence d'un cercle, ils sont disposés en tours de spirale, qui quelquefois s'éloignent peu de la figure circulaire." Nördlinger notes that as many as 400 eggs have been counted in one ring, but Dollman states that they do not average more than from 100-200. Our calculations come between these numbers, and have fallen between 230 and 300. A batch of eggs from Wicken Fen hatched on March 13th, and continued to do so, a few each day until April 1st (Pearson), another batch found on a sallow twig at Braunton hatched April 23rd, 1893 (Bartlett). One egg hatched about 10 p.m. on April 21st, 1900 (batch from Folkestone), the remainder between 9 p.m.-11 p.m. the following day, practically the whole lot being out by noon. On April 27th, 1900, another batch (on same twig as former one) produced one larva, two or three on the 28th, more on the 30th, whilst the remainder appeared on May 1st. Reaumur observed that eggs laid on rose-bushes hatch some weeks earlier (often quite early in April) than when laid on peach-trees, &c. Hawes once found a cluster of eggs laid around the fruit stalk of a pear.

Ovum.—The manner in which the eggs are laid make it difficult to determine the shape of each egg, but the eggs appear (from above) to consist of loose, roughly circular bags, with a central, raised, life-belt looking structure placed on the top (the micropylar end) of each, this latter rather wider than the lower portion of the egg, and, therefore, extends beyond it. The central portion of this upper piece is depressed, dark brown in colour, with the true micropyle prominent as a minute raised button, with a distinct lateral black point in the middle of the depression. The eggs are white in colour, the exposed parts strongly grooved rather than reticulated. The most striking feature of the egg-mass, however, is the brown gummy-looking material, in which the eggs are firmly embedded, and which, dried, looks like irregular pieces of membrane between them. Looked at sideways, it is seen that the lower part of the egg (*i.e.*, the part below the structure previously said to resemble a life-belt) is cylindrical in shape and brown in colour, the latter again being due to the gum in which the eggs are embedded. Reaumur writes (*Mém.*, ii., p. 96) : La forme de chaque œuf tient de celle d'une piramide tronquée à quatre faces qui ne sont pas bien planes; elles ont quelque rondeur, et elles se rencontrent par des angles obtus. La piramide est posée de maniere que la partie de l'œuf, qui est visible, est la base de cette piramide, et que le bout où la piramide est tronquée, est le plus proche de la branche, à la circonférence de laquelle les axes de ces piramides sont perpendiculaires. Il suit de la figure de ces œufs qu'ils ne se touchent que par quelques endroits de leur bord extérieur ; qu'ils sont, surtout, séparés les uns des autres vers leur bout le plus proche de la branche de l'arbre. Tous les vuides qu'ils laissent entre eux sont remplis par la gomme dont nous avons parlé, dans laquelle ils sont tous enchâssés et comme sertis. Le lit de gomme dans lequel ils sont logés va par de-là leurs bouts, et les empêche de toucher l'ècorce de l'arbre.

Habits of larva.—The larvæ leave the egg by an aperture made in the micropylar area, and at once commence to spin a web, in (or on) which they live gregariously, enlarging it as they have to spread out further for food, but remaining in groups until the last instar, after which they live solitarily until pupation. Ratzeburg noticed that when the larvæ hatched in cold weather they remained some days on the egg-ring. From one batch of eggs it will often be found that several colonies have originated, and that these are not united by any close connecting band of web. It frequently happens, too, that (? freshly-moulted) larvæ may be seen in numbers, lying side by side on the stems of trees or bushes, without much web, and stragglers of various ages may be found scattered about solitarily, although the fact remains that the larvæ generally prefer to form a web in common until they have undergone the last ecdysis. When living solitarily they spread themselves over a considerable area. According to Ratzeburg they feed both by day and by night, but Schröder has observed that they do so chiefly in the cooler hours of the morning and particularly in the evening, the latter appearing to be the chief time chosen for feeding. Stephens says that in changeable weather all the individuals which are resting on the outside of the nest simultaneously and repeatedly elevate the anterior part of their bodies, as the larvæ of *Hylobius pini* are said to do. Harrison has noticed that in the early morning as the sun reaches them they jerk their heads and thoracic segments violently from side to side, and this they keep up for some time. In fine weather when shelter is unnecessary the larvæ rest on the bark of a branch, crowding together in scores or hundreds, and covering a large space, and Barrett says that if necessary they leave the original habitation and construct another and others successively, so as to have plenty of food at hand. Schmidberger once saw larvæ busily engaged in repairing and enlarging a "gold-tail" web, which they occupied together with the "gold-tails," feeding with them and accepting them as members of the same family. Newman observes that when about to change their skins the larvæ fix themselves on the outside of the tent, where they undergo the process of moulting, the old skins adhering to the roof of their dwelling; he has noticed more than fifty of the cast-off skins decorating the exterior of a single tent. Dollman says that the larvæ whilst gregarious prefer to sit on the web, that they are very shy, and that if the twig be touched will fall to the ground; when on the move they are very active, and Mrs. Cowl notes that the larvæ bask in rows in the sunshine on the webs, which she observed were placed at the top of a roadside hedge near Brockenhurst. There appears to be considerable diversity, as we have already pointed out as to the habit of remaining in the web. Thus we observe: The young larvæ remain in the web till the second instar (Lane); larvæ found at Binstead left the web when half-grown and lived solitarily (Moberly); the larvæ when young rest within the web when not feeding, but separate after moulting for the last time (Fenn). Newman observes that when the larva is full-fed it rests in a straight position, but falls off its food-plant if slightly shaken; it does not roll in a ring nor feign death, but immediately crawls towards the trunk of the tree whence it has fallen and begins to reascend. The larvæ sometimes occur in incredible numbers, and Graeser notes them as being in "indescribable abundance" in 1885, at Wladiwostock, all the oaks being stripped by them. Walker states that he has often seen the oaks almost defoliated by the larvæ of this species at Algeçiras, near Gibraltar. Schröder observes that in Germany in some seasons they eat whole orchards bare, and for the three years preceding 1897 the trees in the grounds in the neighbourhood of Neumünster were so completely stripped that not only was the crop destroyed but the trees themselves in many cases had died. Jenyns notes the larvæ as being the pest of the hedges in Cambridgeshire, swarming in some seasons so that the foliage has been stripped from them and the bushes laid as completely bare as in the depth of winter. Stephens observes that fruit trees are sometimes quite defoliated by them in the south-eastern counties. Daws notes the larvæ as being sometimes destructive to the foliage of apple trees in the Penzance district.

Millière also observes that they often inflict great damage on the fruit trees in southern France. In 1867 the larvæ were extremely abundant in the London district, being especially noticeable in the parks—Green Park, St. James's Park, &c., on the railings (T. H. Briggs). In June, 1890, the fruit trees were stripped in the Gloucester district (Watkins); usually a pest in Worcestershire (Rea); the larvæ often do damage in apple orchards in the King's Lynn district (Atmore); generally a pest in Belgium (Lambillion); larvæ swarmed at Hitchin in May and June, 1898, when webs of young larvæ were to be found on almost every bush and hedge in the district. They were more particularly abundant on *Prunus spinosa* and *Crataegus oxyacantha*, as well as the plum trees in orchards and gardens (Cottam); often excessively abundant in Beds and doing considerable damage, when a half-pint of petroleum put in a pail of water forms an excellent mixture to syringe on the webs in order to destroy the larvæ (Bond-Smith). On May 17th, 1897, the larvæ were very abundant at Langhorne; nine separate colonies were counted in a distance of 40 yards (Jefferys). It was the insect of the year at Oxton in 1897, being exceedingly abundant (Studd). The larvæ are very injurious to fruit trees both in the Netherlands and Belgium (Heylaerts). Even in Switzerland, where the species is not generally reputed to be very common, Frey says that it is often injurious to fruit trees. It may be well to point out that Balbiana states that the larvæ of *M. neustria* can readily be infected with pébrine, and is, in fact, more susceptible to the disease than is the silkworm (*Bombyx mori*) itself.

