Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
VOL. LXXIII.

CLASSIFICATION OF INSECTS

A Key to the Known Families of Insects and Other Terrestrial Arthropods

BY

CHARLES T. BRUES
Associate Professor of Entomology, Harvard University
Associate Curator of Insects, Museum of Comparative Zoölogy

AND

A. L. MELANDER
Professor of Biology, College of the City of New York
Head, Department of Biology, City College of New York

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
AT HARVARD COLLEGE
1932

Published January, 1932

Classification of Insects

By Charles T. Brues and A. L. Melander

TABLE OF CONTENTS

PART II

Other Terrestrial Arthropoda

PART III

PREFACE

Due to the great abundance and diversity of insects their taxonomy presents many difficulties and complexities. Classification is consequently a discouraging aspect of entomology to the young student who must attempt in a short space of time to gain a sufficient knowledge of relationships that may enable him to recognize the more common and important types of insect life.

Long teaching experience has served clearly to demonstrate to the authors that the fundamental principles of classification cannot be fully appreciated through the study of descriptive text-books, nor can any comprehension of the infinite variety of nature be acquired except by close observational contact with the things themselves. Moreover, the study of a few selected types by the laboratory method fails to give more than a very superficial view of the organic world, and as biological knowledge advances, tends to emphasize the similarities between animals and to minimize the differences that exist between them. It is, therefore, highly desirable that the principles of taxonomy be presented to the student in a practical way to demonstrate particularly certain of its more fundamental and important phases.

The present volume is the outcome of a series of steps, developed by the authors during the course of many years to train students in the practical taxonomy of insects and to provide a manual for the identification of the larger groups of insects; one which would prove useful and reliable in the hands of professional entomologists and other persons, especially biologists working in other fields, for the actual identification of specimens of insects.

The precursor of the present manual was published by the authors in 1915 and printed privately as a "Key to the Families of North American Insects." It has proved to be very useful and workable in the teaching laboratory both by ourselves and others and has, we believe, proved to be a valuable aid to entomologists and other interested persons who have occasion to identify specimens of insects. We have regretted the geographical limitations of the original book which have made it less useful to workers in other parts of the world, and also the almost entire omission of aids for the identification of the immature stages. The lack of lists of literature was also recognized as a fault as well as the omission of keys which would serve to identify specimens of the various other terrestrial arthropods which are frequently collected by those interested in insects.

The new volume has, therefore, been entirely rewritten to include the families of the entire world, and in many cases subfamilies of the larger or more important groups. A selected list of literature on the several groups has been added, and so far as possible, keys for the identification of the immature stages. We have also prepared an additional part dealing with the numerous other groups of terrestrial Arthropoda.

The keys aim to reproduce as accurately as possible the most generally accepted system of classification of each group. They are necessarily to some extent heterogeneous as they represent the accumulated opinions and revisions of hundreds of workers during the course of many decades. Taxonomy is the oldest branch of biological science and as it has in the past had many more devotees than the recently developed branches, it has a much more complex background. The present treatment can in no sense be considered as original, nor does it follow in detail any previous comprehensive system. There are numerous changes from the arrangement in our previous book, although this has served in a general way, more closely in some groups than others, as a model for the present one. In a few groups where recent extensive revisions have been published, these have been quite generally followed. In others, where there is considerable disagreement among authorities, we have attempted so far as possible to present what seems to be the most generally acceptable classification or the one which appears to be most rational. The arrangement of the Hymenoptera and Diptera represents mainly our own viewpoint, and this is to some extent true of the Coleoptera. The systems followed in certain other groups are indicated from time to time in the text. Where recent monographs of certain groups have appeared, the classification there proposed has been accepted with few changes, although we have by no means made it a rule to regard the newest arrangement as the most satisfactory.

The illustrations have been derived from many sources and are in great part redrawn from published figures, although it must be stated that many have been simplified, differently lettered or otherwise modified to adapt them to the purpose of the present manual. In each case, where not original, the source of each is indicated by the name of the author in parentheses.

Most of the figures from our previous book are reproduced here. They were drawn mainly by Beirne Barrett Brues, the wife of one of the authors. To these have been added an extensive series prepared by Anna Scholl O'Connor, a considerable number by Selina Tetzlaff

Johnson, and a few by others, including the writers. The figures have been selected principally to represent the general appearance of the species of the various groups and the special structures used in classification.

The marking of accents and the indications for the proper pronunciation of the names of genera, families and higher groups has been done in great part by Alice M. Brues, daughter of one of the authors.

The manuscript was transferred into typewritten form chiefly by Mrs. O'Connor who has also aided greatly in the reading of the proof and preparation of the index.

For advice and criticism on numerous occasions we are greatly indebted to a number of friends and co-workers, as well as to several students, especially Mr. R. P. Dow, who was of great assistance in the preparation of the section on Hymenoptera.

Professor W. M. Wheeler has examined the section on ants, but far more, has offered encouragement and criticism during the tedious process of preparation.

Finally, we are deeply grateful to Dr. Thomas Barbour for issuing the volume as a contribution from the Museum of Comparative Zoölogy.

No one is more keenly aware than the writers of the great chance that errors of statement or omission may creep into a work of this kind. We have diligently guarded against the occurrence of such errors during the course of preparation, but for any that may remain we trust that we may be forgiven.

INTRODUCTION

Approximately half a million species of insects have so far been described and named, and their number is being gradually increased from year to year. So far as those competent to judge are able to estimate, it seems probable that this number represents perhaps one-tenth or one-twentieth of those which actually exist upon our planet at the present time. Their descriptions fill libraries and their final identification requires the knowledge of specialists. Obviously no single volume can provide means for their complete determination, and attempts to deal with selected series of abundant species from particular regions are always disappointing and untrustworthy. It is possible to deal quite fully with the families into which the insects are divided within a reasonable space and it is with their recognition that the present work is concerned.

Identification of the families has been effected by means of analytical keys, which have been arranged as dichotomies. There are also provided similar keys, first for the determination of the classes of Arthropoda, and later others for the determination of the orders of each class. The families are then tabulated under each order. Unless the class or order is known, the student should, therefore, first consult the "Key to Classes of Arthropoda" on page 26. If it be known that the specimen is an insect or an arachnid, or that it surely belongs to a particular class or order, the appropriate key (as indicated in the "Table of Contents") will form the starting point for the work of identification.

Each key contains a number of couplets, or pairs of contrasting statements which indicate clearly two characters or groups of characters, one of which will agree with the specimen in hand. In the first couplet, for example, two contrasting descriptions are given, one of which should agree with the insect to be determined. The number at the end of the line following this description indicates the couplet which should next be studied, and so on until the final name is reached. All the keys have been arranged in this way, as the writers experience in the classroom shows that specimens can be most easily, rapidly and accurately classified with a key of this type where the contrasting descriptions appear together on the page and may very easily be compared.

Another type of identification key has the pairs of contrasting characters distinguished from other pairs by differences of indention on the page. Keys thus arranged can be constructed to follow natural relationships more closely, but they require much more space for printing

and in long keys are exceedingly difficult to follow. We have, therefore, not adopted such an arrangement.

While the dichotomies frequently represent natural relationships or lines of phyletic development, we have not attempted to indicate natural divisions wherever the convenience and practical arrangement of the keys would have been sacrificed. It is at best not possible to express the natural relationships of animals or plants by any linear arrangement. It may be said, however, that a carefully arranged dichotomy, in most cases, may be made to conform quite closely to such linear arrangement as may seem most appropriate.

The keys present, therefore, to some extent an artificial, as opposed to a natural sequence, although wherever possible a natural order has been retained. The conspectus of families, on the other hand, aims to present a natural classification as nearly as this can be expressed by a linear sequence. As a linear arrangement is the only one which can be used in a list of this sort, it must be understood that it cannot actually indicate the relationship of the several units by their proximity in the list. We must regard the present fauna as representing a horizontal section of the "phyletic tree" which we see only as a multitudinous series of sections through its twigs and branchlets. The linear arrangement of such a complex cannot even suggest the equally irregular branches to which these twigs were attached in the past. Many of the latter represent extinct groups, and these are not considered in the present book, although the researches of palæontologists have served greatly to clarify our views on the relationships of modern insects.

There is a very pronounced tendency continually to restrict the extent of families and consequently increase their number. This is greatly deplored by many zoölogists and regarded as inevitable, if not highly undesirable by others. The reasons for such a change are manifold. The continual discovery of new forms rapidly increases the number of known species and this in itself merely on the basis of numbers makes it easier to deal with classification if we have a greater number of units of convenient size. The more careful study of anatomical structure frequently leads to the discovery that certain groups are polyphyletic, that is to say, are not of common origin, but represent a convergence or parallelism in the possession of certain closely similar characteristics. If we are to develop a natural classification, such groups must, of course, be divided into a number of smaller families, each easily distinguishable from the others, in fact, more easily characterized than the original large family. Such changes are reasonable and will without doubt be acceptable in the future to all who view them without preju-

dice. Many such changes represent merely the elevating of groups from subfamily to family rank, and they have been made much more extensively by workers in some groups than in others. For this reason, if for no other the value of family rank varies in the several groups. There is another reason for such differences which relates to the age of the several groups. Those of greater evolutionary age usually present more constant, clear-cut characters and can be grouped into smaller numbers of families while those now in an active state of evolution or differentiation show so many permutations and intergrades that the value of the family has been cheapened and numerous very closely related series have been accorded family rank. As already indicated we have endeavored to follow the general custom of workers in each group in regard to the number of families that should be recognized at the present time.

The characters useful for the separation of family and other major groups are frequently of very minor nature, due to the fact that characteristics of apparently trivial importance commonly persist over long periods of time, presumably because they are not acted upon by natural selection or other evolutionary factors. The value of such characters is everywhere evident, but in the keys many correlated characters of more noticeable and conspicuous kinds have been added, even though, as indicated, they are not invariably present, and cannot be relied on implicitly. When in the keys, such correlation characters are encountered, there is need for judgment in deciding which way to proceed.

As families and other major groups, as well as genera, are concepts and not percepts they are constantly at the mercy of a changing viewpoint and the characters used to define their limits are valid only as accepted by present students. It is hence impossible to standardize the family concept.

Even the selection of family names is not done in a uniform way by all entomologists. This is very unfortunate as it leads to the use in some cases of several names for the same group. Thus the family name may be formed from the oldest contained genus, or it may represent the oldest usage, or it may be still another name long in use, but originally formed by neither of the first two methods. We have not been entirely consistent in the selection of these family designations, but have tried to follow the most general present usage in each group. Synonyms that are or have been in general use are given in italic capital letters placed in parentheses just preceding the accepted family names in the keys. If uniformity is ever secured in the use of family names,

there will be a number of changes in the ones here used, and the citation of synonyms here must consequently be understood to indicate that there is or has recently been a division in usage. Wherever a family name has been suppressed and the group which it designates has been merged with another, the word "Including" has been added in the parenthesis together with the name thus suppressed.

A short, selected list of genera is given for each family. These represent large or important genera, those characteristic of particular regions or those containing common or important species. In most cases the geographical range is given in greatly abbreviated form. The following abbreviations have been used, all of which should be easily understood without explanation: cosmop., cosmopolitan; tropicopol., tropicopolitan; holarc., holarctic (northern hemisphere); palæarc., palæarctic (Europe and northern Asia); nearc., nearctic (America, north of Mexico); neotrop., neotropical (America, south of the United States); Am., new world; ethiop., ethiopian (Africa, south of the Sahara); ind., India; indomal., indomalayan (India and east Indian Islands); austr., Australian. A few variants of these, as indoaustr. and malay., need no explanation. Where genera occur in most of the regions named or in several widely separated ones, their range is indicated as widespr., widespread.

A number of vernacular names for common or important species or groups are given from place to place, enclosed in parentheses. These are mainly ones that are actually in use among persons not acquainted with entomology, although certain others that have been adopted by the American Association of Economic Entomologists as designations for specific insects are listed also. However, no attempt has been made to include a great many that are newly coined, cumbersome, or otherwise of such origin or formation that they may never be expected to come into general popular use as vernacular names.

In addition to the keys to families we have added a considerable number of keys which serve to distinguish the subfamilies of many of the more important or extensive families. These are printed in more condensed form than the family keys and the couplets are numbered a, b, c, etc. to distinguish them from the main keys in which they are inserted next to the family to which they pertain. Thus, although inserted directly into the family keys they remain entirely independent so far as couplet numbers are concerned.

In all cases we have endeavored to cite the family names in exact form. Family names are by rule formed by adding the suffix "idæ" to the Latin or Latinized stem of the name of the type genus. The com-

pound when thus formed should properly include all of the stem. Unless attention is given to the declension of such words according to Latin rules, errors may occur and unfortunately a few incorrectly formed family names have been used from time to time in publications, sometimes over long periods. We have attempted to correct all such errors of orthography, and trust that we have not overlooked any others. Thus family names based on generic names ending in *-cera* become *-ceratidæ*; in *-cerus* become *-ceridæ*; in *-ceros* become *-cerotidæ*, etc. The names of superfamilies have been consistently treated in a similar way, by adding *-oidea* to the Latin stem of the name of the type genus of the typical family name. No fixed rule is generally accepted for the formation of group names and we have not always corrected the spelling of such names. For example, Nematocera is in general use to replace Nemocera as a suborder of Diptera. Properly this should be Nematocerata and the well known designation of Rhopalocera for the butterflies should be Rhopalocerata. Whether such well established names should be emended is certainly open to question on the basis of long usage.

The pronunciation of all family, group and generic names is indicated in the text, following a very simple and quite satisfactory method which was apparently first used by Asa Gray in 1848 in the first edition of his "Text Book of Botany." Later revisions of Gray's manual have continued the same method but for some reason it has not been very generally adopted by others. An accent mark is placed over the vowel in the accented syllable, thus indicating whether the accent should be placed on the penultimate or antepenultimate syllable. A long vowel is indicated by a grave accent (*e.g.* è, È) and a short vowel by an acute accent (*e.g.* é, É). Thus with the length of the important vowel and the accent indicated, the word may be pronounced with small chance of error. Usage is not consistent in the pronunciation of the character "oi" which occurs in the names of superfamilies, etc. We are advocating the sound given to the diphthong in the word "coin," rather than the pronunciation of the two vowels separately. The difficulty of indicating this by means of accented type has led us to mark the diphthong oi with a grave accent over the "o," thus: òi, ÒI.