Larva.—In the *first stadium* the head (though comparatively large on emergence) is small when well-grown in this instar, black, smooth, shiny, rather tall, tending to be square, with small bright brown hairs scattered over it. The body of fairly even thickness; thoracic segments slightly more bulky than abdominals, which slightly taper towards anus; a slight lateral flange present; hairs light brown, tapering, serrated or finely thorned, some very long (on dorsal area some are quite half the length of larva). Legs black and shiny. Prolegs pale but not distinctively coloured. Skin smooth, without spicules. Colour black or dusky, the dorsal area yellowish-orange, with a dark longitudinal median band; the orange colour most strongly developed as a border to this band, and fading gradually into the ground colour on outer area of dorsum; sides dusky, but suggesting differently coloured bands; a whitish subspiracular band coincident with the flange; the coloration is most marked on the middle abdominal segments fading out on the thoracic and anal segments. Each abdominal segment appears to be divided into four subsegments, and the thoracic into five or six, but they are of unequal size and clearness, differing according as the point of view be lateral or dorsal, the larger ones appear to have less distinctly marked subdivisions when the larva is in movement. The tubercles are shiny black, the larger ones chitinous and raised, giving rise to three or more hairs, and thus form warts; i bears about five hairs on the abdominal and seven or eight on the meso- and metathoracic segments, ii is very small, bearing two hairs on the abdominal and a very minute one only on the meso- and metathoracic segments; there is a minute single-haired tubercle in addition to ii on dorsal area; ii is farther from the median line than i, and the additional tubercle is almost exactly behind i longitudinally and transversely in line with ii; this extra tubercle occurs also on the meso- and metathorax, and is probably closely connected with ii (possibly belonging to its group); there is also a small single-haired tubercle on anterior edge of abdominal segments, slightly anterior to i, and yet another equally far forward, midway between this and the supplementary prespiracular wart (described later); iii is small, but wart-like, and bears two small hairs; iv and v are puzzling—on the lateral ridge beneath the spiracle, and rather posterior to it, is a two-haired tubercle, which is probably iv (but might doubtfully be iv and v combined), just in front of it and beneath spiracle is a small single-haired tubercle which is probably v (but might be supplementary); in front of this again, and slightly before the spiracle but on the lateral flange, is a similar single-haired tubercle, which might be supplementary to v (if the one just previously mentioned be v). There is also a supplementary prespiracular wart (carrying three tubercular hairs) above the flange, in horizontal line with the spiracle, on the anterior edge of segment (actually anterior to i), and there is also a small single-haired tubercle a short distance directly below this. Tubercle vii is present, and there are one or two other minute single-haired tubercles, the position of which I have not exactly noted. The spiracles are not easily made out; their position, however, is determinable by a dimple in the skin, noticeable when the larva is moving (Bacot. Described April 27th, 1900, from larvæ hatched April 22nd, from eggs obtained in Folkestone Warren by Mr. Hills). In the *second stadium* the larva is very strikingly marked with the longitudinal lines that characterise its adult stage. The head is shiny black, sparingly covered with tubercular points giving rise to black hairs, the ocelli black. The prothorax is swollen, velvety in appearance, with two large, black, lateral warts bearing radiate black hairs. The ground colour of the other segments is also black. The mesothorax, metathorax, and the abdominal segments, have a narrow, white, longitudinal band, on each side of the broader median band (of the ground colour), then a broad band of the ground colour, followed by a well-marked white supraspiracular, and a less clear spiracular, line, extending to the 8th abdominal segment, which is swollen, slightly humped, and of a velvety-black colour; the pale longitudinal lines are continued on the 9th abdominal, but the anal segment again is black. A series of dorsal orange blotches crosses the intersegmental areas between 2-3, 3-4, 4-5, 5-6, 6-7 and the posterior edge of 7 (the last not crossing to 8), without, however, disturbing the mediodorsal line of the ground colour; where these areas occur the white of the inner dorsal line is largely replaced by orange, leaving only a small portion of the line in the centre of each segment white. Some of the long hairs on the prothorax are black, but the remainder of the body hairs are brown. The meso- and metathorax are subdivided into three subsegments, the abdominal segments 1-7 being divided into two, the anterior being broad, the posterior comparatively narrow. On the meso- and metathorax is a black raised wart-like tubercle on either side of the 2nd subsegment of each of these segments, situated between the dorsal and subdorsal longitudinal lines and giving rise to two (rarely three) radiating brown hairs (less long and less red than those of *M. castrensis*); on the abdominal segments 1-7, is a similar pair of wart-like tubercles on the wide 1st subsegment. So far as can be detected the ordinary tubercles are still much as in the first stadium, but are already much obscured by secondary hairs, and the hairs arising from the tubercles themselves appear to be more numerous. There is a pale subspiracular flange, broken by the segmental incisions running above the legs, from the mesothorax to the 7th abdominal. The spiracles black and practically indistinguishable under a two-thirds lens. The ventral area is blackish-grey; the true legs black, with pale grey joints; the prolegs blackish-grey, with a grey plate on the outside, the retractile terminal joint yellow, and bearing many black hooks. The *full-grown larva* has the head rounded, antennæ rather long, surface dull, colour greyish-blue with a distinct bloom, an obliquely set oblong black spot on either side of median suture above clypeal triangle (these spots give the characteristic face-like appearance to the head of the larva of *M. neustria*) ; mouth-parts shiny, black ; on sides of head some darker blue-grey mottlings and a few small black spots ; many fine hairs scattered over head, those on face mostly short and black, those on crown, sides, and especially the downward sweeping fringe just above mouth, larger, longer, and bright brown in colour. Body of even thickness, slightly humped on 8th abdominal segment ; dorsal area velvety-black, a very distinctly marked white mediodorsal band of irregular width, narrowly bordered with the velvety black of the ground colour ; this is followed by a narrow, somewhat broken, bright vermilion-red streak, a somewhat broader stripe of the black ground colour separates this from a second narrower and more broken red streak, the black ground colour between these red streaks is, in places, slightly mottled with blue ; the outer red streak is separated from a broad rather greyish-blue subdorsal band by a narrow streak of the ground colour ; the greyish-blue subdorsal band spreads upwards to the dorsal, and downwards to the lateral, area on prothorax ; beneath this subdorsal band, but still well above the spiracles, is a broad streak or narrow band of bright orange, somewhat irregular in width, and broken. This is also narrowly edged with black, rather more heavily above than beneath ; the spiracular area (beneath the orange band) is irregularly streaked and mottled with pale bluish-grey, white, black and red ; the red and white mottlings show a tendency to form an exceedingly irregular and broken spiracular band ; ventral area blue-grey, mottled with black. The hairy coat is more scanty than that of the larva of *M. castrensis*, but the same tendency for it to be least developed on the subdorsal and upper lateral areas is noticeable, it is, however, most decidedly scantier on the gaily-coloured dorsal area of *M. neustria* than on that of the more sober-tinted *M. castrensis ;* on *M. neustria* the longer dorsal hairs are black, and rise from the position occupied in the early stages by the anterior trapezoidals, the short dorsal and the lateral hairs are pale brown, not nearly so bright as those of *M. castrensis;* those on the lateral area have the same tendency as in *M. castrensis* to be collected into downward-sweeping tufts ; the persistence of the black ground-colour, round the bases of the hairs arising from the white and blue areas is as noticeable a feature in *M. neustria* as in *M. castrensis*, and is especially well marked on the blue subdorsal band ; the ground colour also persists strongly on the raised area of the 8th abdominal segment ; there is, too, a marked tendency for the black border on the upper side of the orange lateral band to encroach on the blue band above it, and to form a black spot in it, at or near the middle of each segment ; this spot is large and distinct on the 8th and 9th abdominal segments; there is also a large black spot in this position on each thoracic segment (strongest on the pro-, and weakest on the metathorax), rather more dorsal on the prothorax. True legs black and shiny. Prolegs dark indigo-blue (Bacot). Linné gave a very recognisable description of the *adult larva*, which reads: "Larva subpilosa, lineis albis rubris cæruleis. Verruca supra anum; hinc diversa a sequenti (*castrensis*), cui maxime affinis statura et natura" (*Sys. Nat.*, 12th ed., p. 818). Fenn describes the *adult larva* as having: The head rounded, greyish-blue in tint, with two striking black spots one on each lobe; the body cylindrical, hairy at the sides, the dorsum smooth; longitudinal stripes of different colours, dorsal line white and conspicuous, a band on each side orange-red, margined with blackish, subdorsal line dark-grey, a broad blue band on each side above the spiracles, in the centre of which band appears the orange, black-edged spiracular line; the spiracles black, beneath them a fringe of fulvous hairs; two black opposite spots on the 2nd segment; the 12th segment with small, black, dorsal projection; venter slate-coloured with a row of diamond-shaped black spots down the centre; spiracular region irrorated with white; each of the normal tubercles emits a few black hairs.

Variation of larva.—The larval markings are arranged in linear series extending from the prothorax to the anus; these lines are of different colours, and are crossed by the greyish-black segmental incisions. There are two chief forms of the larva, one in which red, the other in which brown predominates. Buckler figures (plate l., figs. 2, 2*a*) both forms:

(1) With the dorsal area red, with a fine white mediodorsal line, and a fine black latero-dorsal line on each side running through the red; a bluish supra-spiracular, and a red spiracular line; the ventral area bluish-grey.

(2) Yellowish-brown, with a white medio-dorsal line; dark brown latero-dorsal lines, separated on each side by a well-marked black line; a blue supraspiracular line; the area below the latter yellowish-brown.

Pupation.—The larvæ usually spin their cocoons within a curled leaf, or in the fork of two or three twigs, but other places are frequently chosen, and the overhanging ledges of fences and walls, cracks and crannies in fences, or the bark of a tree, are places in which we have observed them. Others report the cocoons as: Often placed behind, or woven among, the living leaves of a tree, or under ledges, or in crannies of the bark (E. S. Harrison), spun up among the leaves of the food-plant frequently in a single leaf (Fenn), to be found at the base of stems of whitethorn, or spun up in dead leaves, or upon fences near food-plant (Grover), placed under copings on walls, or on twigs, whilst one was found in a leaf of rhubarb, and another in a mulberry leaf (Hancock), found in all sorts of situations, very frequently under the cross-pieces of posts and fences (Whittle), placed in a curled leaf, or on the bark of a twig, branch, or trunk, or on some neighbouring fence, wall, or other convenient place, always in a chink or corner and the less conspicuous, as it is not very unlike the egg-covering of a large spider (Barrett), spins up on a fence, railing, tree-trunk, stone wall, or spins together the leaves of its food-plant (Newman), many under the coping of rather high walls at Portslade and Hythe (Colthrup), usually placed among the food-plant (Dollman), found under the ledges of fences at Hoddesdon (Bayne), under copings of walls at varying heights from the ground, as a rule as high as possible (Phillips), under the leaves of low plants and in cracks of walls at Namur (Lambillion), in the angle formed by the coping stone with the bricks of a wall, also in angles formed by the upright and cross pales of a wooden fence (Sich). Horton observes that he once found two cocoons, linked together, hanging on a reed, near the sea at Looe.

Cocoon.—The cocoon is about 24mm.-30mm. in length, and 10mm.-12mm. in width. It consists of a loose outer web of whitish silk, enclosing a closely spun, strong, oval, inner cocoon, thickly sprinkled (when made by healthy and well-fed larvæ) with particles of a yellow powder. This powder consists of very minute crystals formed from a substance secreted by the malpighian tubules and discharged from the anus of the larva. The yellow colour is said to be probably an unstable organic pigment, as it is destroyed at a comparatively low temperature, leaving the crystals unaltered. The crystals themselves have been shown to be composed of calcium carbonate in the form of aragonite. Harrison has observed that the cocoons, instead of being felted like those of *Lasiocampa quercûs*, are more or less thickly coated with a pollen-like dust, but this latter is absent in the cocoons spun by poorly fed larvæ. Rössler describes the yellow material as "a sharply irritating dust." Bacot says that the cocoon of the female is 2mm.-3mm. wider than that of the male; the outline of the pupa sometimes easily seen through the material; the loose, flimsy, outer structure of irregular size and shape, in which the cocoon proper is placed, is used to attach the latter to the object on or among which the larva spins.

Double and triple cocoons.—Ingall notes that on July 3rd, 1836, he found a cocoon which contained two pupæ, male and female. Prideaux records that in 1888 two larvæ spun a common cocoon from which the moths emerged in no way malformed. Simes notices two cocoons that contained respectively two and three pupæ, and Montgomery observes that he has sometimes found two and even three pupæ in one cocoon in confinement. Mansbridge records a cocoon which contained two pupæ, and observed that though the imagines had emerged from the pupa-cases they were unable to get out of the cocoon; the latter is described as consisting of a single cavity partially divided.