As the names are regarded as Latin, the rules for the pronunciation of Latin words are followed, although most generic and family names are actually of Greek derivation. Many new Latin words or those of non-classical origin have to be treated by analogy, for example, those based on the names of entomologists (Winthemia, after Winthem, Meigenia, after Meigen). In some cases, where names do not readily

lend themselves to Latin pronunciation, none is indicated. One of the authors has already dealt at some length with the rules governing the pronunciation of insect names.[1]

A selected list of literature on the classification of insects and the other arthropods dealt with in the present volume is included in the text. This is intended to introduce the student to the taxonomic literature as completely as is possible in the space which could be devoted to that purpose and since the amount of published material is enormous, only those papers which may be most generally useful have been cited. During the past ten years, approximately 30,000 separate publications on entomology have been issued, by far the greater part of these dealing with taxonomy. Many other earlier monographs and synopses have not yet been supplanted, either wholly or in part by more recent studies. It has, therefore, not been an easy task to determine exactly what ought to be included in such a list. In general we have listed monographs, revisions or synopses of families and larger groups, relating to the fauna of the whole world, or to extensive regions. Often such treatments relating to quite restricted areas are cited where the circumstances seem to warrant their inclusion. Similar publications relating to subfamilies or smaller groups in some cases appear in the lists also where the abundance or importance of the groups concerned render them of special interest. Large works relating to the faunas of extensive regions are included and to some extent the parts of such works are listed separately under the several groups for more ready reference.

Catalogues and bibliographies are cited rather extensively as they serve to introduce the student to the smaller, highly specialized papers which he will find it necessary to consult for the serious study of any particular group. The literature of some of the larger orders like the Coleoptera and Lepidoptera has been more frequently listed than that of the other groups and here we have generally restricted the citations to the most useful works, catalogues, bibliographies and those containing keys for the identification of genera and species. Almost no references to papers containing only scattered descriptions or very incomplete synopses are included since these will be found by an examination of the catalogues and specialized bibliographies.

In many instances long titles have been abbreviated or paraphrased to save space and to render the scanning of the lists easier, but we have tried in all cases to do this in such a way as not to interfere with

[1] A. L. Melander. The Pronunciation of Insect Names. Bull. Brooklyn Entom. Soc., **11**, pp. 93–101 (1916).

the usefulness of the lists, for the present purpose. The references are given with sufficient completeness to insure the ready location of each paper.

Several languages are necessarily represented, although nearly all of the papers cited are in one of the widely used languages, *i.e.* English, German, French, Italian, Latin, Spanish or Portuguese. The language of the individual papers may be ascertained from the titles, which although abbreviated are given in the language used by the author.

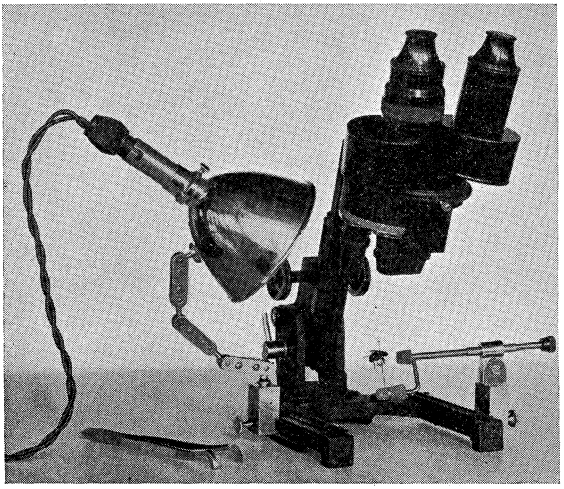
The literature relating to each order is inserted at the end of the keys of that order. In the case of the larger orders, general references are placed together, followed by other lists relating to superfamilies or other groups as indicated in each case, and every individual list is arranged in alphabetical order by authors. The more general works relating to more than a single order are placed at the end of the key to the Orders of Insects on page 38. The literature relating to the Arachnida and other groups of terrestrial Arthropods is arranged in a similar way, in parts following the several keys.

It is impossible to avoid the use of highly technical terms, but we have reduced their number as greatly as clarity permits. A special glossary will be found on page 605, containing definitions of such special terms as are not defined in the text or by reference to figures, or of those that cannot be readily understood by the use of a good dictionary. The nomenclature applied to the body parts, wings, veins, etc., is that used generally in the literature, and represents the current usage in each group. Until quite recently the workers in nearly every group of insects made use of special terminologies for the wing-veins but within the last few years a more or less uniform system of nomenclature is coming into use. This change has been adopted in the present book as representing the most rational method. The student will, however, encounter some difficulties in consulting the older, and even some of the more recent, treatises and papers. Unfortunately this change is one that cannot be avoided.

The equipment necessary for the identification of specimens of insects is quite simple and inexpensive, at least that required for the study of the larger species. Extremely small forms present greater difficulties on account of the very minute size of the structures which must be examined.

For species of moderate or large size, all that is necessary to observe most structural details is a good hand lens. This should be preferably one having a rating of 12x or 14x magnification. Such lenses are made

of several types. The best, known as an achromatic triplet, which gives a clear, sharp image, is made of three lenses cemented together into a single piece. Such a lens may be purchased for about six or



AN ENTOMOLOGICAL PRISM BINOCULAR MICROSCOPE
Built by the Spencer Lens Company from specifications of A. L. Melander

An inclination joint permits tilting the prism body forward for restful observation and allows reversal of the usual position of the stand, thus affording a free working space unobstructed by the upright support. At the right is an insect holder adjustable on a universal joint, with cork-tipped elbow for holding the insect pin so that the specimen can be rotated constantly in focus. At the left on a gooseneck support is the spotlight reflector, operating on low voltage.

seven dollars; or a pair, giving 8x and 12x magnification respectively, mounted in a single holder for about ten dollars. Cheaper types, known as Coddingtons or doublets may be purchased at considerably lower prices, but their optical properties are comparatively poor and they are very unsatisfactory, except for examining large or very flat

structures. For small insects and for others as well, a binocular microscope is the most satisfactory. Such an instrument, provided with two or three paired objectives and two pairs of eyepieces made by any of several first class manufacturers may be purchased for $150 or slightly more. With an automobile spotlight, lighted by a storage battery or by a small transformer such as is used for the running of electrical toys, set above the table so as to throw a spot of light on the object, the most minute details of structure may be observed with surprising clearness. Such an apparatus is so much better than any other that its use is strongly to be advised.

As a rule no special method of preparation is necessary since most of the characters made use of in the keys are readily observed on dried pinned specimens. However, in a few cases some previous treatment is necessary. The wings of Lepidoptera must usually be freed from their scaly covering before the venation can be made out. For this, they may be soaked in eau de Javelle to loosen the scales which may then be removed by a camel's hair brush, after which they may be dehydrated, cleared and mounted in balsam or varnish, on slides. Certain small insects such as Thysanoptera may also be mounted very satisfactorily on slides in balsam or spar varnish, preferably the latter as it does not clear transparent structures so completely. Scale insects should be boiled in a solution of caustic potash, washed, dehydrated, cleared and mounted in the same way to show the minute structures upon which these insects are classified.

For the methods of collecting, preparing and preserving insects the reader is referred to a very comprehensive account by Professor Nathan Banks, entitled "Directions for Collecting and Preserving Insects," published as Bulletin No. 67 by the United States National Museum in Washington in 1909.

Directions for the preparation of chitinous structures for study are contained in Lee's "Microtomist's Vade-Mecum," published by P. Blakiston's Sons & Co., Philadelphia (9th edit., 1928), as well as in other less inclusive and pretentious works.

PART I

INSECTA

CONSPECTUS OF THE HIGHER GROUPS OF INSECTA

Subclass **APTERYGOTA**

Order **PROTURA**
(Eosentomidæ, Acerentomidæ)

Order **THYSANURA**
(Machilidæ, Lepismatidæ)

Order **ENTOTROPHI**
CAMPODEOIDEA (Campodeidæ)
JAPYGOIDEA (Japygidæ, Projapygidæ)

Order **COLLEMBOLA**
Suborder **Arthropleona** (Entomobryidæ, Onychiuridæ, Poduridæ)
Suborder **Symphypleona** (Sminthuridæ, Neelidæ)

Subclass **PTERYGOTA**

Order **GRYLLOBLATTODEA**
(Grylloblattidæ)

Order **ORTHOPTERA**
Suborder **Tettigoniodea**
TETTIGONIOIDEA (Tettigoniidæ, Gryllacridæ, Gryllidæ, Stenopelmatidæ, Phasmodidæ)
GRYLLOTALPOIDEA (Gryllotalpidæ, Tridactylidæ, Cylindrachetidæ)
Suborder **Acridodea**
ACRIDOIDEA (Acrididæ, Tetrigidæ, Proscopiidæ)
PNEUMOROIDEA (Pneumoridæ)

Order **PHASMATODEA**
PHASMATOIDEA (Bacillidæ, Phyllidæ, Phasmatidæ)
BACTERIOIDEA (Bacunculidæ, Bacteriidæ)

Order **DERMAPTERA**
Suborder **Forficulina**
PROTODERMAPTERA
PYGIDICRANOIDEA (Echinosomatidæ, Pyragridæ, Pygidicranidæ, Karschiellidæ, Anateliidæ, Diplatyidæ)
PARADERMAPTERA
LABIDUROIDEA (Platylabiidæ, Allostethidæ, Esphalmenidæ, Psalididæ, Labiduridæ, Parisolabidæ, Brachylabidæ)

EUDERMAPTERA
LABIOIDEA (Pericomidæ, Nesogastridæ, Vandicidæ, Strongylopsalididæ, Sparattidæ, Spongiphoridæ, Labiidæ)
FORFICULOIDEA (Chelisodochidæ, Cheliduridæ, Anechuridæ, Forficulidæ, Eudohrniidæ, Neolobophoridæ, Ancistrogastridæ, Opisthocosmiidæ, Diaperasticidæ)
Suborder **Arixenina** (Arixeniidæ)
Order **DIPLOGLOSSATA**
(Hemimeridæ)
Order **Thysanoptera**
Suborder **Terebrantia**
ÆOLOTHRIPOIDEA (Æolothripidæ, Orothripidæ, Melanothripidæ, Franklinothripidæ)
THRIPOIDEA (Heterothripidæ, Thripidæ, Panchætothripidæ, Ceratothripidæ, Merothripidæ)
Suborder **Tubulifera**
PHLŒOTHRIPOIDEA (Phlœothripidæ, Ecacanthothripidæ, Eupatithripidæ, Pygothripidæ, Hystrichothripidæ, Megathripidæ, Idolothripidæ, Chirothripoididæ)
UROTHRIPOIDEA (Urothripidæ)
Order **BLATTARIÆ**
PHYLLODROMIOIDEA (Blaberidæ, Oxyhaloidæ, Panchloridæ, Epilampridæ, Nyctiboridæ, Perisphæriidæ, Diplopteridæ, Panesthesiidæ, Cryptocercidæ, Phyllodromiidæ, Areolariidæ, Chorisoneuridæ, Ectobiidæ, Nothoblattidæ, Attaphilidæ)
BLATTOIDEA (Blattidæ, Archiblattidæ, Nocticolidæ)
CORYDIOIDEA (Latindiidæ, Homœogamiidæ, Polyphagidæ, Corydiidæ, Atticolidæ, Euthyrrhaphidæ)
Order **MANTODEA**
(Mantidæ)
Order **EMBIODEA**
(Embiidæ, Oligotomidæ)
Order **ISOPTERA**
(Mastotermitidæ, Calotermitidæ, Hodotermitidæ, Rhinotermitidæ, Termitidæ)
Order **CORRODENTIA**
Suborder **Parapsocida** (Phyllipsocidæ, Perientomidæ, Lepidopsocidæ, Psoquillidæ, Atropidæ, Troctidæ, Archipsocidæ)
Suborder **Eupsocida** (Mesopsocidæ, Myopsocidæ, Cæciliidæ, Psocidæ, Amphientomidæ, Thyrsophoridæ)
Order **ZORAPTERA**
(Zorotypidæ)
Order **MALLOPHAGA**
Suborder **Amblycera** (Gyropidæ, Boopiidæ, Trimenoponidæ, Menoponidæ, Læmobothridæ, Ricinidæ)

Suborder **Ischnocera** (Trichodectidæ, Trichophilopteridæ, Nesiotinidæ, Philopteridæ)

Order **ANOPLURA** (Hæmatomyzidæ, Echinophthiriidæ, Hæmatopinidæ, Hæmatopinoididæ, Pediculidæ, Phthiriidæ)

Order **HOMOPTERA**

Suborder **Auchenorrhyncha**

CICADOIDEA (Cicadidæ)

MEMBRACOIDEA (Membracidæ)

CERCOPOIDEA (Machærotidæ, Tomaspididæ, Clastopteridæ, Cercopidæ)

JASSOIDEA (Cicadellidæ, Gyponidæ, Penthimiidæ, Thaumastoscopidæ, Ledridæ, Bythoscopidæ, Jassidæ, Paropiidæ, Stenocotidæ, Kœbeliidæ, Ulopidæ, Nirvanidæ, Signoretiidæ, Euacanthidæ, Pythamidæ, Æthialoniidæ)

FULGOROIDEA (Tettigometridæ, Cixiidæ, Delphacidæ, Derbidæ, Achilixiidæ, Meenoplidæ, Kinnaridæ, Dictyopharidæ, Fulgoridæ, Achilidæ, Tropiduchidæ, Nogodinidæ, Flatidæ, Acanaloniidæ, Issidæ, Ricaniidæ, Lophopidæ, Eurybrachidæ)

Suborder **Sternorrhyncha**

CHERMOIDEA (Chermidæ)

ALEYRODOIDEA (Aleyrodidæ)

APHIDOIDEA (Aphididæ, Phylloxeridæ)

COCCOIDEA (Ortheziidæ, Monophlebidæ, Diaspididæ, Conchaspididæ, Lecaniidæ, Lacciferidæ, Apiomorphidæ, Asterolecaniidæ, Phenacoleachidæ, Coccidæ, Cylindrococcidæ, Eriococcidæ, Kermesidæ)

Suborder **Coleorrhyncha** (Peloridiidæ, Pleidæ)

Order **HEMIPTERA**

Suborder **Gymnocerata**

SCUTELLEROIDEA (Corimelænidæ, Plataspididæ, Cydnidæ, Scutelleridæ, Pentatomidæ, Podopidæ)

COREOIDEA (Corizidæ, Coreidæ, Alydidæ)

GERROIDEA (Gerridæ, Veliidæ)

ARADOIDEA (Isodermidæ, Aradidæ, Termatophylidæ, Dysodiidæ, Saldidæ, Thaumastotheriidæ, Mesoveliidæ, Hebridæ, Hydrometridæ)

LYGÆOIDEA (Lygæidæ, Hyocephalidæ, Neididæ, Colobothristidæ, Pyrrhocoridæ)

TINGIDOIDEA (Piesmidæ, Tingididæ)

REDUVIOIDEA (Henicocephalidæ, Phymatidæ, Reduviidæ, Ploiariidæ, Nabidæ, Joppeicidæ)

POLYCTENOIDEA (Polyctenidæ)

CIMICOIDEA (Aepophilidæ, Cimicidæ, Velocipedidæ, Anthocoridæ, Miridæ, Microphysidæ, Isometopidæ)

DIPSOCOROIDEA (Dipsocoridæ, Schizopteridæ)

HELOTREPHOIDEA (Helotrephidæ)

Suborder **Cryptocerata** (Nerthridæ, Ochteridæ, Naucoridæ, Nepidæ, Belostomatidæ, Notonectidæ, Corixidæ)

Order **ODONATA**

Suborder **Zygoptera**

CŒNAGRIOIDEA (Hemiphlebiidæ, Protoneuridæ, Cœnagriidæ, Synlestidæ, Megapodagriidæ, Lestidæ, Pseudostigmatidæ)

AGRIOIDEA (Amphipterygidæ, Libellaginidæ, Epallagidæ, Polythoridæ, Agriidæ)

Suborder **Anisozygoptera**

EPIOPHLEBIOIDEA (Epiophlebiidæ)

Suborder **Anisoptera**

ÆSCHNOIDEA (Petaluridæ, Gomphidæ, Cordulegastridæ, Æschnidæ)

LIBELLULOIDEA (Cordulidæ, Libellulidæ)

Order **PLECTOPTERA**

EPHEMEROIDEA (Palingeniidæ, Polymitarcidæ, Ephemeridæ, Potamanthidæ, Prosopistomatidæ)

BAETOIDEA (Baetidæ, Caenidæ, Leptophlebiidæ, Ephemerellidæ, Oligoneuridæ)

SIPHLUROIDEA (Baetiscidæ, Siphluridæ, Ametropodidæ, Heptageniidæ)

Order **PLECOPTERA**

(Perlidæ, Pteronarcidæ, Eustheniidæ, Austroperlidæ, Leptoperlidæ, Capniidæ, Nemouridæ)

Order **MEGALOPTERA**

CORYDALOIDEA (Corydalidæ)

SIALOIDEA (Sialidæ)

Order **RAPHIDIODEA** (Raphidiidæ)

Order **NEUROPTERA**

ITHONOIDEA (Ithonidæ)

HEMEROBIOIDEA (Hemerobiidæ, Sympherobiidæ, Dilaridæ, Psychopsidæ, Osmylidæ, Polystœchotidæ, Sisyridæ, Chrysopidæ, Apochrysidæ, Berothidæ, Trichomatidæ, Mantispidæ)

NEMOPTEROIDEA (Nemopteridæ)

MYRMELEONTOIDEA (Myiodactylidæ, Nymphidæ, Myrmeleontidæ, Stilbopterygidæ, Ascalaphidæ)

CONIOPTERYGOIDEA (Coniopterygidæ)

Order **MECOPTERA**

Suborder **Protomecoptera** (Notiothaumidæ, Meropidæ)

Suborder **Eumecoptera** (Panorpidæ, Boreidæ, Bittacidæ)

Order **TRICHOPTERA**

Suborder **Æquipalpia**

RHYACOPHILOIDEA (Rhyacophilidæ, Philopotamidæ, Polycen-

tropodidæ, Hydropsychidæ, Psychomyiidæ, Calamoceratidæ, Odontoceridæ, Leptoceridæ, Molannidæ)

HYDROPTILOIDEA (Hydroptilidæ)

Suborder **Inæquipalpia**

PHRYGANOIDEA (Phryganeidæ, Limnephilidæ)

SERICOSTOMATOIDEA (Sericostomatidæ)

Order **LEPIDOPTERA**

Suborder **Jugatæ**

MICROPTERYGOIDEA (Micropterygidæ, Eriocraniidæ, Mnesarchæidæ)

HEPIALOIDEA (Hepialidæ, Prototheoridæ, Anomosetidæ, Palæosetidæ)

Suborder **Frenatæ**

COSSOIDEA (Zeuzeridæ, Cossidæ, Argyrotypidæ, Metarbelidæ, Hypoptidæ, Ratardidæ)

CASTNIOIDEA (Castniidæ, Tascinidæ)

PSYCHOIDEA (Psychidæ, Talæporiidæ, Heterogynidæ, Zygænidæ, Charidæidæ, Himantopteridæ, Pyromorphidæ, Eucleidæ, Megalopygidæ, Dalceridæ, Chrysopolomidæ, Mimallonidæ)

TORTRICOIDEA (Olethreutidæ, Tortricidæ, Phaloniidæ, Carposinidæ)

PTEROPHOROIDEA (Pterophoridæ, Orneodidæ, Agdistidæ, Oxychirotidæ)

PYRALIDOIDEA (Pyralididæ, Tineodidæ, Hyblæidæ)

URANIOIDEA (Epiplemidæ, Uraniidæ, Lonomiidæ, Epicopeiidæ)

BOMBYCOIDEA (Lasiocampidæ, Bombycidæ, Lemoniidæ, Citheroniidæ, Saturniidæ, Eupterotidæ, Brahmæidæ, Oxytenidæ, Cercophanidæ)

GEOMETROIDEA (Œnochromatidæ, Boarmidæ, Geometridæ, Sterrhidæ, Larentiidæ, Hemitheidæ, Acidaliidæ, Brephidæ)

SPHINGOIDEA (Sphingidæ)

TINEOIDEA (Adelidæ, Incurvariidæ, Nepticulidæ, Ashinagidæ, Amphitheridæ, Agonoxenidæ, Acrolophidæ, Setomorphidæ, Tineidæ, Amydriidæ, Tischeriidæ, Lyonetiidæ, Opostegidæ, Œnophilidæ, Prodoxidæ, Epipyropidæ, Coleophoridæ, Momphidæ, Elachistidæ, Phyllocnistidæ, Heliozelidæ, Douglasiidæ, Œcophoridæ, Ethmiidæ, Xyloryctidæ, Stenomidæ, Gelechiidæ, Metachandidæ, Epimarptidæ, Blastobasidæ, Hyposmocomidæ, Cosmopterygidæ, Scythrididæ, Epermeniidæ, Argyresthesiidæ, Chlidanotidæ, Yponomeutidæ, Cecidosidæ, Ridiaschinidæ, Plutellidæ, Cyclotornidæ, Anomologidæ, Glyphipterygidæ, Heliodinidæ, Copromorphidæ, Ægeriidæ)

NOCTUOIDEA (Endromididæ, Anthelidæ, Drepanidæ, Thyatiridæ, Hypsidæ, Lymantriidæ, Noctuidæ, Lithosiidæ, Plusiidæ, Nolidæ, Hylophilidæ, Cocytiidæ, Arctiidæ, Euchromiidæ,

Agaristidæ, Pericopidæ, Apoprogenidæ, Sematuridæ, Cymatophoridæ, Callidulidæ, Pterothysanidæ)

Suborder **Rhopalocera**

HESPERIOIDEA (Euschemonidæ, Megathymidæ, Hesperiidæ)

PAPILIONOIDEA (Asciidæ, Papilionidæ, Parnassiidæ, Danaidæ, Eueididæ, Ithomiidæ, Satyridæ, Brassolidæ, Morphoidæ, Nymphalidæ, Libytheidæ, Riodinidæ, Lycænidæ)

Order **DIPTERA**

Suborder **Nematocera**

TIPULOIDEA (Trichoceratidæ, Tipulidæ, Limoniidæ)

PSYCHODOIDEA (Psychodidæ, Tanyderidæ, Ptychopteridæ)

BLEPHAROCERATOIDEA (Blepharoceratidæ, Deuterophlebiidæ)

CHIRONOMOIDEA (Chironomidæ, Ceratopogonidæ, Thaumaleidæ, Simuliidæ)

CULICOIDEA (Culicidæ, Dixidæ)

ANISOPODOIDEA (Anisopodidæ, Mycetobiidæ, Pachyneuridæ)

BIBIONOIDEA (Hesperinidæ, Bibionidæ, Scatopsidæ)

MYCETOPHILOIDEA (Mycetophilidæ, Sciophilidæ, Bolitophilidæ, Ditomyiidæ, Ceroplatidæ, Macroceratidæ, Diadocidiidæ, Sciaridæ, Cecidomyiidæ)

Suborder **Brachycera**

Division ORTHORRHAPHA

STRATIOMYIOIDEA (Stratiomyiidæ, Pantophthalmidæ, Chiromyzidæ, Xylomyiidæ)

TABANOIDEA (Rhagionidæ, Xylophagidæ, Cœnomyiidæ, Tabanidæ)

THEREVOIDEA (Therevidæ, Scenopinidæ, Nemestrinidæ, Acroceratidæ)

ASILOIDEA (Bombyliidæ, Asilidæ, Apioceratidæ, Mydaidæ)

EMPIDOIDEA (Empididæ, Dolichopodidæ)

Division CYCLORRHAPHA

Series ASCHIZA

LONCHOPTEROIDEA (Lonchopteridæ)

PHOROIDEA (Phoridæ, Termitoxeniidæ, Thaumatoxenidæ, Braulidæ)

PLATYPEZOIDEA (Platypezidæ, Sciadoceratidæ)

SYRPHOIDEA (Pipunculidæ, Syrphidæ)

Series SCHIZOPHORA

Section MYODARIA

MUSCOIDEA THECOSTOMATA (Tachinidæ, Dexiidæ, Phasiidæ, Rhinophoridæ, Sarcophagidæ, Calliphoridæ; Muscidæ, Glossinidæ, Anthomyiidæ, Cordyluridæ, Œstridæ)

MUSCOIDEA HAPLOSTOMATA (Gastrophilidæ, Ctenostylidæ, Conopidæ, Pyrgotidæ, Phytalmiidæ, Platystomatidæ, Pterocallidæ, Ortalidæ, Ulidiidæ, Richardiidæ, Rhopalomeridæ,

Rhinotoridæ, Trypetidæ, Tachiniscidæ, Lonchæidæ, Pallopteridæ, Tanypezidæ, Nothybidæ, Micropezidæ, Neriidæ, Sepsidæ, Piophilidæ, Thyreophoridæ, Megamerinidæ, Diopsidæ, Clusiidæ, Tetanoceratidæ, Dryomyzidæ, Neottiophilidæ, Lauxaniidæ, Celyphidæ, Periscelidæ, Cœlopidæ, Helomyzidæ, Trichoscelidæ, Chyromyiidæ, Psilidæ, Anthomyzidæ, Opomyzidæ, Ochthiphilidæ, Tethinidæ, Agromyzidæ, Odiniidæ, Carnidæ, Milichiidæ, Cryptochætidæ, Drosophilidæ, Diastatidæ, Astiidæ, Aulacogastridæ, Canaceidæ, Ephydridæ, Oscinidæ, Borboridæ, Leptoceratidæ)

Section PUPIPARA

HIPPOBOSCOIDEA (Hippoboscidæ, Streblidæ, Nycteribiidæ)

Order **SIPHONAPTERA**

Suborder **Fractocipita** (Ischnopsyllidæ, Hystrichopsyllidæ, Macropsyllidæ)

Suborder **Integricipita** (Pulicidæ, Ctenophthalmidæ, Dolichopsyllidæ, Uropsyllidæ, Hectopsyllidæ, Tungidæ)

Order **COLEOPTERA**

Suborder **Adephaga**

CARABOIDEA (Cicindelidæ, Carabidæ, Pseudomorphidæ, Omophronidæ, Amphizoidæ, Hygrobiidæ, Haliplidæ, Dytiscidæ)

GYRINOIDEA (Gyrinidæ)

PAUSSOIDEA (Paussidæ)

CUPOIDEA (Cupidæ)

RHYSODOIDEA (Rhysodidæ, Jacobsoniidæ)

Suborder **Polyphaga**

HYDROPHILOIDEA (Hydrophilidæ, Hydroscaphidæ)

STAPHYLINOIDEA (Silphidæ, Thorictidæ, Sphæritidæ, Leptinidæ, Clambidæ, Scaphidiidæ, Scydmænidæ, Brathinidæ, Staphylinidæ, Platypsyllidæ, Pselaphidæ, Clavigeridæ)

CUCUJOIDEA (Cucujidæ, Parandridæ, Helotidæ, Passandridæ, Silvanidæ)

CANTHAROIDEA (Lampyridæ, Cantharidæ, Lycidæ, Drilidæ, Lymexylidæ, Micromalthidæ, Atractoceridæ, Telegeusidæ, Dasytidæ, Malachiidæ, Cleridæ, Corynetidæ)

MORDELLOIDEA (Cephaloidæ, Œdemeridæ, Mordellidæ, Rhipiphoridæ, Meloidæ, Eurystethidæ, Pythidæ, Pyrochroidæ, Pedilidæ, Anthicidæ, Euglenidæ)

ELATEROIDEA (Cerophytidæ, Cebrionidæ, Plastoceridæ, Rhipiceratidæ, Elateridæ, Melasidæ, Throscidæ, Buprestidæ)

DRYOPOIDEA (Psephenidæ, Dryopidæ, Helmidæ, Heteroceridæ, Georyssidæ)

DASCYLLOIDEA (Dascyllidæ, Helodidæ, Chelonariidæ, Dermestidæ, Byturidæ, Byrrhidæ, Nosodendridæ, Ptinidæ, Ectrephidæ, Gnostidæ, Eucinetidæ)

HISTEROIDEA (Histeridæ, Niponiidæ, Synteliidæ)
COLYDIOIDEA (Colydiidæ, Murmidiidæ, Ostomatidæ, Monotomidæ, Cryptophagidæ, Nitidulidæ, Brachypteridæ, Rhizophagidæ, Ciidæ, Mycetophagidæ, Erotylidæ, Languriidæ, Catopochrotidæ, Phalacridæ, Lyctidæ, Anobiidæ, Bostrychidæ, Lathridiidæ, Monotomidæ, Derodontidæ, Endomychidæ, Mycetæidæ, Coccinellidæ, Orthoperidæ, Phænocephalidæ, Sphæriidæ, Ptiliidæ, Hydroscaphidæ, Discolomidæ, Cyathoceridæ)
TENEBRIONOIDEA (Tenebrionidæ, Cossyphodidæ, Cistelidæ, Petriidæ, Lagriidæ, Elacatidæ, Nilionidæ, Sphindidæ, Melandryidæ, Scraptiidæ, Monommatidæ, Trictenotomidæ)
CERAMBYCOIDEA (Prionidæ, Lamiidæ, Cerambycidæ, Donaciidæ, Megascelidæ, Sagridæ, Crioceridæ, Cryptocephalidæ, Chlamydidæ, Megalopodidæ, Clytridæ, Chrysomelidæ, Lamprosomatidæ, Eumolpidæ, Galerucidæ, Halticidæ, Hispidæ, Cassididæ, Mylabridæ)
CURCULIONOIDEA (Brentidæ, Cyladidæ, Rhinomaceridæ, Curculionidæ, Platypodidæ, Chapuisiidæ, Scolytidæ, Scolytoplatypodidæ, Ipidæ, Anthribidæ, Aglycideridæ, Proterhinidæ)
SCARABÆOIDEA (Passalidæ, Lucanidæ, Sinodendridæ, Trogidæ, Scarabæidæ, Geotrupidæ, Pleocomidæ, Glaphyridæ, Orphnidæ, Ochodæidæ, Hybosoridæ, Aphodiidæ, Ægialiidæ, Melolonthidæ, Euchiridæ, Rutelidæ, Pachypodidæ, Dynastidæ, Phænomeridæ, Cetoniidæ, Trichiidæ)