Pupa.—♂ 14mm.-14·75mm. in length, 4·75mm. in width (at broadest part). ♀ 17·25mm.-21·2mm. in length, 8mm. in width (at end of wing-cases = the widest part). *Female pupa:* Laterally the outline is that of a bow—straight along the ventral area, arched dorsally from the somewhat rounded anus upwards to the large 4th abdominal segment, and more rapidly to the bluntly rounded head from the 2nd abdominal segment. Colour black, or very dark brown; smooth; wings, legs, antennæ, and face-parts, also 8th and 9th abdominal segments, shiny; remaining surface dull, for the most part covered with fine hairs, which entangle the yellow particles of aragonite from the cocoon and some of the larval hairs; the dorsum of anal segment prolonged, projecting considerably beyond the anus, which is ventral; the anal armature consists of short, stout bristles, slightly knobbed at apices, best developed and thickest at extremity, but covering altogether a large portion of anal segment and running back to its margin dorsally; the position of anal orifice and sexual organs well and clearly marked; the spiracles are not remarkable, that on the 3rd abdominal segment just shows at edge of hindwings; the metathorax is very short, the mesothorax very long, the prothorax fairly large with a portion separated in front by a suture, but which does not separate from it on dehiscence; this is apparently the dorsal head-piece; the caput, to which the antennæ and eye-pieces articulate, is slightly ventral in position, and bears a few hairs as does also a small triangle beneath it and just above the mouth-parts; these latter show up very clearly, being pale brown in colour, very delicate in appearance, and differing greatly from any other portion of the pupa; the 1st abdominal segment is very short, the 2nd, 3rd and 4th increase in size, the 4th being the largest of the body, the forewings are small, short, extending to nearly the end of the 4th abdominal; a narrow strip of the hindwings runs from the metathorax to about three-quarters over the 3rd abdominal; the tips of the third pair of legs show just beyond the wing apices, the second pair comes immediately inside the antennæ, and extends to about the end of the 3rd abdominal segment; the first pair (? last joint) extends but very slightly, if at all, beyond the antennæ; the antennæ are short, commence just above the eyes, then turn slightly outwards for about half their length, then inwards somewhat abruptly and end at about the level of suture between the 2nd and 3rd abdominal segments; the first half is fairly broad, but after they turn medio-ventrally they dwindle rapidly and are distinctly narrow for the cases of pectinated antennæ; the eye is large, and divided, so that a small and more highly-glazed slip comes next the antenna. *Male pupa:* More curved ventrally than the female pupa, differs slightly in shape and proportion of parts, but apparently not structurally, except that the antennæ appear to be proportionally rather larger. Fenn describes the pupa as being "uniform, dull, dark brown in colour, the last three segments tapering to a very blunt point; the dorsum and abdomen covered with short bristles, the antennæ and spiracles strongly defined." Stephens describes it as "dull lead colour covered with fine powder." Borkhausen notes it as "somewhat elongated, very soft, dark brown in colour, thickly coated with yellow powder." He adds that the pupal stage lasts from three to four weeks. Fenn observes that the pupa is very lively when touched.

PARASITES.—*Exorista vulgaris*, Fall. (Bignell), *Phorocera cilipeda* (Norgate *teste* Bignell), *Apanteles reconditus*, Nees (Rondani), *Cryptus ornatus*, Grv. (Rondani), *Metopus necatorius*, Fab. (Rondani).

FOOD-PLANTS.—Trees, the larva polyphagous (Linné), almost all trees and shrubs (Millière), all fruit-trees, rose, and almost anything (E. Harrison), *Cotoneaster* (Watts), osier (Jefferys), birch (Turner), currant (Morley), plum (Grover), pear (Newman), elm (Edelsten), bramble (Luff), rose, oak, sloe, crab-apple (Montgomery), laurel (Fuller), sallow, plum, apple (Carr), fruit-trees (Rühl), willow, poplar, (Hering), almond (Freeman), hawthorn, hazel, pear (Burraud), quince, cherry, apricot, beech, maple, raspberry, privet, white and black alder, juniper (Schröder).

HABITS AND HABITAT.—The habits of the perfect insect are little known. The male is rarely found at rest, unless it be in the afternoon, sitting on the cocoon from which it has just emerged, or a female sitting on a leaf near where it has just laid its eggs, or beaten into the umbrella or beating-tray, when working for larvæ. Sheldon netted a male flying at dusk, at Morthoe, and its habit is certainly to fly by night, and from 9 p.m.-10 p.m. the males are, on some occasions, attracted to light in amazing numbers, and their mad flight around the lantern on Wicken Fen, on a really good night for "light," is a sight to be remembered. Fletcher's note (*anteà*, pp. 552-553) shows that the same habit is fully developed on the shores of the Pacific, and that the females also may be attracted, a fact rarely (if ever) observed in this country. Gätke has pointed out that this species migrates in amazing numbers, and that on some nights thousands of examples fly around and past the lighthouses at Heligoland, when they are evidently on passage. The imagines rest by day on trees and walls, and fly by night about 9 p.m., in Belgium (Lambillion); a male, at Rainham, on a "sugared" tree, not at the sugar, July 21st, 1894 (Burrows); a male picked up on a grass stem, at Sandown, July 21st, 1896 (Prout); common at electric light, at Taunton (Tetley); very abundant at the electric light, in 1896, at Aix-les-Bains (Agassiz); males "assembled" at Whitwell, August 5th, 1898 (Freeman). As for its habitat one might say "everywhere," were it not for the marvellously sudden break that occurs in England and Ireland, excluding it from the northern counties of England, the whole of Scotland, and the north of Ireland, although it abounds in almost similar districts a few miles to the south or west. This sudden break in distribution is quite paralleled in Switzerland, where Frey says that it occurs everywhere in the lower parts of the country, but rarely extends to any elevation, and is scarcely ever found in the lower Alps, and although Täschler notes it in the sub-alpine region of St. Gallen, and Rätzer as occurring above 5000ft. in the Gadmenthal, still it is usually rare at moderate elevations. Hormuzaki, too, observes that whilst the insect is abundant in the lower parts of Bucovina, it is exceedingly rare in the mountains. In the southern counties of England it is very abundant, especially in certain years, by hedgerows, in woods, in fruit orchards, on stunted bushes on downs and cliffs by the seashore. Our notes as to the habitats affected by the species read—on hedges and fruit-trees in gardens, the webs conspicuous, in Gloucestershire (Merrin); destructive to the foliage of the apple trees, at Sudbury (Ransom); chiefly affects hedgerows of blackthorn and whitethorn, and woods, in Berks, Hants, and Oxon (Clarke); in Surrey very abundant on the fruit-trees in the gardens (Kaye); very abundant on the blackthorn bushes growing on the cliffs outside the forts at Milford Haven, in May, 1897, there were hundreds of nests (Robertson); on rough ground by the sea, at Eastbourne (Bower); at Sandown, on sallow, close to the shore (Prout); affects the crab-apple trees on the chalkhills at Emsworth, and at Oxford the hawthorn by the side of the canal (Christy); the full-grown larvæ, old webs, and cast skins, abundant on blackberry bushes in different parts of Herm, although the insect has only once been seen in Guernsey (Luff); on whitethorn hedges at Angmering (Dollman); hedgerows at Ealing and Uxbridge, bushes bordering dykes, at Pevensey (Montgomery); on oak and apple trees at Clevedon (Mason); on plum and apple trees, at Birchwood, and the sallow bushes in Wicken Fen (Carr); larvæ very abundant in the Zürich district on fruit-trees, sloe, and oak, but the imagines are exceedingly rare, only two or three being seen (Rühl); abundant on hedges and on commons in the Weald of Sussex (Nicholson); never observed out of gardens in the Baltic provinces, except in the woods of Oesel, where the larva feeds on the wild apple trees (Nolcken); shows a great preference for standard rose trees, one small bush with no less than seven broods on it in 1891, at Sheerness (Mathew), and so on.