Order **STREPSIPTERA**

MENGEOIDEA (Mengeidæ, Mengenillidæ)
STICHOTREMATOIDEA (Stichotrematidæ)
XENOIDEA (Callipharixenidæ, Myrmecolacidæ, Stylopidæ, Hylecthridæ, Xenidæ)
HALICTOPHAGOIDEA (Diozoceratidæ, Halictophagidæ)
ELENCHOIDEA (Elenchidæ)

Order **HYMENOPTERA**

Suborder **Chalastogastra**

PAMPHILIOIDEA (Pamphiliidæ, Xyelidæ)
TENTHREDINOIDEA (Megalodontidæ, Cimbicidæ, Pergidæ, Argidæ, Blasticotomidæ, Tenthredinidæ, Diprionidæ)
SIRICOIDEA (Xiphydriidæ, Cephidæ, Siricidæ)
ORYSSOIDEA (Oryssidæ)

Suborder **Clistogastra**

Division TEREBRANTIA

ICHNEUMONOIDEA (Megalyridæ, Stephanidæ, Aulacidæ, Gasteruptionidæ, Evaniidæ, Ichneumonidæ, Braconidæ, Agriotypidæ, Alysiidæ, Trigonalidæ)
CHALCIDOIDEA (Callimomidæ, Agaontidæ, Leucospididæ, Or-

myridæ, Eurytomidæ, Perilampidæ, Eucharididæ, Cleonymidæ, Encyrtidæ, Pteromalidæ, Miscogastridæ, Elasmidæ, Leptocœnidæ, Eulophidæ, Trichogrammatidæ, Mymaridæ)

SERPHOIDEA (Pelecinidæ, Monomachidæ, Heloridæ, Roproniidæ, Vanhorniidæ, Serphidæ, Belytidæ, Diapriidæ, Scelionidæ, Calliceratidæ, Platygastridæ)

CYNIPOIDEA (Ibaliidæ, Cynipidæ, Figitidæ)

Division ACULEATA

BETHYLOIDEA (Rhopalosomatidæ, Bethylidæ, Dryinidæ, Embolemidæ, Sclerogibbidæ)

CHRYSIDOIDEA (Cleptidæ, Chrysididæ, Alienidæ)

SCOLIOIDEA (Sapygidæ, Plumariidæ, Scoliidæ, Tiphiidæ, Anthoboscidæ, Sierolomorphidæ, Thynnidæ, Methocidæ, Myrmosidæ, Mutillidæ, Apterogynidæ)

FORMICOIDEA (Formicidæ)

VESPOIDEA (Vespidæ)

PSAMMOCHAROIDEA (Psammocharidæ)

SPHECOIDEA (Ampulicidæ, Sphecidæ, Mellinidæ, Gorytidæ, Nyssonidæ, Trypoxylidæ, Stizidæ, Dimorphidæ, Bembicidæ, Larridæ, Miscophidæ, Philanthidæ, Cerceridæ, Alysonidæ, Pemphredonidæ, Crabronidæ, Oxybelidæ)

APOIDEA (Colletidæ, Prosopididæ, Andrenidæ, Megachilidæ, Panurgidæ, Podaliriidæ, Bombidæ, Euglossidæ, Xylocopidæ, Ceratinidæ, Stelididæ, Chrysanthedidæ, Nomadidæ, Melectidæ, Apidæ)

KEY TO THE CLASSES OF ARTHROPODA

1. Antennæ absent; often four or five pairs of legs, sometimes more, very rarely less.....2
   One or two pairs of antennæ present; legs variable, often three or many pairs.....9
2. Marine animals, occasionally living near the tidal zone.....3
   Terrestrial, rarely aquatic species living in fresh water; never living in the ocean below the tidal zone.....4
3. Respiratory organs well developed, consisting of blood gills; four anterior pairs of legs chelate at tip; large animals, the body covered by a convex carapace. King crabs, Horseshoe crabs.
   XIPHOSÙRA
   Respiratory organs absent or vestigial; none of the legs chelate at tip; body small, with extremely long legs....**PYCNOGÓNIDA**
4. Four pairs of legs in the adult, sometimes with another more anterior pair of appendages (pedipalpi) resembling walking legs.....5
   Three pairs of legs or less.....6
5. With a well developed respiratory system composed of book lungs or of tubular tracheæ opening by spiracles, or of both in the same animal; reproductive organs opening near the base of the abdomen below; integument usually heavily chitinized at least on part of the body. Spiders, Scorpions, Mites, Ticks, etc.
   ARÁCHNIDA (Page 535)
   Without any special respiratory organs, reproductive organs opening into the alimentary canal; very small or microscopic animals with weakly chitinized integument, living in damp places or aquatic. Water bears, Bear animalcules.
   TARDÌGRADA (Page 581)
6. With three pairs of legs, or with only two pairs, in the latter case the body is vermiform and shows many minute transverse wrinkles or annulations; small or minute animals.....7
   Without legs in the adult which is vermiform and shows many minute transverse wrinkles or annulations, or with two pairs in the embryo or young larva which is short and not thus annulate; internal parasites of vertebrates (see couplet 5). (Order Pentastomida).....**ARÁCHNIDA**, part. (Page 535)
7. Three pairs of legs.....8
   Two pairs of legs; body long, tapering, the integument with

minute transverse rings or wrinkles; living in plant or animal tissues. Some Acarina (see couplet 5).

ARÁCHNIDA, part. (Page 535)

8. Body elongate; abdomen consisting of eleven segments, its basal three segments each bearing a pair of vestigial legs. (Order Protura. (If internal parasites, *cf.* Strepsiptera, p. 467).

INSÉCTA, part. (Page 28)

Body short, rounded or oval; abdomen not segmented and without appendages below. The young of some Acarina.

ARÁCHNIDA, part. (Page 535)

9. Only one pair of antennæ. 10

Two pairs of antennæ; five or more pairs of legs; aquatic (very rarely terrestrial) animals living in the sea or in fresh water, provided with true gills, except in some parasitic forms.

CRUSTÀCEA (Page 534)

10. With three pairs of legs in the adult, and usually with wings; legs reduced in size and structure or often completely absent in the larva. . . . . **INSÉCTA** (Page 28)

More than three pairs of legs; no wings; body usually very elongate. 11

11. Legs of the first three segments behind the head similar, composed of distinct joints, but of a different type from the more posterior pairs which are not clearly jointed. Larvæ of some insects.

INSÉCTA, part. (Page 28)

Legs essentially similar, at most only the first pair strikingly different from the more posterior ones. 12

12. Legs composed of distinct, heavily chitinized segments which are articulated by sharply differentiated joints; integument usually heavily chitinized. 13

Legs fleshy with numerous annulations, but without any clearly articulated joints; long cylindrical, soft-bodied animals. Tropical. . . . . **ONYCHÓPHORA** (Page 532)

13. Not more than one pair of legs on any segment of the body. 14

Two pairs of legs on some, usually on most of the segments of the body (as indicated by the tergites); body usually more or less cylindrical. . . . . **DIPLÓPODA** (Page 585)

14. Antennæ simple, not branched. 15

Antennæ branched apically, terminating in three multiarticulate setiform appendages; nine pairs of legs; minute animals without respiratory organs. . . . . **PAURÓPODA** (Page 583)

15. Legs terminating in a single tarsal claw; first pair of legs modified

to form jaw-like poison fangs; at least nineteen body segments and fifteen or more pairs of legs in the adult. Centipedes.

CHILŌPODA (Page 599)

Legs each bearing two tarsal claws; first pair of legs more or less reduced in size, not jaw-like and without poison gland; 15 to 22 body segments and twelve pairs of legs.

SŸMPHYLA (Page 603)

CLASS **INSÉCTA**

(*HEXÁPODA*)

Small or moderate-sized, frequently very small or minute, never very large, Arthropoda. Body of adult and sometimes also of the immature stages more or less clearly divided into three groups of segments, head, thorax and abdomen; those forming the head fused into a single piece. Three thoracic segments, each bearing a pair of legs; the first segment often much more freely articulated than the others; second and third each usually bearing a pair of wings, sometimes absent on the third or entirely wanting. Abdomen composed of eleven segments or less, frequently six to eight, often terminated by a pair of cerci. One pair of antennæ almost always present; three pairs of mouthparts; a pair of mandibles fitted for chewing or piercing, and two pairs of maxillæ, the latter usually bearing a jointed palpus and the first pair usually biramose. Compound eyes and three simple ocelli usually present. Legs almost always terminating in claws, usually nine- or eight-jointed, occasionally less. Wings usually supplied with a series of branched veins or chitinous thickenings, fore pair often thicker than the hind ones. Respiration by branched, tubular tracheæ opening by segmentally arranged pairs of spiracles. Development direct in the primitive forms or with a metamorphosis often involving great changes in form and habits. Younger stages without functional wings; in the forms undergoing metamorphosis with the legs and antennæ much reduced and the body grub-like, caterpillar-like, or vermiform. Insects.

KEY TO THE ORDERS OF INSECTA

1. Wings developed.....2
   Wingless, or with vestigial wings.....32
2. The wings of the mesothorax (the fore wings) horny, leathery or parchment-like, at least at the base; differing materially in texture from the membranous hind wings which exceptionally

may be absent. Prothorax large and not fused with the mesothorax (except in the rare Strepsiptera, which have minute fore wings).....3

The mesothoracic wings membranous.....12

3. Mesothoracic wings (called tegmina or hemelytra) containing veins, or at least the metathoracic wings not folded crossways when hidden under the upper wings.....4

Mesothoracic wings (called elytra) veinless, of uniform, horny consistency, the metathoracic wings, when present, folded crossways as well as lengthwise when at rest and hidden beneath the elytra; mouth mandibulate.....11

4. Mouthparts forming a jointed beak, fitted for piercing and sucking.....5

Mouthparts with mandibles fitted for chewing and moving laterally.....6

5. Head usually horizontal and with the beak arising from the under part so as to project downwards, the gula well developed; mesothoracic wings usually leathery at the base and abruptly membranous on the apical portion, the membranous parts usually overlapping one another and lying flat over the abdomen when at rest. True bugs.....**HEMÍPTERA** (Page 140)

Head usually vertical and with the beak arising from the back part so as to project backward between the front legs; gula absent, or represented by a small membrane.

HOMÓPTERA (Page 106)

6. Hind wings not folded, similar to the fore wings; social species, living in colonies. Termites.....**ISÓPTERA** (Page 93)

Hind wings folding, fan-like, broader than the fore wings.....7

7. Usually rather large or moderately large species; antennæ usually lengthened and thread-like; prothorax large and free from the mesothorax; cerci present; fore wings rarely minute, usually long.....8

Very small active species; antennæ short, with few joints, at least one joint bearing a long lateral process; no cerci; fore wings minute; prothorax small. Rare, short-lived insects, parasites of other insects, usually wasps and bees.

Males of **STREPSÍPTERA** (Page 467)

8. Hind femora not larger than the fore femora; mute species; body more or less flattened with the wings superposed when at rest; tergites and sternites subequal.....9

Hind femora almost always much larger than the fore femora,

jumping species, if not (Gryllotalpidæ) the front legs broadened for burrowing; species usually capable of chirping or making a creaking noise; body more or less cylindrical, the wings held sloping against the sides of the body when at rest; tergites usually larger than the sternites. Grasshoppers, Katydids, Crickets. **ORTHÓPTERA** (Page 48)

9. Body elongate; head free, not concealed from above by the prothorax; deliberate movers.....10

Body oval, much flattened; head nearly concealed beneath the oval pronotum; legs similar and fitted for rapid running, the coxæ large. Roaches.....**BLATTÀRIÆ** (Page 77)

10. Prothorax much longer than the mesothorax; front legs almost always heavily spined, formed for seizing prey; cerci usually with several joints. Mantes, Leaf insects. **MANTÒDEA** (Page 83)

Prothorax short; legs similar, formed for walking; cerci one-jointed. Stick insects, Walking sticks. **PHASMATÒDEA** (Page 61)

11. Abdomen terminated by movable, almost always heavily chitinized forceps; antennæ long and slender; fore wings short, leaving most of the abdomen uncovered, hind wings nearly circular, delicate, radially folded from near the center; elongate insects. Earwigs..... **DERMÁPTERA** (Page 65)

Abdomen not terminated by forceps;[1] antennæ of various forms but usually eleven-jointed; fore wings usually completely sheathing the abdomen; generally hard-bodied species. Beetles, Weevils.....**COLEÓPTERA** (Page 408)

12. With four wings.....13

With but two wings (the mesothoracic) usually outspread when at rest.....30

13. Wings long, very narrow, the margins fringed with long hairs, almost veinless; tarsi one- or two-jointed, with swollen tip; mouthparts asymmetrical, without biting mandibles, fitted for lacerating and sucking plant tissues; no cerci; minute species. Thrips.....**THYSANÓPTERA** (Page 72)

Wings broader and most often supplied with veins, if rarely somewhat linear the tarsi have more than two joints and the last tarsal joint is not swollen.....14

14. Hind wings with the anal area folded in plaits, fan-like, in repose,

[1] If very rarely (one African genus) with apical forceps-like appendages, the wings are not as in Dermaptera.

larger than the fore wings; antennæ prominent; veins usually numerous; larvæ aquatic.....15

Hind wings not folded, not larger than the fore wings, the anal area small and not separated.....17

15. Tarsi five-jointed; cerci not pronounced.....16

Tarsi three-jointed; body rather flattened, with jointed cerci; wings at rest overlapping the abdomen, prothorax large, free; species of moderate to large size. Stone-flies.
PLECÓPTERA (Page 176)

16. Costal area with few crossveins; wing with the surface hairy; prothorax small; species of small to moderate size. Caddice flies.
TRICHÓPTERA (Page 191)

Costal area with many crossveins; prothorax rather large; species of moderate to large size.....**MEGALÓPTERA** (Page 179)

17. Antennæ short and inconspicuous; wings netveined with numerous crossveins; nymphs aquatic. (SUBULICÓRNIA).....18

Antennæ larger, distinct, if rarely small the crossveins are few; larvæ almost always terrestrial.....19

18. Hind wings much smaller than the fore wings; abdomen ending in long, thread-like processes; tarsi normally four- or five-jointed; sluggish fliers. May flies.....**PLECTÓPTERA** (Page 169)