Time of appearance.—Throughout July and August, varying according to the season, but usually found on the wing for a month, rarely as early as June, or as late as September. Larvæ full-grown in June, imagines in July, in Pomerania (Hering); larvæ in April, imagines from June until August, in Upper Austria (Himsl); in August at Sofia (Bachmetjew); emerges in Belgium from about July 15th, until mid-August (Lambillion); end of July at light, rare, at Berne, July 15th, 1893 (Hiltbold); imagines emerge from the middle of June until the middle of July, in the Baltic provinces (Nolcken); Fritsch gives dates for imagines extending from May 10th-August 15th, for the Vienna district; Walker observes that, at Gibraltar, emergence takes place about June 20th; bred in August and September, in the Isle of Askold (Oberthür); it was already out by June 11th, 1897, at Kobé, but in immense numbers from July 13th-24th, 1897, at Kormiloff, in Korea (Fletcher); in July and August, in Switzerland (Frey); July and August, in Baden (Reutti); in July, in the Alpes-Maritimes (Millière); August 1st-20th, 1855, July 10th-14th, 1857, at Notting Hill, July 11th, 1867, July 29th, 1877, at Chertsey (Clarke); July 18th, 1856, at Bisterne (*Subst.*, p. 29); two broods of larvæ, April 23rd, 1865, at Abbey Wood, produced imagines from July 4th-15th (A. H. Jones); July 14th, 1866, swarming at light, at Lee, August 13th-15th, 1879, common at light, at Erith, July 23rd-August 16th, 1885, at Lee, July 14th, 1886, bred from Chattenden, July 25th, at Lee, July 19th-22nd, 1887, July 24th-August 9th, 1888, at light, at Lee, larvæ May 26th-June 24th, at Lee, imagines bred July 16th-19th, 1890, July 22nd, 1892, at light, at Lee (Fenn); bred July 15th-17th, 1871, from larvæ found at Southstoke, in web, May 15th, and which pupated June 22nd-25th, also bred June 25th, 1893, July 13th-20th, 1894, from larvæ in web June 20th, 1894, at Ringwood, bred July 11th-19th, 1894, from larvæ obtained June, 1894, at Eton, one brood emerged July 3rd-16th, 1896, another from July 8th-29th, 1896, from larvæ taken at Tiverton May, 1896, a brood from Rainham, emerged June 25th, 1896, males common at light from June 21st-July 4th, 1896, July 20th-24th, 1897, &c., at Oxton (Studd); July 26th, 1875, at light, at Reading, July 23rd, 1889, at Pangbourne, July 30th, 1890, at Bulmershe, August 17th, 1891, at Warren, August 28th, 1891, at Whitchurch (Holland); larvæ just leaving web at Lewisham, May 30th, 1876, several spun up by June 22nd, imagines appeared from July 15th-August 4th (R. Adkin); September 6th, 1877, September 18th, 1879, at light, at Lee (Bower); at light, August 10th-11th, 1882, August 5th, 1884, larva July 26th, 1887, produced imago, August 3rd, 1887, all at Hitchin (Durrant); July 15th, 1882, July 12th, 1892, in Isle of Purbeck, August 7th, 1896, in Holme Fen (Bankes); July 26th, 1885, from larva found June 21st, at Gravesend, July 11th, 1889, from larvæ found June 23rd, at Fobbing, July 10th-August 7th, 1890, from Benfleet, July 18th, 1895, from Great Wakering, July 6th-17th, 1896, July 29th, 1897, July 27th, 1898, from Southend (Whittle); bred many July 20th-29th, 1888, from Farnboro', caught August 3rd, 1889, at Freshwater, rare July 6th-August 10th, 1891, at Wicken, common last week in July and first week in August, 1892, at Wicken, August 12th, 1891, at Bourg d'Oisans, &c. (Tutt); larvæ in web, at

Walton, June 17th, 1888, spun up July 12th-22nd, emerged from August 3rd, web of young larvæ at Arundel, June 2nd, 1889, imagines emerged July 5th-September 1st (Williams); larvæ May 31st, 1889, at Enniskillen, produced imagines July 20th-24th, imagines August 17th, 1890 (Brown); nests of larvæ common, May, 1890, at Southend, imagines July 16th-August 7th, larvæ at Sandown, July 17th, 1897, pupated August 3rd, ♀ emerged August 26th (Prout); July 17th, 1890, at Tottenham (Bayne); August 1st-11th, 1890, July 31st, 1891, June 22nd, 1893, at Ealing, July 16th-19th, 1896, at Uxbridge (Montgomery); larvæ June 6th, 1890, imagines from July 26th, onwards, July 24th, 1892, July 21st, 1894, August 4th, 1896, July 20th, 1898, August 4th, 1898, at Rainham (Burrows); larvæ June 5th-28th, 1891, June 28th-August 3rd, 1898, at Whitwell, the larva found on August 3rd, pupated August 7th, whilst imagines from the same locality were "assembled" on August 5th (Freeman); September 3rd, 1891, at light, at Maldon, August 15th, 1898, at light, at Hazeleigh (Raynor); July 17th, 1891, July 23rd, 1894, at Weston-super-Mare, larvæ June 18th, 1891, emerged July 30th, 1891, larvæ May 29th, 1895, spun up June 10th, 1895, emerged July 11th, 1895, larvæ June 29th, 1897, July 17th, 1891, at Barmouth (Arkle); June 18th-19th, 1891, at light, at Wicken, August 3rd, 1891, at Soham, August 5th, 1891, at Ely (Bloomfield); imagines emerged July 2nd-4th, 1897, at Bristol (Bartlett); June 26th, 1893, at Worcester Park, August 3rd, 1896, at Wicken (Kaye); July 15th-24th, 1893, at Wicken (Mitchell); July 12th, 1894, at light, at Gloucester (Lifton); July 5th-28th, 1894, at Feering (P. Reid); larvæ May 23rd, 1896, at Angmering, produced imagines June 27th, 1896 (Dollman); June 27th, 1896, at Chelmsford (Miller); a web of larvæ May 21st, 1896, in the Warren, Folkestone, pupated June 23rd, 1896, and produced imagines July 24th-August 10th (Lane); July 10th, 1896, at Dartford (Image); bred July 5th-7th, 1897, August 5th, 1898, at Boxworth (Thornhill); July 6th-August 8th, 1897, bred at Guildford (Grover); July 15th-August 1st, 1898, at Enfield (Edelsten); July 20th-August 25th, 1898, at Hayling Island (May); July 22nd-26th, 1898, at light, at Wicken Fen (James); July 10th, 1898, and onwards to end of month, at Penzance (Daws); August 15th-19th, 1898, at electric light, in Zermatt (Jones); July 11th-24th, 1898, at Leicester (Dixon); full-grown larvæ and cocoons July 6th, 1898, at Bexley, produced imagines July 27th-August 9th, imagines at light, at Shoreham, August 1st, 1898, larvæ June 19th-25th, 1898, at Wicken Fen, produced imagines July 15th (5 ♂s), 16th (5 ♂s and 1 ♀), 17th (3 ♂s and 3 ♀s), and others each day up to July 25th, at light August 5th-11th, 1899, at Shoreham (Carr); July 19th-August 14th, 1899, from Snodland (Colthrup); July 27th, 1899, at Bushey Heath (Burraud); August 3rd-7th, 1899, from Kingsbury (Phillips); July 19th, 1899, at Farnborough (Alderson). *Larvae*: Besides the above, the following records for larvæ have accumulated: April 23rd, 1868, two broods at Abbey Wood, June 16th, 1866, in abundance at Gravesend, May 18th, 1867, at Darenth, June 10th, at Llanrwst (A. H. Jones); May 7th, 1865, larvæ common on oak at Abbey Wood, May 14th-June 25th, 1874, abundant at Lee, May 24th-June 22nd, 1875, abundant at Lee and Sidcup, June 10th, 1884, larvæ at Erith, June 20th, 1885, and June 8th, 1889, at Chattenden, June 12th, 1894, at Lee, May 16th-29th, 1896, abundant at Tor Cross (Fenn); May 17th, 1871, just hatched at Sheerness (Mathew); June 31st, 1878, at Barmouth, May 29th, 1897, at Oundle (Sheldon); May 24th, 1883, at Chiswick, May 21st, 1893, at Colwell Bay (Sich); June 20th, 1885, at Abbott's Wood (Hawes); June 15th, 1889, at Herm (Luff); June 11th, 1890, at Romford, June 14th, 1890, at Woodham Ferris, June 6th, 1894, at Toft, June 6th, 1896, at Beeston (Raynor); May 14th, 1890, June 4th, 1894, at Rainham (Burrows); June 1st, 1890, full-fed at Reading (Butler); May 13th, 1891, May 26th, 1894, at Gloucester (Lifton); June 17th, 1891, and on through month at Barmouth (Arkle); June 18th, 1891, May 29th, 1895, at Weston-super-Mare (Bartlett); May 14th, 1893, already singly, at Oxton (Studd); May 27th, 1893, at Enniskillen (Partridge); June 8th-17th, 1894, in New Forest, June 5th-11th, 1898, at Rhinefields (Wells); June 3rd, 1894, July 3rd-16th, 1896, at Bexley, June 1st, 1896, at Chattenden (Bower); July 15th-24th, 1894, at Wicken (Mitchell); June 3rd, 1895, at Aylesbury, July 2nd, 1897, full-fed, at Hoddesdon (Bayne); May 25th, 1896, in second instar, at Uxbridge, June 4th, 1898, in second instar, at Ealing, June 15th, 1898, in first instar, at Pevensey (Montgomery); June 5th, 1896, at Waltham Cross (Image); May 16th, 1896, in Epping Forest (Tremayne); June 8th, 1896, at Benfleet (Mera); June 8th-14th, 1897, at Epping, May 19th-22nd, 1898, in New Forest (Prout); June 11th, 1898, at Norton Malreward (Griffiths).