Hind wings nearly like the fore wings; no caudal setæ; tarsi three-jointed; vigorous, active fliers, often of large size. Dragon flies, Damsel flies.....**ODONÀTA** (Page 159)

19. Head produced into a mandibulate beak (Fig. 354), hind wings not folded; wings usually with color pattern, the crossveins numerous; male genitalia usually greatly swollen, forming a reflexed bulb. Scorpion flies.....**MECÓPTERA** (Page 189)

Head not drawn out as a mandibulate beak; male abdomen not forcipate.....20

20. Mouth mandibulate.....21

Mouth haustellate, the mandibles not formed for chewing; no cerci; crossveins few.....28

21. Tarsi five-jointed, if rarely three- or four-jointed, the hind wings are smaller than the front ones and the wings lie flat over the body; no cerci.....22

Tarsi two-, three- or four-jointed; veins and crossveins not numerous.....25

22. Prothorax small or only moderately long. (In Mantispidæ the prothorax is very long, but the front legs are strongly raptorial).....23

Prothorax very long and cylindrical, much longer than the head; front legs normal; antennæ with more than eleven joints; crossveins numerous. . . . . **RAPHIDIÒDEA** (Page 180)

23. Wings similar, with many veins and crossveins; prothorax more or less free. If the neuration is very rarely reduced (Coniopteryx) the wings are powdered. 24

Wings with relatively few angular cells, the costal cell without crossveins; hind wings smaller than the fore pair; prothorax fused with the mesothorax; abdomen frequently constricted at the base and ending in a sting or specialized ovipositor. Ants, Wasps, Bees, etc. . . . . **HYMENÓPTERA** (Page 471)

24. Costal cell, at least in the fore wing, almost always with many crossveins. . . . . **NEURÓPTERA** (Page 181)

Costal cell without crossveins. . . . . **MECÓPTERA** (Page 189)

25. Wings equal in size, or rarely the hind wings larger, held superposed on the top of the abdomen when at rest; media fused with the radial sector for a short distance near the middle of the wing; tarsi three-, four-, or five-jointed 26

Hind wings smaller than the fore wings; wings held at rest folded back against the abdomen; radius and media not fusing; tarsi two- or three-jointed. 27

26. Tarsi apparently four-jointed; cerci usually minute; social species, living in colonies. . . . . **ISÓPTERA** (Page 93)

Tarsi three-jointed, the front metatarsi swollen; cerci conspicuous; usually solitary species. . . . . **EMBIÒDEA** (Page 91)

27. Cerci absent; tarsi two- or three-jointed; wings remaining attached throughout life; radial sector and media branched, except when fore wings are much thickened.

CORRODÉNTIA (Page 96)

Cerci present; tarsi two-jointed; wings deciduous at maturity, the neuration greatly reduced; radial sector and media simple, unbranched. . . . . **ZORÁPTERA** (Page 100)

28. Wings not covered with scales, not outspread when at rest; prothorax large; antennæ with few joints; mouthparts forming a jointed piercing beak. 29

Wings and body covered with colored scales which form a definite pattern on the wings; antennæ many-jointed; mouthparts when present forming a coiled tongue. Moths and Butterflies.

LEPIDÓPTERA (Page 198)

29. Beak arising from the back of the head.

HOMÓPTERA (Page 106)

Beak arising from the front part of the head.

HEMÍPTERA (Page 140)

30. Mouth not functional; abdomen furnished with a pair of caudal filaments 31

Mouthparts forming a proboscis, only exceptionally vestigial; abdomen without caudal filaments; hind wings replaced by knobbed halteres. Flies, Mosquitoes, Midges.

DÍPTERA (Page 264)

31. No halteres; antennæ inconspicuous; crossveins abundant. A few rare May flies..... **PLECTÓPTERA** (Page 169)

Hind wings represented by minute hook-like halteres; antennæ evident; neuration reduced to a forked vein; crossveins lacking; minute delicate insects. Males of Scale insects.

HOMÓPTERA (Page 106)

32. Body more or less insect-like, *i.e.* with more or less distinct head, thorax and abdomen, and jointed legs, and capable of locomotion..... 33

Without distinct body parts, or without jointed legs, or incapable of locomotion..... 75

33. Terrestrial, breathing through spiracles; rarely without special respiratory organs..... 34

Living in the water; usually gill-breathing, larval forms..... 61

Parasites on warm-blooded animals 69

34. Mouthparts vestigial, retracted in the head and scarcely or not at all visible; underside of the abdomen with styles or other appendages; very delicate small or minute insects. (APTERYGÒTA)..... 35

Mouthparts mandibulate, formed for chewing (if body is covered with scales, see Thysanura)..... 38

Mouthparts haustellate, formed for sucking..... 57

35. Abdomen consisting of ten to twelve segments, no ventral sucker at its base, no terminal springing apparatus..... 36

Abdomen consisting of six segments or less, with a forked sucker at base below and usually with a springing apparatus (furcula) near the tip beneath; cerci absent.

COLLÉMBOLA (Page 44)

36. Basal three segments of the abdomen with ventral styles; antennæ absent; no cerci, but a short anal tube present; head pear-shaped; prothorax short; abdomen with twelve segments; minute, cylindrical species. (Class *MIRIENTÓMATA*).

PROTÙRA (Page 40)

Ventral styles occurring to the seventh segment; antennæ thread-like; cerci present; prothorax not short.....37

37. Body never scaly; mouthparts concealed except for the palpi; apex of the abdomen without a median process.
ENTÓTROPHI (Page 43)

Body usually covered with minute scales; tips of the mouthparts visible; abdomen with a median cerciform appendage.
THYSANÙRA (Page 41)

38. Underside of abdomen entirely without legs.....39

Abdomen bearing false legs beneath which differ from those of the thorax; body caterpillar-like, cylindrical, the thorax and abdomen not distinctly separated; larval forms.....55

39. Antennæ long and distinct.....40

Antennæ short, not pronounced; larval forms.....53

40. Abdomen terminated by strong movable forceps; prothorax free. Earwigs.....**DERMÁPTERA** (Page 65)

Abdomen not ending in forceps.....41

41. Abdomen not strongly constricted at the base, broadly joined to the thorax.....42

Abdomen strongly constricted at the base; prothorax fused with the mesothorax. Ants, etc.....**HYMENÓPTERA** (Page 471)

42. Head not prolonged into a beak.....43

Head produced into a mandibulate beak.
MECÓPTERA (Page 189)

43. Very small (three millimeters), louse-like jumping species; prothorax inconspicuous. Book lice. **CORRODÉNTIA** (Page 96)

Larger, or at least not louse-like species; prothorax large.....44

44. Hind legs fitted for jumping, the femora enlarged; wing-pads of larvæ when present in inverse position, the metathoracic overlapping the mesothoracic.....**ORTHÓPTERA** (Page 48)

Hind legs not enlarged for jumping; wing-pads, if present, in normal position.....45

45. Prothorax much longer than the mesothorax; front legs fitted for grasping prey.....**MANTÒDEA** (Page 83)

Prothorax not greatly lengthened.....46

46. Cerci present; antennæ usually with more than fifteen joints, often many-jointed.....47

No cerci; body often hard-shelled; antennæ usually with eleven joints.....**COLEÓPTERA** (Page 408)

47. Cerci with more than three joints.....48

Cerci short, with one to three joints.....50

48. Body flattened and oval; head inflexed; prothorax oval. Roaches. **BLATTÀRIÆ** (Page 77)
Body elongate; head nearly horizontal.....49
49. Cerci long; ovipositor chitinized, exserted; tarsi five-jointed. **GRYLLOBLATTÒDEA** (Page 47)
Cerci short; no ovipositor; tarsi four-jointed. **ISÓPTERA** (Page 93)
50. Tarsi five-jointed; body very slender and long. Walking-sticks. **PHASMATÒDEA** (Page 61)
Tarsi two- to four-jointed; body not linear.....51
51. Front tarsi not enlarged.....52
Front tarsi with the first joint swollen...**EMBIÒDEA** (Page 91)
52. Tarsi apparently four-jointed; cerci with several joints; antennæ with nine to thirty joints.....**ISÓPTERA** (Page 93)
Tarsi two-jointed; cerci one-jointed; antennæ nine-jointed; minute species .....**ZORÁPTERA** (Page 100)
53. Body cylindrical, caterpillar-like ....**MECÓPTERA** (Page 189)
Body more or less depressed, not caterpillar-like.....54
54. Mandibles united with the corresponding maxillæ to form sucking jaws (Fig. 975).....Larvæ of **NEURÓPTERA**
Mandibles almost always separate from the maxillæ (Figs. 972, 973, 976, 977, 979, 980, 983, 984, 986, 992).
Larvæ of **COLEÓPTERA, RAPHIDIÒDEA, STREPSÍPTERA**
55. False legs numbering five pairs or less; located on various abdominal segments; but not on the second; the false legs (prolegs) tipped with many minute hooks. (Figs. 978, 982).
Larvæ of **LEPIDÓPTERA** (Page 240)
False legs numbering from six to ten pairs, one pair of which occurs on the second abdominal segment; the prolegs not tipped with minute hooks.....56
56. Head with a single ocellus on each side. (Figs. 966–971).
Larvæ of some **HYMENÓPTERA** (Page 408)
Head with several ocelli on each side. Larvæ of **MECÓPTERA**
57. Body bare or with few scattered hairs, or with waxy coating....58
Body densely clothed with hairs or scales; proboscis if present coiled under the head. Moths. **LEPIDÓPTERA** (Page 198)
58. Last tarsal joint swollen; mouth consisting of a triangular unjointed beak; minute species. Thrips. **THYSANÓPTERA** (Page 72)
Tarsi not bladder-like at the tip, and with distinct claws.....59
59. Prothorax distinct.....60

Prothorax small, hidden when viewed from above.
DÍPTERA (Page 264)

60. Beak arising from the front part of the head.
HEMÍPTERA (Page 140)
Beak arising from the back part of the head.
HOMÓPTERA (Page 106)

61. Mouth mandibulate.....62
Mouth haustellate, forming a strong pointed inflexed beak.
Nymphs of **HEMÍPTERA**

62. Mandibles exserted straight forward and united with the corresponding maxillæ to form piercing jaws.
Larvæ of some **NEURÓPTERA**
Mandibles normal, moving laterally to function as biting jaws..63

63. Body not encased in a shell made of sand, pebbles, leaves, etc...64
Case-bearing forms; tracheal gills usually present. Periwinkles, Caddis-worms. (Fig. 974).....Larvæ of **TRICHÓPTERA**

64. Abdomen furnished with external lateral gills or respiratory processes (a few Coleoptera and Trichoptera here also).....65
Abdomen without external gills.....66

65. Abdomen terminated by two or three long caudal filaments.
Larvæ of **PLECTÓPTERA**
Abdomen with short end processes..Larvæ of **MEGALÓPTERA**

66. Lower lip strong, extensile, and furnished with a pair of opposable hooks.....Larvæ of **ODONÀTA**
Lower lip not capable of being thrust forward and not hooked.....67

67. Abdomen without false legs.....68
Abdomen bearing paired false legs on several segments.
A few larvæ of **LEPIDÓPTERA**

68. The three divisions of the thorax loosely united; antennæ and caudal filaments long and slender....Larvæ of **PLECÓPTERA**
Thoracic divisions not constricted; antennæ and caudal filaments short (also a few Trichoptera here). (See couplet 54).
Larvæ of **COLEÓPTERA**

69. Body flattened.....70
Body strongly compressed; mouth formed as a sharp inflexed beak; jumping species. Fleas.....**SIPHONÁPTERA** (Page 404)

70. Mandibulate mouthparts formed for chewing.....71
Haustellate mouthparts formed for piercing and sucking.....73

71. Mouth inferior; cerci long.....72
Mouth anterior; no cerci; generally elongate-oval insects with

somewhat triangular head; parasites of birds or mammals. Biting lice. . . . . **MALLÓPHAGA** (Page 101)

72. Cerci straight, eyes absent; antennæ short; external parasites of rodents. . . . . **DIPLOGLOSSÀTA** (Page 71)

Cerci strongly bent or angulate at the middle; eyes present; antennæ nearly as long as the body; external parasites of bats. Some **DERMÁPTERA** (Page 65)

73. Antennæ exserted, visible, though rather short. 74

Antennæ inserted in pits, not visible from above. Pupiparous **DÍPTERA** (Page 264)

74. Beak unjointed; tarsi formed as a hook for grasping the hairs of the host; permanent parasites. Lice. . **ANOPLÙRA** (Page 104)

Beak jointed; tarsi not hooked; temporary parasites. **HEMÍPTERA** (Page 140)

75. Legless grubs, maggots or borers; locomotion effected by a squirming motion. Larvæ of Strepsiptera, and of some Coleoptera (see couplet 54), Diptera, Lepidoptera and Hymenoptera. (If living in the body of wasps or bees, with the flattened head exposed, compare the females of Strepsiptera).

Sedentary forms, incapable of locomotion. 76

76. Small degraded forms bearing little superficial resemblance to insects, with a long slender beak, and usually covered with a waxy scale or powder or cottony tufts; living on various plants. Scale insects. . . . . **HOMÓPTERA** (Page 106)

Body quiescent, but able to bend from side to side; not capable of feeding, enclosed in a skin which is tightly drawn over all the members, or which leaves the limbs free but folded against the body; sometimes free; sometimes enclosed in a cocoon or in a shell formed from the dried larval skin. 77

77. The skin encasing the legs, wings, etc., holding the members tightly against the body; prothorax small; a proboscis showing. 78

Legs, wings, etc., more or less free from the body; biting mouthparts showing. 79

78. Proboscis long; four wing cases; sometimes in a cocoon. (Figs. 990, 996) . . . . . Pupæ of **LEPIDÓPTERA**

Proboscis short; two wing cases. (Figs. 991, 997). Pupæ of **DÍPTERA** (Page 368)

79. Prothorax small, fused into one piece with the mesothorax; sometimes enclosed in a loose cocoon. Pupæ of **HYMENÓPTERA**

Prothorax larger and not closely fused with the mesothorax. . . . 80

80. Wing cases with few or no veins. (Fig. 994).
Pupæ of **COLEÓPTERA**
Wing cases with a number of veins. (Fig. 993).
Pupæ of **NEUROPTEROID ORDERS**

LITERATURE ON INSECTS

General Works on Insects and References Dealing with at least Several Orders Together

Balfour-Browne, F. Keys to the Orders of Insects. Cambridge Univ. Press, 58 pp. (1920).

Banks, N. Synopsis, Catalogue and Bibliography of Neuropteroid Insects of North America. Trans. American Entom. Soc., **19**, pp. 328–373 (1892). (Includes Neuroptera, Odonata, Plectoptera, Plecoptera, Trichoptera, Mecoptera, Isoptera, Embiodea, Megaloptera).

A List of Works on North American Entomology. Bull. Bur. Entom., U. S. Dept. Agric., No. 81, 120 pp. (1910). (A most valuable list of selected works, classified by groups, including also the Arachnida).

Berlese, A. Gli Insetti. 2 vols., 2018 pp., Milan (1909–25).

Biological Abstracts. Published by the Union of American Biological Societies, University of Pennsylvania, Philadelphia, **1–4** (1926–30). An index to biological literature beginning with 1926, with an abstract of those papers to which reference is made.

Britton, W. E. Check List of the Insects of Connecticut. Bull. State Geol. Nat. Hist. Surv., Connecticut, No. 31, 397 pp. (1920).

Brohmer, P., Ehrmann, P. and Ulmer, G., Editors. Die Tierwelt Mitteleuropas, 1928; vol. 2 contains the lower Arthropoda; vol. 3, Arachnida; vol. 4, Insects. (The parts are by numerous contributors, and so far as published are listed under the separate groups).

Brues, C. T. and Melander, A. L. Key to the Families of North American Insects. 140 pp., Boston, Mass. and Pullman, Wash. (1915).

Carus, J. V. Bibliographia Zoologica. Vols. 1–24 issued with the Zoologischer Anzeiger, Leipzig (1900–13); vols. 25–40 issued separately by the Concilium Bibliographicum, Zurich (1913–30).

Cockerell, T. D. A. Zoölogy of Colorado. 262 pp., Boulder, Colo., (1927).

Concilium Bibliographicum. Zurich, Switzerland. Index cards to zoölogical literature, 1896–. (Deals with the whole animal kingdom; the cards issued, one card for each title, usually with brief indication of contents.)

Comstock, J. H. The Wings of Insects. 423 pp., Comstock Pub. Co., Ithaca, N. Y. (1918).

An Introduction to Entomology. Comstock Pub. Co., Ithaca, N. Y., 1044 pp. (1924).

Essig, E. O. Insects of Western North America. 1035 pp. New York, MacMillan (1926).

Ewing, H. E. Manual of External Parasites. 225 pp. Springfield, Ill., C. C. Thomas (1929).

FELT, E. P. Key to American Insect Galls. Bull. New York State Mus., No. 200, 310 pp. (1917). (Contains an extensive bibliography.)

FERRIS, G. F. The Principles of Systematic Entomology. Stanford Univ. Publ. Biol. Sci., **5**, pp. 103–269 (1928).

FLETCHER, T. B. South Indian Insects. 587 pp. Madras (1914).

Tentative Keys to the Orders and Families of Indian Insects. Bull. Agric. Res. Inst. Pusa, No. 162, 101 pp. (1926).

FROGGATT, W. W. Australian Insects. 463 pp. Sydney (1908).

GODMAN, F. D. and SALVIN, O., Editors. Biologia Centrali-Americana, Contributions to a Knowledge of the Fauna and Flora of Mexico and Central America. (Contains Arachnida, Diplopoda, Chilopoda and Insects in many volumes, some of which we have listed separately). London (1896–1915).

HAGEN, H. A. Bibliotheca Entomologica. 2 vols. Leipzig (1862–63). (Literature up to the year 1863).

HANDLIRSCH, A. Die fossilen Insekten und die Phylogenie der rezenten Formen. Leipzig (1906–08).

Geschichte, Litteratur, Technik, Paläontologie, Phylogenie und Systematik der Insekten. Schröder's Handbuch der Entomologie, **3**, 1201 pp. Jena (1925).

Insecta. Kükenthal, Handbuch der Zoologie, **4**, Berlin (1929).

HORN, W. and SCHENKLING, S. Index Litteraturæ Entomologicæ. (Before 1863). Berlin-Dahlem, 4 vols. (1928–29).

HOULEBERT, C. Bibliothèque de Zoologie. In Encyclopédie Scientifique, Paris, Doin. (Insects form part 5 and numerous volumes.)

IMMS, A. D. A General Textbook of Entomology. E. P. Dutton, New York and Methuen and Co., London (1926).

LEONARD, M. D. List of the Insects and Spiders of New York State. Mem. Cornell Agric. Expt. Sta., No. 101, 1121 pp. (1926).

LUTZ, F. E. Field Book of Insects. (Northeastern North America.) 509 pp. New York (1918).

MAXWELL-LEFROY, H. and HOWLETT, F. M. Indian Insect Life. 798 pp. Calcutta (1909).

RILEY, C. V. Enumeration of the Published Synopses, Catalogues and Lists of North American Insects (1888).

ROUSSEAU, E. Les larves et nymphes aquatiques des Insectes d'Europe. **1**, 967 pp. (1921).

SCHULZE, F. E., Editor. Das Tierreich. Berlin (1897–). (The parts are listed separately.)

SHARP, D. Insects. Cambridge Natural History, vols. 5 and 6, MacMillan & Co., New York and London (1895–99).

SHARP, D., Editor. Fauna Hawaiiensis. 3 vols. Honolulu (1899–1913).

SMITH, J. B. Catalogue of the Insects of New Jersey. Ann. Rept. New Jersey State Mus., 1909, 888 pp. (1910).

TASCHENBERG, O. Bibliotheca Zoologica. Vol. 1 (1863); vols. 2 and 3 (1889–90). (Literature of Entomology to the year 1880).

THOMPSON, M. T. Illustrated Catalogue of American Insect Galls. 116 pp. Nassau, N. Y. (1916).

TILLYARD, R. J. The Insects of Australia and New Zealand. 560 pp. Angus and Robertson, Sydney (1926).

TULLGREN, A. and WAHLGREN, E. Svenska Insekter. Stockholm, 812 pp. (1920–1922).

WEISS, H. B. Some Old Classifications of Insects. Canadian Entom., **47**, pp. 369–376 (1915).

WYTSMAN, P., Editor. Genera Insectorum. Brussels (1902–). (The many fascicles of this work are listed separately under the families and subfamilies; each contains a synoptic key to genera and a catalogue of species of the family or subfamily treated.)

ZOÖLOGICAL RECORD. Zoölogical Society of London (1865–). (Complete review of all literature in Zoölogy, year by year. The most complete and useful bibliographic index extant.)

ORDER **PROTÙRA**

(*MIRIENTÓMATA*)

Minute, slender, delicate, wingless, terrestrial, colorless or yellowish, blind species. Body bare; head pear-shaped, eyes and ocelli both absent; antennæ absent or reduced to a tubercle; abdomen comprising eleven segments, the last three very short, the basal three segments furnished with styles, no cerci; mouthparts formed for sucking, but retracted within the head, the mandibles long and styliform; legs short, tarsi one-jointed, with a single claw. Younger stages with only nine abdominal segments.

Two pairs of spiracles present, one pair on the mesothorax the other on the metathorax; second and third pairs of abdominal appendages two-jointed. (**Eoséntomon, Protápteron**, widespr.) ..... **EOSENTÓMIDÆ**

Spiracles absent; no tracheal system; second and third pairs of abdominal appendages one-jointed. (**Aceréntomon** (Fig. 4), **Aceréntulus** (Fig. 12), widespr.)..... **ACERENTÓMIDÆ**

LITERATURE ON PROTURA

BERLESE, A. Monografia dei Myrientomata. Redia, **6** (1909).

EWING, H. E. New Genera and Species of Protura. Proc. Biol. Soc. Washington, **23**, pp. 193–202 (1921).

SILVESTRI, F. Descrizione di un nuovo genere di insetti apterigoti rappresentanti di un nuovo ordine. Boll. Lab. Zool. Gen. Agrar. Portici., **1**, (1907).

STACH, J. *Eosentomon armatum.* (With list of known Protura.) Spraw. Kom. fizyogr., Krakow., **61**, pp. 205–215 (1927).

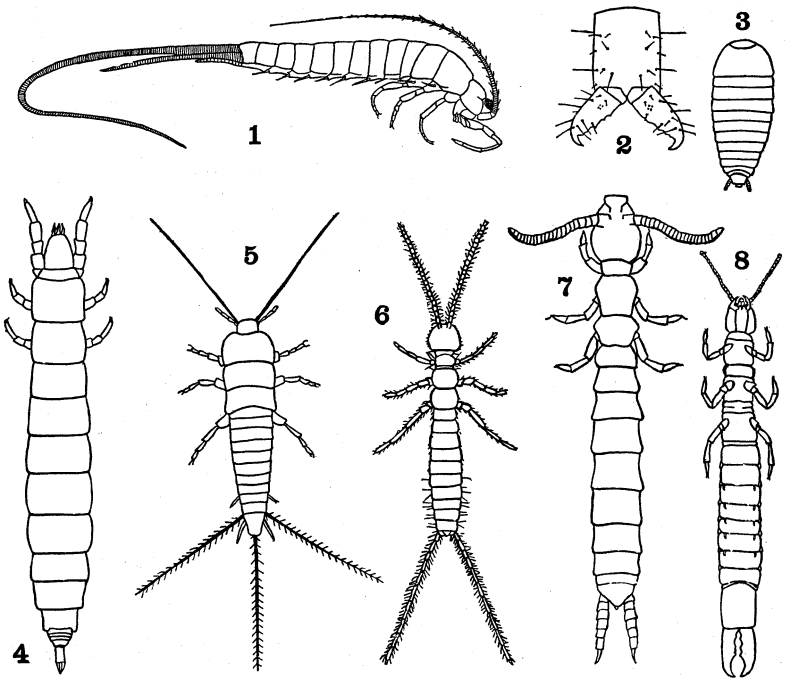
WOMERSLEY, H. Notes on the British Species of Protura. Entom. Monthly Mag., **63**, pp. 140–148 (1927).

Further Notes on the British Species of Protura. Entom. Monthly Mag., **64**, pp. 113–115 (1928).

ORDER **THYSANÙRA**

(*ECTÓTROPHI, ECTÓGNATHA*)

Moderate-sized or small, wingless, terrestrial insects of active habits. Body tapering behind, generally clothed with scales. Antennæ long,



Figs. 1–8. **Protura, Thysanura, Entotrophi**

1. **Nesomachilis** (Tillyard) Machilidæ.
2. **Parajapyx,** apex of abdomen (Silvestri) Japygidæ.
3. **Gastrotheus** (Silvestri) Lepismatidæ.
4. **Acerentomon** (Silvestri) Acerentomidæ.
5. **Lepisma** (Butler) Lepismatidæ.
6. **Campodea** (Maxwell-Lefroy) Campodeidæ.
7. **Anajapyx** (Silvestri) Projapygidæ.
8. **Japyx,** from below (Berlese) Japygidæ.

slender, tapering, many-jointed. Head closely articulated with the thorax; compound eyes present, large, reduced, or absent. Mouth-parts external, their tips projecting from a mouth cavity; mandibles large, toothed; maxillæ long. Thorax composed of three similar, freely articulated segments. Legs similar, the coxæ large; tarsi two- or three-jointed, with two or three claws. Abdomen composed of eleven segments, bearing at tip a pair of long, filiform, many-jointed cerci and a similar long median cerciform appendage; some ventral segments, usually the second to seventh, each with a pair of styles and generally also with a median sac; eighth and ninth ventral segments of female with paired, sometimes jointed appendages. No metamorphosis. Bristle tails. (Figs. 1, 3, 5, 9 and 10).

Eyes large, composed of very many minute facets, extending over the front and usually touching above on the vertex; maxillary palpi very long, seven-jointed; eleventh tergite not covered by tenth; four posterior coxæ with a style or hooked process. Body strongly convex above. A cosmopolitan family more abundant in the tropics. (**Máchilis, Petròbius, Machilòides, Machilìnus**; **Dílta**). (Superfamily MACHILÒIDEA).

MACHÍLIDÆ

Eyes small or wanting, when present composed of a few large facets, set on the sides of the head and not extending over the front; maxillary palpi five- or six-jointed; eleventh tergite partly covered by the tenth; coxæ without style or process. Body more or less flattened. A widespread group. . (**Lepísma, Thermòbia, Maindrònia, Atelùra, Nicolètia**). (Superfamily LEPISMATÒIDEA) ..... **LEPISMÁTIDÆ**

LITERATURE ON THYSANURA AND ENTOTROPHI

(These are combined since many citations refer to both groups)

BÄR, H. Beitrag zur Kenntnis der Thysanuren. Jenaische Zeitschr., **48**, pp. 1–92 (1912).

BARTHOLIN, T. Catalogue of Danish Apterygota (Danish). Nath. Medd., **67**, pp. 155–209 (1916).

DALLA-TORRE, K. W. Die Gattungen und Arten der Apterygogenea. Innsbruck, 23 pp. (1895).

ESCHERICH, K. Das System der Lepismatiden. Zoologica, Heft 43 (1905).

HANDSCHINN, E. Urinsekten oder Apterygota. In Tierwelt Deutschlands, Lief. 16 (1929).

JACKSON, C. F. Key to the families and genera of the Thysanura. Ohio Naturalist, **6**, pp. 545–549 (1906).

LUBBOCK, J. Monograph of the Collembola and Thysanura. Roy. Soc. London (1873).

MACGILLIVRAY, A. D. Catalogue of North American Thysanura. Canadian Entom., **23**, pp. 267–276 (1891).

SCHÖTT, H. North American Apterygogenea. Proc. California Acad. Sci., **6**, pp. 169–196 (1896).

SILVESTRI, F. Nuova contribuzione alla consocenza dell' Anajapyx. Ann. Lab. Zool. Gen. Agrar., Portici, **6**, 15 pp. (1905).

Contribuzione alla conoscenza dei Campodeidæ. Boll. Lab. Zool. Gen. Agrar., Portici, **6**, pp. 110–147 (1912).

Nuovi generi e specie di Campodeidæ. Boll. Lab. Zool. Gen. Agrar., Portici, **6**, pp. 5–25 (1912).

Thysanura. Fauna süd-west Australiens, **2**, pt. 4, pp. 47–68 (1908).

SWENK, M. H. A Synopsis of the North American Species of Japyx. Journ. New York Entom. Soc., **11**, pp. 129–132 (1903).

VERHOEFF, K. W. Zur vergleichende Morphologie und Systematik der Japygiden. Arch. f. Naturg., Jahrg. 71, Heft 1, pp. 63–114 (1904).

WAHLGREN, E. Svenska Insektfauna, I. Apterygota. Entom. Tidskr., **27**, pp. 233–270 (1906).