LOCALITIES.—The limited range of this insect in the British Islands is very remarkable. Not known to occur in Ireland, north of Dublin (Kane), entirely absent in Scotland, abundant in England, as far as the north midland counties, and then suddenly ceases—so rare in Chester that only one was taken at light in two years, yet it abounds in Denbigh and Carnarvon, practically absent in Yorks, yet abundant in Lincolnshire, &c. BEDS: Potton (Bond-Smith). BERKS: generally distributed (Clarke), Pangbourne, Bulmershe (Holland), Reading (Butler). BRECON: Valley of Wye (Jefferys). BUCKS: Aylesbury (Bayne), Eton (Studd), Buckingham (Slade). CAMBS: everywhere in the Fen dist. (Balding), Wicken, common (Tutt), Boxworth (Thornhill), Wisbech (Mousley), Soham, Ely (Bloomfield), Cambridge and district, common (Moss). CARMARTHEN: Llanstephan, common (Newland), Langharne, very abundant (Jefferys). CARNARVON: Carnarvon, Abersoch, very common (Day), Llanrwst dist. (A. H. Jones). CHESHIRE: local but tolerably common where it occurs (Ellis), Chester, rare (Newstead), Hoylake (Johnson), West Kirby (Gregson), Upton Valley (Brockholes). CLARE: Ennis (Brakey). CORK: Skibbereen, once only (Wolfe), Glengariff (Kane). CORNWALL: west of county (Mera), Looe (Horton), New Quay (Riding), Penzance dist., abundant (Daws). CUMBERLAND: Keswick, rare (Beadle). DENBIGH: Colwyn Bay, Bajillt (G. O. Day), Llanrwst dist. (A. H. Jones). DEVON: Bickleigh Vale (Dell), Barnstaple (Mathew), Paignton (Bowles), Tiverton, Exeter, Oxton, very abundant (Studd), Morthoe (Sheldon), Braunton (Bartlett), Tor Cross (Fenn). DORSET: generally distributed (Dale), Portland (Brown), Isle of Purbeck (Bankes), Swanage (Bloomfield), Weymouth dist., abundant (Forsyth). DUBLIN: Clondalkin (Grierson). DURHAM: South Shields (Eales), one in a pond at the Lowe (Wasserman). ESSEX: generally common—Rainham, Mucking, &c. (Burrows), Havering (Tutt coll.), Tottenham marshes (Pickett), Hazeleigh, Brentwood, common, Woodham Ferris, Woodham Walter, Romford, Maldon, very abundant (Raynor), Walton (Williams), Colchester (Harwood), Leyton (Meldola), Chingford (Riches), Chelmsford (Miller), Epping (Image), Feering (Reid), Fobbing, Leigh, Benfleet, Great Wakering, Southend (Whittle), Loughton (Garland), Hale End (Jackson). FERMANAGH: Enniskillen (Brown). GALWAY: not rare (Kane), Castle Taylor, abundant (Nugent). GLAMORGAN: Oxwich Bay, Swansea (Robertson). GLOUCESTER: generally abundant (Merrin), Bristol dist., generally distributed, Gloucester, &c. (Watkins), Almondsbury (Griffiths), nr. Cheltenham (Robertson), Stonehouse (Nash). HANTS: generally distributed (Clarke), Isle of Wight—Colwell Bay (Sich), Shanklin (Ince), Freshwater (Tutt), Sandown (Prout), New Forest (Dixon), Rhinefields (Wells), Ringwood (Studd), Brockenhurst (Cowl), Binstead (Moberly), Basingstoke (Holdaway), Winchester (Hewett), Southsea, abundant (Moncreaff), Stokes Bay, Gosport (Pearce), Emsworth (Christy), Bisterne (*Subs.*, p. 29), Hayling Island (May). HEREFORD: Hereford (Chapman), Leominster (Hutchinson), Tarrington (Wood). HERTS: Hoddesdon (Sheldon), Bushey Heath (Burraud), Waltham Cross (Image), Hitchin (Durrant). Cheshunt (Tremayne). HUNTINGDON: Holme Fen, common (Bankes), St. Ives (Norris). ISLE OF MAN: Douglas, once (Shortridge-Clarke). KENT: generally distributed—Rochester and Chatham districts, abundant, Strood, Higham, Chattenden, Cuxton, Woolwich and Plumstead districts, Greenwich and Blackheath districts, Westcombe Park, Darenth, Folkestone, Dover, Deal (Tutt), Lewisham (Adkin), Birchwood, Shoreham (Carr), Bexley (Bower), Dartford (Image), Sandwich (Shepherd), Queenborough (Walker), Sheerness (Mathew), Brockley (Turner), Abbey Wood, Gravesend, Eltham (A. H. Jones), comparatively scarce now in the south-east metropolitan district—Foot's Cray, Sidcup, Lee, Erith, &c. (Fenn), Snodland, Hythe (Colthrup), Farnborough (Alderson). KERRY: Killarney (two) (Watts). LANCS: local, but tolerably common where it occurs (Ellis), Blackpool, Lytham (Chappell). LEICESTER: Leicester dist., abundant (Fuller), Quorn (Harris), Loughborough (Wieldt), Market Harborough (Matthews). LINCOLN: Lincoln, plentiful (Pearson), Toft, Newton (Wilkinson). MERIONETH: Barmouth (Sheldon). MIDDLESEX: Chiswick (Sich), Ealing, Uxbridge (Montgomery), Clapton (Argent), Chelsea (Clifford), Enfield, swarms (Edelsten), Kingsbury, Wembley, Northwood, Pinner (Phillips), Harrow, abundant (Rothschild), Oxhey (Rowland-Brown), Mill Hill (South), Dalston (Prout), Harefield (Wall), Hampstead (Watts), Willesden (Wormald), Hounslow, Harlington (Newman), Notting Hill (Clarke), Tottenham (Bayne), Ponder's End (Buckell), Walham (Dawe), Highgate (Southey), Southall (Battley). MONMOUTH: Abergavenny (Chapman). NORFOLK: Cromer (Barclay), Ranworth (Wheeler), Norwich (Pitman), King's Lynn (Atmore), Whitwell (Freeman), Waxham (Bacot). NORTHAMPTON: Oundle (Sheldon), Peterboro,' very common (Morley). NOTTS: Nottingham dist. not abundant (Lievers), Beeston (Raynor), Chilwell (Pearson). OXON: generally distributed (Clarke), Oxford (Christy), Chinnor (Spiller), Nettlebed (Henderson), Warren, Whitchurch (Holland), Bagley Wood (Burr), Southstoke (Studd). PEMBROKE: Milford Haven (Robertson), Pembroke (Barrett). SOMERSET: generally distributed, but not common (Hudd), Bath, common (Greer), Weston-super-Mare (Bartlett), Castle Cary, abundant (Macmillan), Taunton (Tetley), Clevedon, common (Mason), Norton Malreward (Griffiths). SUFFOLK: very common (Bloomfield), Ipswich (Pyett), Sudbury, very abundant (Ransom). SURREY: Woking (Russell), Croydon (Sheldon), Chertsey (Clarke), Worcester Park, very common (Kaye), Epsom (Morley), Wimbledon (Clifford), Guildford, common (Grover), Oxshott, Peckham dist. (Turner), Frensham (Newland), Dulwich (Wood), Barnes (Tarbat). SUSSEX: generally abundant in the county—Brighton, &c. (Merrifield), Bognor, very abundant (Lloyd), Abbott's Wood (Hawes), Chichester (Anderson), Polegate (Robbins), Arundel (Williams), Southwick (Morley), Wannock (Pearson), Eastbourne (Bower), Weald dist., abundant—Chailey, &c. (Nicholson), Worthing, Bersted (Fletcher), Hastings, St. Leonards (Bloomfield), Angmering (Dollman), Pevensey (Montgomery), Hailsham (Carr), Portslade (Colthrup), Lewes, Bramber, Horsham (McArthur), Littlehampton (Sich). WARWICK: Birmingham dist., scarce, Trench Woods (Wainwright). WATERFORD: nr. Cappagh (Vernon). WICKLOW: Newcastle (Kane). WILTS: Bremhill, Calne (Eddrupp), Salisbury (Ridley). WORCESTER: common throughout the county (Rea), Trench Woods (Wainwright), nr. Worcester, very common (Hancock). YORKS: very scarce (Porritt), Pontefract (Hartley), Sheffield (Doncaster), York (Cooke).