ORDER **ENTÓTROPHI**

(*ENTÓGNATHA, CAMPODEÒIDEA, DIPLÙRA*)

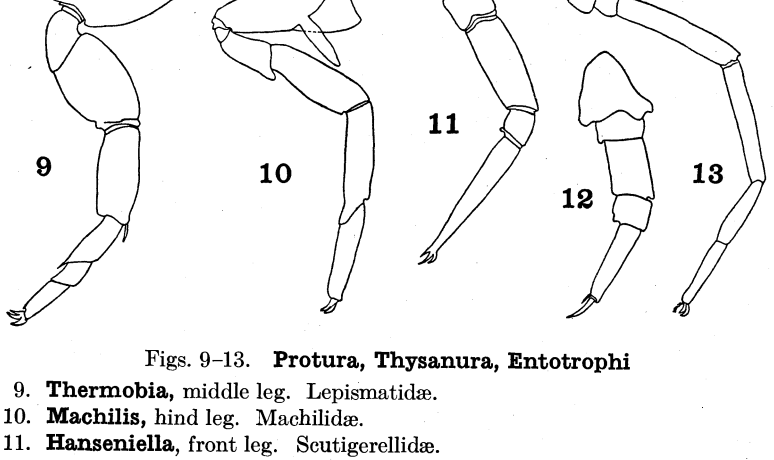
Small, slender, wingless insects, incapable of springing and of sluggish habits. Body almost always without scaly covering. Head large, freely articulated with the thorax; mouthparts concealed in a cavity within the head. Antennæ long, many-jointed. Eyes absent. Mandibles toothed; maxillæ and labium reduced, their palpi vestigial. Segments of thorax similar, freely articulated. Legs similar; coxæ small; tarsi one-jointed, with two claws. Abdomen consisting of eleven segments, the last segment either more or less covered by the preceding or fused with it; no ventral tube, but some of the ventral segments, usually the second to seventh, provided with ventral styles; apex of abdomen without median process; cerci long and many-jointed, or short and indistinctly jointed; appendages of eighth and ninth segments greatly reduced. No metamorphosis. (Figs. 2, 6, 7, 8 and 13).

1. Cerci composed of a number of distinct joints; eleventh tergite nearly or quite covered by the tenth; anal valves very distinct. 2

   Cerci single-jointed, very heavily chitinized, forming a strong forceps; eleventh tergite fused with the tenth; anal valves not distinct. Younger stages with the cerci indistinctly jointed, A cosmopolitan group. (**Jápyx, Enalljápyx, Heterojápyx, Parajápyx**) ..... **JAPÝGIDÆ**

2. Cerci long, slender, many-jointed, of approximately the same length as the antennæ, without a gland opening on the last segment. A cosmopolitan group. (**Campòdea, Hemicámpa, Haplocámpa, Plusiocámpa**) ..... **CAMPODÈIDÆ**

Cerci much shorter, stout, composed of a few short joints and with the opening of a gland at the tip of the last segment. A widespread group. (**Anajápyx, Projápyx**).... **PROJAPÝGIDÆ**



Figs. 9–13. **Protura, Thysanura, Entotrophi**

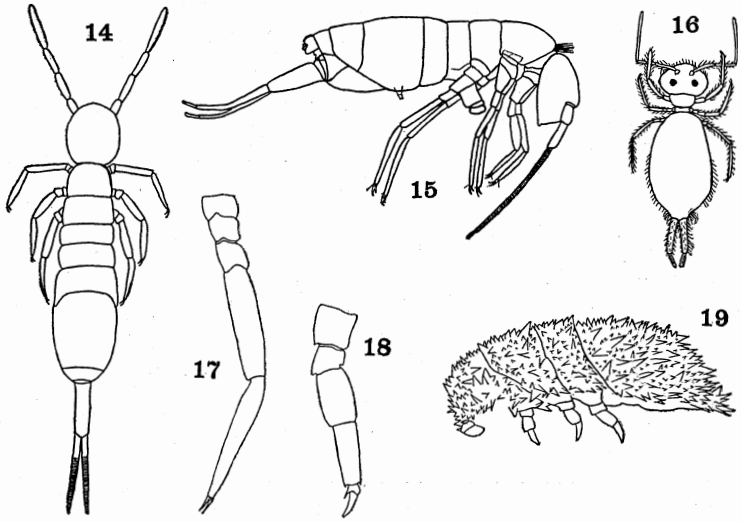
9. **Thermobia,** middle leg. Lepismatidæ.
10. **Machilis,** hind leg. Machilidæ.
11. **Hanseniella**, front leg. Scutigerellidæ.
12. **Acerentulus**, middle leg. Acerentomidæ.
13. **Campodea,** middle leg. Campodeidæ.

ORDER **COLLÉMBOLA**

Small or minute, soft-bodied, wingless, springing insects, the body sometimes clothed with scales or hairs. Head freely movable. Antennæ four- to six-jointed. Eyes of a degenerate compound type, composed of a few separated facets; sometimes entirely absent. Mouthparts retracted within the head; mandibles well developed; palpi vestigial. Thorax with the segments fused into a single mass. Legs similar, slender; tarsi one-jointed, with a single claw and a smaller claw-like empodium. Abdomen consisting of six segments; without cerci, and never terminated by caudal filaments or pincers-like appendages; usually with a leaping appendage which is often forked at apex and

arises from the fourth or fifth segment. Ventral tube always present as a simple or bifid process developed under the base of the abdomen. No metamorphosis. Spring tails. (Figs. 14–19).

1. Abdomen consisting of six evident segments or at least with only two of these indistinctly separated; body lengthened, subcylindrical, frequently clothed with scales. (Suborder ARTHROPLÈONA) 2



Figs. 14–19. **Collembola**

14. **Isotoma** (Imms) Entomobryidæ.
15. **Tomocerus** (Folsom) Entomobryidæ.
16. **Sminthurus** (Sharp) Sminthuridæ.
17. **Tomocerus,** hind leg. (Ewing) Entomobryidæ.
18. **Onychiura,** hind leg. (Ewing) Onychiuridæ.
19. **Anoura** (Tillyard) Poduridæ.

Abdomen with the segments fused; divided into two portions; a very large basal one and a small apical one often separated by a constriction; body subglobular, the abdomen little longer than wide; body never with scales. (Suborder SYMPHYPLÈONA) 5

2. Head horizontal, the antennæ inserted anteriorly 3

Head vertical, the antennæ inserted at the middle; body without scales; furca large. (**Actalètes,** palæarc.) .... **ACTALÉTIDÆ**

3. Pronotum visible from above; body without scales; furca when present arising from the fourth segment; antennæ short, four-jointed 4

   Pronotum concealed from above; body often with scales; furca when present usually arising from the fifth segment; antennæ with four to six joints. (**Entomòbrya, Orchesélla, Sinélla, Tomócerus, Isótoma, Sìra**)..... **ENTOMOBRŸIDÆ**

4. Front with false ocelli present; eyes absent; furcula usually absent; sluggish species with tuberculate integument. (**Onychiùra** (=*Aphorùra*) holarc.; **Tetrodontóphora,** palæarc.). (*APHORÙRIDÆ*) ..... **ONYCHIÙRIDÆ**

   Front without false ocelli; eyes often present. (**Podùra, Anùrida, Achoreùtes, Xenýlla**) ..... **PODÙRIDÆ**

5. Coxæ long; last joint of antennæ short, not divided into false ring-joints; antennæ not longer than the head, inserted at the middle of the head or below; thorax longer than the abdomen. (**Neèlus, Megalothòrax,** holarc.). (*MEGALOTHORÁCIDÆ*). **NEÉLIDÆ**

   Coxæ of the usual length; last joint of antennæ long, usually divided into false ring-joints; antennæ much longer than the head; inserted above the middle of the head. (**Sminthùrus, Sminthurìnus, Dicýrtoma** (=*Papírius*), **Corynephòria, Bourletiélla**). (Including *CORYNEPHORIDÆ* = *PAPIRÌIDÆ*) ..... **SMINTHÙRIDÆ**

LITERATURE ON COLLEMBOLA

BÖRNER, C. Neelidæ. Gen. Insectorum, fasc. 45, 5 pp. (1906).

Das System der Collembolen. Mitt. naturh. Mus. Hamburg, **23**, pp. 147–188 (1906).

Die Familien der Collembolen. Zool. Anz., **16**, pp. 315–322 (1913).

CARPENTER, G. H. and EVANS, W. Collembola and Thysanura of Scotland. Proc. Roy. Phys. Soc. Edinburgh, **14**, pp. 221–266 (1899).

FOLSOM, J. W. Tomocerinæ of North America. Proc. U. S. Nat. Mus., **46**, pp. 451–472 (1914).

North American Collembolous Insects of the Subfamilies Achoreutinæ, Neanurinæ and Podurinæ. Proc. U. S. Nat. Mus., **50**, pp. 477–525 (1916).

Subfamily Onychiurinæ. Proc. U. S. Nat. Mus., **53**, pp. 637–659 (1917).

GUTHRIE, J. E. The Collembola of Minnesota. Geol. Nat. Hist. Surv. Minnesota, ser. 4, 110 pp. (1903).

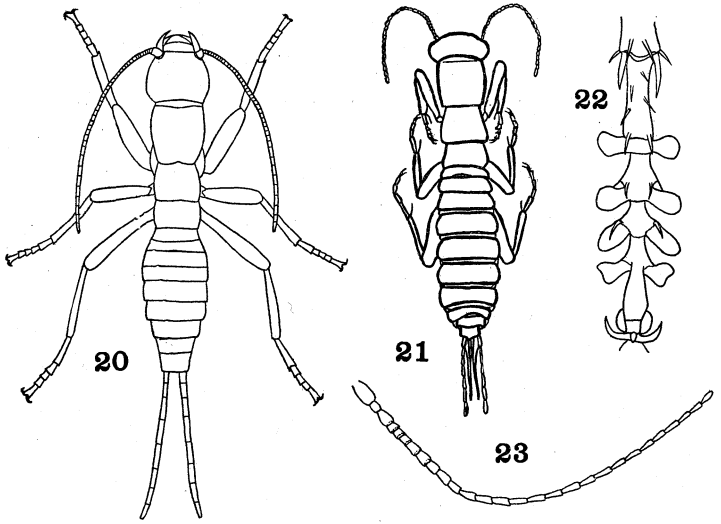
LINNANIEMI, W. M. Die Apterygoten-fauna Finlands. Acta Sci. Faun. Flor. Fennica, **40**, pp. 1–361 (1907–12).

LUBBOCK, J. Monograph of the Collembola and Thysanura. Roy. Soc. London (1873).

ORDER **GRYLLOBLATTÒDEA**

(*GRYLLOBLATTÒIDEA, NOTÓPTERA*)

Elongate, more or less depressed, wingless insects, measuring about an inch in length. Head rather large, free, horizontal or slightly inclined; eyes small or absent, no ocelli; antennæ long, filiform, with about 30 to 40 joints, inserted at the sides of the front of the head near



Figs. 20–23. **Grylloblattodea**

20. **Ishiana** (Silvestri) Grylloblattidæ.
21. **Grylloblatta** (Walker) Grylloblattidæ.
22. **Grylloblatta,** tarsus of male (Walker) Grylloblattidæ.
23. **Galloisiana,** antenna (Crampton) Grylloblattidæ.

the mandibles; mandibles large and strong. Prothorax quadrate or somewhat longer than wide, not expanded laterally; free and larger than the meso- or metathorax. Legs similar, formed for running, the coxæ close together; tarsi five-jointed, with two claws, those of the adult male with a pair of membranous lobes beneath each joint. Abdomen elongated, tergites more or less equal, transverse, extending down at the sides of the abdomen; cerci long, eight- or nine-jointed; ovipositor exserted, sword-shaped, composed of six paired pieces.

Metamorphosis very slight, the nymphs very much like the adults and apparently of slow growth; terrestrial in all stages. (Figs. 20–23).

A single family. (**Grylloblátta**, Western Canada, California; **Galloisiàna, Ishiàna**, Japan) ..... **GRYLLOBLÁTTIDÆ**

LITTERATURE ON GRYLLOBLATTODEA

CAUDEL, A. N. Grylloblatta in California. Canadian Entom., **53**, pp. 148–150 (1923).

Notes on Grylloblatta. Journ. Washington Acad. Sci., **14**, pp. 369–371 (1924).

CAUDELL, A. N. and KING, J. L. A New Genus of Grylloblattidæ from Japan. Proc. Entom. Soc. Washington, **26**, pp. 53–60 (1924).

SILVESTRI, F. Grylloblattidæ. Boll. Zool. Gen. Agrar. Portici, **20**, pp. 107–121 (1928).

WALKER, E. M. A New Species of Orthoptera Forming a New Genus and Family. Canadian Entom., **46**, pp. 93–97 (1914).

The Male and Immature Stages of Grylloblatta. Canadian Entom., **51**, pp. 131–139 (1919).

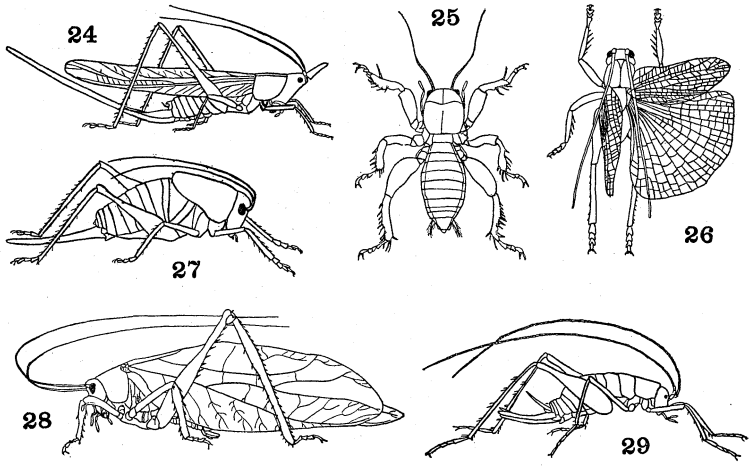
ORDER **ORTHÓPTERA**

(*ULONÀTA* part; *SALTATÒRIA*)

Small to large, nearly always jumping species, often possessing a device on the wings for making a creaking or chirping sound; hind femora almost always very much stouter basally, or longer, or both, than the middle femora; wings of adults reposing over the abdomen, the fore wings toughened, narrower and thicker than the membranous, plaited hind pair; sometimes the wings vestigial or completely absent; head usually vertical, sometimes conically produced forward; ovipositor almost always free, often long, sword- or needle-shaped; mouthparts conspicuous, mandibulate; antennæ long and many-jointed or short with few joints; tarsi usually four- or three-jointed; prothorax large, free, often much enlarged; cerci short. Metamorphosis gradual, the young resembling the adults, but with the small wings in a reversed position in the last two nymphal stages, the hind wings then overlapping the fore wings.