DISTRIBUTION.—ASIA: Amurland—Chabarowka, Blagoweschtschensk, Wladiwostock, Sutschan, Bikin (Graeser), Western Asia, Siberia, Samarkand, Issyk-Kul, Namangan (Staudinger), East Siberia—Bureia mountains (Bremer), China—Khardijitai (Alpheraky), Japan (Motchulsky), Kobé, Gensan, Kormiloff, Port Lazaref (Fletcher), Isle of Askold (Oberthür), Korea (Fixsen), Altai, Amasia, Tokat, North Persia, Kouldja (Alpheraky), Pamir—common in all Ferghand (Grumm Grshimailo). AUSTRO-HUNGARY: Upper Austria (Himsl), Tyrol, common to 4300ft. (Hinterwaldner), Taufers, Innsbruck (Weiler), Bucovina, common in lowlands (Hormuzaki), Pressburg (Rozsay), Bohemia, Upper Carinthia—Salzburg (Nickerl), Galicia, common, Cracow (Zebrawski), Neu Sandec (Klemesiewicz), Stanislawow (Werchratski), Brünn (Müller), Hermannstadt (Czekelius), Epiries, common (Husz), Chemnitz (Pabst), Hungary—Kocsocz (Vángel), Gölnitz (Hudák), Glockner, Fiume (Mann), Lavantthal (Höfner), Upper Styria—S. Lambrecht (Kodermann), Vienna dist., &c. (Fritsch). BELGIUM: very common—Namur, &c. (Lambillion), Virton, very common (Bray). BULGARIA: Sofia (Bachmetjew). CHANNEL ISLANDS: Herm

(Luff), Jersey (Ansted), Guernsey, one only (Lowe). Denmark : very common everywhere (Bang-Haas). Finland : southern Finland (Aurivillius), Abo, Karelia (Lampa). France : very common in N. France, Seine-Inférieure, Pont de l'Arche (Dupont), very abundant at Aix-les-Bains (Agassiz), Sarthe (Desportes), Bourg d'Oisans (Tutt), Rennes, Cancale, &c. (Oberthür), Dept. Loir-et-Cher, swarms (Harrison), Aube (Jourdheuille), Douai (Foucart), Auvergne (Sand), Eure-et-Loir (Guénée), Haute-Garonne, very common (Caradja), Paris, Meuse, Moselle, Meurthe districts (Speyer), Puy de Dôme (Guillemot), Dept. Var (Cantener), Morbihan (Griffith), Gironde (Trimoulet), Doubs (Bruand), Aude (Mabille), Loire-Inférieure (Bonjour), Saone-et-Loire (Constant), Seine-Inférieure (Viret), St. Quentin (Dubus), Alpes-Maritimes (Millière). Germany : north-west Germany, almost everywhere (Jordan), Thuringia, generally distributed, and common (Knapp), Waldeck, Upper Hartz to 2100ft. (Speyer), Pomerania, common (Hering), Silesia, common (Prittwitz), Heligoland (Gätke), Rhine Palatinate (Bertram), Würtemberg (Seyffler), Giessen (Dickore), Lower Elbe, common (Zimmermann), Erfurt (Keferstein and Werneburg), Zeitz-on-Elster (Wilde), Halle (Stange), Munich, common (Kranz), Rudolstadt (Meurer), Mecklenburg, Prussia—Königsberg (Schmidt), Bremen, very common (Rehberg), Saxon Upper Lusatia, common (Schütze), Dresden (Steinert), Upper Lusatia, very common (Moeschler), Nassau (Rössler), Ratisbon (Schmid), Dessau (Richter), Alsace (Peyerimhoff), Wernigorode (Fischer), Brunswick (Heinemann), Hanover, very common (Glitz), Frankfort-on Oder (Kretschmer), Eutin (Dahl), Baden, very common (Reutti), Neumünster (Schröder). Italy : common throughout (Curò), Lombardy (Turati), Modena (Fiori), Pavia (Oberthür), Buttier Valley, common (Baker), Roman Campagna, very common nr. Rome (Calberla). Netherlands : very common—Breda, &c. (Heylaerts). Roumania : generally distributed, and common (Caradja). Russia : Baltic provinces, generally distributed—Oesel, &c. (Nolcken), southern Russia (Moeschler), generally distributed in Transcaucasia (Romanoff), Moscow dist. (Albrecht), Wolmar (Lutzau), south-west Caspian dist.—Lenkoran (Radde), Crimea (Melioransky), St. Petersburg (Erschoff). Scandinavia : south and central Sweden, south Norway (Lampa), common in south Sweden (Aurivillius), Norway, rare—Chistiania (Siebke), southern Lapland—Ume (Zetterstedt). Spain : Bilbao, common (Rössler), Gibraltar, common, Algeçiras (Walker), Andalusia—nr. Granada (Rambur), Teruel—Alcañiz (Zapater and Korb), Galicia—Madonie, Messina (Macovelado), Barcelona, &c. (Cuní y Martorell), Catalonia (Martorell y Peña). Switzerland : generally distributed up to about 3000ft. in St. Gallen and Berne (Frey), to 5000ft. at Gadmenthal (Ratzer), Zürich dist. (Rühl), Berne, rare (Benteli), Dranse Valley, common (Baker), Visp Valley, Zermatt, Valais (Jones), Weissenburg (Huguenin), Grisons (Killias), Bonner dist. (Frings), Saas Valley (Jordan), Aigle (Lowe). Turkey : Gallipoli (Mathew), Varna (Lederer).

ADDENDA.

NARYCIA MONILIFERA.—Page 145, to line 2 add—Epping Forest (Clark).

DIPLODOMA HERMINATA.—Page 154, to "Localities" add—ESSEX: Epping Forest (Clark), Hale End (Prout). HERTS: Cheshunt (Boyd). SUFFOLK: Lowestoft (Boyd).

EPICHNOPTERIX PULLA.—Page 358, add to paragraph on "Variation"—

η. var. *montanella*, Heyl., "Ann. Soc. Ent. Belg.," xliv., p. 189 (May 14th, 1900).—Cette variété est distinguée par l'apex des ailes antérieures, qui est prononcé, tandis que le type et toutes les autres variétés l'ont très arrondi (Heylaerts).

The footnote, *anteà*, p. 353, states the suspicion that Millière's specimens from southern France, which he included with those from Greece, as being the same species, when he described the latter as *graecella*, were *E. pulla*. This suspicion we stated at length in a note published (*Ent. Record*, xii., pp. 86-87) April 15th, 1900. This note and an advanced proof of our remarks on *P. graecella*, published in this work, were forwarded to Heylaerts, who has Millière's types, in March last, and he has now confirmed our suspicion, and named the *pulla* from southern France var. *montanella*.

θ. var. *montana*, Heyl., "Ann. Soc. Ent. Belg.," xlv., p. 189 (May 14th, 1900).—Je possède une autre variété de l'*Epichnopteryx pulla*, Esp., qui me vient de feu le professeur Zeller, qui l'avait trouvée en spécimens nombreux à Bergün (Engadine, Suisse). La taille est relativement grande, les ailes sont densément couvertes de poils et d'écailles d'un brun noirâtre. Les fourreaux sont courts et larges. J'en ai aussi de M. Millière, qui les a trouvés à Saint-Martin Lantosque. Je nomme la variété *montana* (Heylaerts).

There are several of Zeller's Bergün specimens in the British Museum collection. We have already referred to them (*anteà*, p. 354), and have no doubt that they are there correctly placed as belonging to the "type" form and "var. *sieboldii*," which is scarcely distinguishable from the type. Heylaerts' colour description "brun-noirâtre" suggests that his examples are faded.

POECILOCAMPA POPULI.—Page 475, to line 27 add—*Metopus necatorius*, Fab. (Rondani). Page 480, to line 64 add—AMURLAND: Chabarowka (Graeser).

TRICHIURA CRATAEGI.—Page 494, between lines 24 and 25 insert: PARASITES: *Ichneumon culpatorius*, Grv. (Rondani), *Ichneumon nitens*, Grv. (Rondani). Page 497, to line 21 add—ROXBURGH: Galashiels (Haggart).

LACHNEIS LANESTRIS.—Page 513, to line 35 add—*Chrysolampus bombycum*, Fnsc. (Rondani).

MALACOSOMA HYBRIDS.—Page 523, line 23, add after "*castrensis*"—although it is quite possible that the hybrid is really that of *neustria* × *franconica*, in which case the hybrids follow both parents in the particular of the transverse lines. Page 524, line 8, add after "*franconica* and *castrensis*," "possibly *neustria* × *franconica*." A later study leads us to suppose that they may be the latter hybrids, there is no label on them to show what they are.

MALACOSOMA CASTRENSIS VAR. KIRGHISICA.—Page 535, to line 32 add—Cilicia, near Gözna, in August (Holtz).

MALACOSOMA NEUSTRIA.—Page 566, to line 52 add—Cilicia, near Gözna, June 26th (Holtz).

ACANTHOPSYCHE OPACELLA.—Page 381, to "Sexual Dimorphism" add—To see the female of *Acanthopsyche opacella* uninjured, one must extract her from the pupa-shell, just when she is ready to emerge, but before she has done so and rubbed off much of her clothing of wool. Such a specimen has the 2nd, 3rd, 4th, 5th, 6th and 7th abdominal segments encircled, except for a narrow dorsal strip, each with a zone of fine hairs, each zone separated from the next by bare intersegmental (?) membrane. The hairs are waved, densely packed together, and, though not perfectly white, have a very white silvery silken look against the yellowish tint of the insect itself (Chapman).

ERRATA.

p. 98, line 34, for "*Myrmecocela*" read "*Myrmecozela*."

p. 107, line 35, for "*roboricolella*" read "*casta*."

p. 108, line 18, for "*Psychinae*" read "*Psychidae*."

p. 110, line 50, for "*conspurcatella*" read "*staintoni*."

p. 111, line 8, for "*roboricolella*" read "*casta*."

p. 114, line 4, insert "female" before "*N. monilifera*." The antennæ of male *Narycia* is as distinctly Psychid in its general characters as those of *Diplodoma*. *See* p. 147.

p. 114, lines 23 and 29, for "*conspurcatella*" read "*staintoni*."

p. 116, line 45, for "*Psychidia*" read "*Psychidea*."

p. 116, line 49, for "*Psychographa*" read "*Psychagrapha*."

p. 117, line 15, for "*triquetrella*" read "*lichenella*."

p. 118, last line, for "Micro-Psychids" read "Macro-Psychids."

p. 122, line 24, for "*conspurcatella*" read "*staintoni*."

p. 123, lines 5, 23 and 39, for "*Metrua*" read "*Metura*."

p. 270, line 30, for "*bombycella*, *sapho*, and *nudella*," read "*bombycella*, *nudella*, and *pulla*."

p. 295, line 14, for "Theydon Bois" read "Chingford."

p. 296, lines 18 and 49, for "Theydon-Bois" read "Chingford."

p. 298, line 28, for "June 9th, 1891" read "May 14th-June 4th, 1895."

p. 298, line 29, for "Theydon Bois" read "Chingford"; for "June 28th-29th" read "June 26th, 1895, and July 3rd, 1895."

p. 298, lines 34 and 35, for "on willow-trunk near Theydon Bois" read "beaten from mixed growth—blackthorn, buckthorn, whitethorn—at Chingford."

p. 298, line 39, for "Theydon-Bois" read "Chingford."

p. 409, line 4, for "differing" read "dipping."

p. 431, description of fig. 2, line 7, for "clothed" read "clubbed."

p. 433, second column, line 40, for "*wockei*, Staud." read "*wockei*, Stndfs."

p. 433, second column, line 52, for "*Oiketicina*, Heyl." read "*Oiketicoïdes*, Heyl."

p. 434, bottom line, for "Europterid" read "Eupterotid."

p. 456, line 50, for "*Hetropacha*" read "*Heteropacha*."

p. 464, line 28 (and in later records of synonymy for Guénée's work), for "1867 read "1875," *see* p. 482.

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PLATES.

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