1. Antennæ usually long and many-jointed, delicately tapering and exceeding the body in length, rarely very short, with twelve segments or less; auditory organs if present, near the base of the front tibia; ovipositor of female almost always long and well developed; tarsi usually four-jointed. (Suborder TETTIGONIÒDEA (=*LOCUSTÒDEA*)) 2

Antennæ shorter, with less than 30 joints, filiform, rarely clubbed or serrate, but not delicately tapering; auditory organ if present, near the base of the abdomen; ovipositor of female never elongated; tarsi three-jointed, rarely with the front and middle ones two-jointed. (Suborder ACRIDÒDEA) 9



Figs. 24–29. **Orthoptera**

24. **Conocephalus** (Blatchley) Tettigoniidæ.
25. **Stenopelmatus** (Saussure) Stenopelmatidæ.
26. **Gryllacris** (Karny) Gryllacridæ.
27. **Anabrus** (Caudell) Tettigoniidæ.
28. **Stilpnochlora** (Saussure) Tettigoniidæ.
29. **Ceuthophilus** (Blatchley) Stenopelmatidæ.

2. Tarsi four-jointed, at least on the four posterior legs; antennæ always very long and tapering; ovipositor usually long and sword-shaped 3
   Tarsi with three joints or less; ovipositor when present, needle-shaped 6
3. Tarsi more or less depressed 4
   Tarsi distinctly compressed; almost always apterous forms, usually dull-colored ..... **STENOPELMÂTIDÆ**

This family comprises five subfamilies, separable as follows:

a. Front tibiæ with an auditory organ ..... b
   Front tibiæ without an auditory organ c

b. Cerci short; first and second joints of tarsi indistinctly separated; wings large, with a chirping organ. (**Prophalangópsis** (= *Tárraga*), ind.) ..... **PROPHALANGOPSÌNÆ**

Cerci long; first and second tarsal joints distinctly separated; usually wingless. (**Anostóstoma**, ethiop., Austr.; **Demácrida**, Austr.; **Magréttia**, ethiop., As.) ... **ANOSTOSTOMATÌNÆ**

c. Hind femora at base more sharply produced below than above; legs rather long and slender. Cave crickets. (**Ceuthóphilus**, Am. (Fig. 29); **Dolichópoda**, palæarc.; **Troglóphilus**, palæarc.; **Rhaphidóphora**, indoaustr.). (*CEUTHOPHILÌNÆ*). **RHAPHIDOPHORÌNÆ**

Hind femora at base more sharply produced above than below; legs stouter ..... d

d. Front coxæ armed in front with a tooth-like projection. (**Mimnêrmus**, ethiop.; **Cratomèlus**, neotrop.). **MIMNERMÌNÆ**

Front coxæ simple, unarmed. (Fig. 25.). (**Stenopelmàtus**, Am.). **STENOPELMATÌNÆ**

4. Front tibiæ without an auditory organ 5

Front tibiæ with an auditory organ. Long-horned locusts, Katydids. (*PHASGONÙRIDÆ, LOCÙSTIDÆ*). **TETTIGONÌIDÆ**

This very extensive family includes a number of subfamilies which may be separated as follows:

a. Antennæ inserted between the eyes, nearer to the top of the occiput than to the clypeal suture. (Fig. 32) ..... b

Antennæ inserted below the eyes, or between their lower margins, nearer to the clypeal suture than to the top of the occiput. (Fig. 33) ..... o

b. First and second joints of tarsi longitudinally sulcate laterally. (Fig. 35) c

First and second tarsal joints smooth (Fig. 36); hind tibiæ with an apical spine on each side above. A large cosmopolitan group, including many leaf-like species. (**Phanerópteria**, widespr.; **Isopsèra**, ind.; **Scuddèria**, Am.; **Tylópsis**, palæarc., ethiop.; **Isóphya**, palæarc., Am.) ..... **PHANEROPTERÌNÆ**

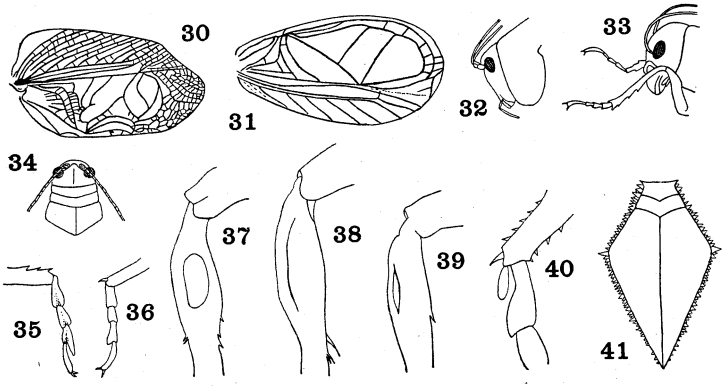
c. Auditory pits on front tibiæ open. (Fig. 37) ..... d

Auditory pits covered partly by an ear-like or shell-shaped extension of the chitinous rim which partly covers them and narrows the aperture or reduces it to a linear slit. (Figs. 38, 39) ..... g

d. Posterior tibiæ with an apical spine on each side above ..... e

Posterior tibiæ without apical spines above; body winged, very slender with slender legs. (**Zaprochìlus** (= *Prochìlus*), Austr.). (*PROCHÍLIDÆ*) ..... **ZAPROCHILÌNÆ**

e. Prosternum armed with a pair of spines or tubercles.....f
Prosternum simple, unarmed. (**Meconèma, Cyrtáspis,** palæarc.; **Amýtta, Anepitácta,** ethiop.; **Thaumáspis,** ind.).
MECONEMÌNÆ



Figs. 30–41. **Orthoptera**

30. **Gryllus,** fore wing (Handlirsch) Gryllidæ.
31. **Œcanthus,** fore wing (Handlirsch) Gryllidæ.
32, 33. Superior and inferior insertion of antennæ (Caudell) Tettigoniidæ.
34. **Mecopoda,** dorsal view of head and pronotum (Caudell) Tettigoniidæ.
35. Tarsus with sulcate segments (Caudell) Tettigoniidæ.
36. Tarsus with smooth segments (Caudell) Tettigoniidæ.
37. Open auditory pit (Caudell) Tettigoniidæ.
38. Linear auditory pit (Caudell) Tettigoniidæ.
39. Ear-like or shell-shaped auditory pit (Caudell) Tettigoniidæ.
40. Tarsus with free plantula (Caudell) Tettigoniidæ.
41. **Phyllophora,** hooded form of pronotum (Caudell) Tettigoniidæ.

f. Pronotum hood-like, strongly and acuminately produced behind; lateral carinæ of pronotum dentate or crenulate. (Fig. 41). (**Phyllóphora,** indoaustr.; **Hyperhómala,** austromal.).
PHYLLOPHORÌNÆ
Pronotum not hood-like, nor much produced behind. (Fig. 34). (**Mecópoda,** austromal.; **Acridóxena, Apteroscírtus,** ethiop.; **Tabària, Rhammatópoda,** neotrop.).....**MECOPODÌNÆ**
g. Front tibiæ without terminal spines above.....h
Front tibiæ with a terminal spine above on the outer side (except *Arytropteris*).....n
h. Antennal scrobes (*i.e.* the grooves in which the antennæ lie) with the margins produced. (**Pseudophýllus,** palæarc., indomal.; **Cleándrus, Phyllomìmus,** indomal.; **Zabàlius,** ethiop.).
PSEUDOPHYLLÌNÆ

Antennal scrobes with the margins hardly produced.....i

i. Hind tibiæ without apical spines above. (**Sàga**, palæarc., **Clònia, Hemiclònia**, ethiop.; **Hemisàga**, Austr.) ..... **SAGÌNÆ**

Hind tibiæ with an apical spine above on one or both sides.....j

j. Hind tibiæ with an apical spine only on the outer side above. (**Tympanóphora**, Austr.; **Mortoniéllus**, malay.). **TYMPANOPHORÌNÆ**

Hind tibiæ with an apical spine on both sides above, or only on the inner side.....k

k. Front and middle tibiæ armed with short or medium sized spines.l

Front tibiæ, or both front and middle tibiæ, armed with long spines decreasing in length apically. (**Listróscelis, Phlùgis**, neotrop.; **Hexacéntrus**, indomal.; **Phìsis**, ethiop., indoaustr.). **LISTROSCELÌNÆ**

l. All the femora unarmed beneath, rarely the hind ones armed on the outer or on both sides; usually smaller species. (**Conocéphalus** (=*Xiphídion*) cosmop.; **Orchélimum**, widespr.; **Odontoxiphídium**, nearc.). (*XIPHIDIÌNÆ*). **CONOCEPHALÌNÆ**

All femora usually spined below; rarely the hind ones armed only on the outer side, in which case the fastigium of the vertex is either forked or extended considerably beyond the basal joint of the antennæ; usually larger species.....m

m. Fastigium of the vertex usually noticeably narrower than the first joint of the antennæ, sometimes dorsally sulcate.(**Agrœcia**, neotrop., ethiop., austromal.; **Eschatócerus**, neotrop.; **Nícsara**, austr.; **Salomòna**, indoaustr.) ..... **AGRŒCIÌNÆ**

Fastigium of the vertex usually distinctly broader than the first joint of the antennæ, never sulcate. (**Neoconocéphalus**, Am.; **Euconocéphalus**, ethiop., indoaustr.; **Homorocóryphus**, cosmop.; **Copíphora**, neotrop.). (*CONOCEPHALÌNÆ*). **COPIPHORÌNÆ**

n. First joint of hind tarsi with a free plantula beneath (Fig. 40). (**Ánabrus**, nearc.; **Metrióptera**, holarc., ethiop.; **Décticus**, palæarc., ethiop.). (*DECTICÌNÆ*) ..... **TETTIGONIÌNÆ**

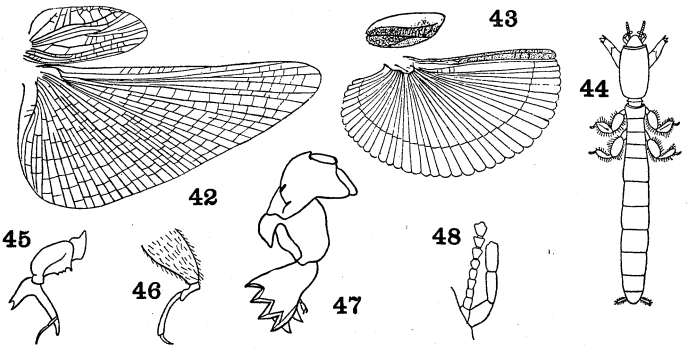
First joint of hind tarsi without a free plantula, or with a very short one. (**Phasgonùra** (=*Locústa*), palæarc.; **Onconòtus**, palæarc.). (*LOCUSTÌNÆ*)..... **PHASGONURÌNÆ**

o. Third joint of hind tarsi longer than the second; front tibiæ with an apical spine on the inner side; hind tibiæ without an apical spine above on the outer side.....p

Third joint of hind tarsi shorter than the second; front and hind tibiæ with an apical spine above on both sides. (**Bradýporus**, palæarc.; **Derállimus, Callímenus**, palæarc). **BRADYPORÌNÆ**

p. Antennæ inserted between the lower margins of the eyes; pronotum unarmed; both sexes winged; front tibiæ with an apical spine above on the outer side; hind tibiæ with four apical spurs below. (**Pycnogáster, Ephíppiger, Urómenus, Steropleùrus,** palæarc.) ..... **EPHIPPIGERÌNÆ**

Antennæ inserted distinctly below the eyes; pronotum spined; female wingless; front tibiæ without apical spines above; hind tibiæ without apical spurs below, or with only two. (**Hetròdes, Acánthoplus, Eugáster, Anepiscéptus,** ethiop.). **HETRODÌNÆ**



Figs. 42–48. **Orthoptera**

42. **Gryllotalpa**, wings (Handlirsch) Gryllotalpidæ.
43. **Tridactylus,** wings (Handlirsch) Tridactylidæ.
44. **Cylindracheta** (Giglio-Tos) Cylindrachetidæ.
45. **Tridactylus,** front leg (Saussure) Tridactylidæ.
46. **Tridactylus,** middle leg (Saussure) Tridactylidæ.
47. **Gryllotalpa,** front leg (Berlese) Gryllotalpidæ.
48. **Cylindracheta,** antenna and palpus (Giglio-Tos) Cylindrachetidæ.

5. Head vertical, body stout; usually brownish in color, with or without wings. (**Grýllacris,** tropicopol. (Fig. 26); **Camptonòtus,** Am.; **Paragrýllacris,** Austr.; **Erèmus,** As., ethiop., indoaustr.) (Including *PROPHALANGÓPSIDÆ*) .... **GRYLLÁCRIDÆ**

Head horizontal; body long and slender, the legs all very thin and long; wingless species resembling walking sticks. (**Phasmòdes,** Austr.) ..... **PHASMÓDIDÆ**

6. Antennæ very short, with twelve joints or less, not tapering at tip. 7
Antennæ many jointed, long and tapering 8

7. Tarsi two-jointed; hind legs very short, body long, cylindrical; front tibiæ strongly dilated and digitate; large, entirely wingless species boring in the stems of plants. (**Cylindrácheta,** Austr., Chile) (Figs. 44, 48) ..... **CYLINDRACHÉTIDÆ**

Hind tarsi one-jointed; hind legs greatly enlarged, saltatorial; three small ocelli; small species not boring in plants. (**Tridáctylus**, cosmop.; **Rhipípteryx**, Am.) ..... **TRIDACTÝLIDÆ**

8. Front tibiæ strongly dilated, digitate; ovipositor short, not protruded; large species with very large, elongate prothorax, burrowing in the soil. (**Gryllotálpa** (Figs. 42, 47), cosmop.; **Scapteríscus**, Am.) ..... **GRYLLOTÁLPIDÆ**

Front tibiæ not dilated and digitate; ovipositor projecting, usually long; antennæ always with more than thirty joints. (*ACHÉTIDÆ*) ..... **GRÝLLIDÆ**

The Gryllidæ include six subfamilies, distinguishable as follows:

a. Tarsi compressed, the second joint minute, compressed..... b

Tarsi with the second joint cordate, depressed..... e

b. Hind tibiæ greatly widened, furnished with a few strong movable spines; hind femora very broad, oval; antennæ relatively blunt at tips; eyes minute; small, wingless species living in ants' nests. (**Myrmecóphila**, widespr.) ..... **MYRMECOPHILÌNÆ**

Hind tibiæ slender or only slightly widened, serrulate, or serrulate and spinose; femora more slender; antennæ finely tapered at tips; usually large, free living species..... c

c. Hind tibiæ spinose, but not serrulate; stout-bodied, usually dark colored species. (Fig. 30.). (**Gryllus, Nemòbius**, cosmop.; **Gryllòdes**, widespr.; **Ácheta**, palæarc., ethiop.). (*NEMOBIÌNÆ, ACHETÌNÆ*)..... **GRYLLÌNÆ**

Hind tibiæ serrulate, sometimes spinose also..... d

d. Hind tibiæ spinose, serrulate between the spines; body and legs slender; moderate or large species. Tree crickets. (**Œcánthus**, cosmop. (Fig. 31); **Amphiacústa, Phalangópsis**, Am.; **Endacústa**, Austr., neotrop.; **Phæophýllacris**, ethiop.). . . **ŒCANTHÌNÆ**

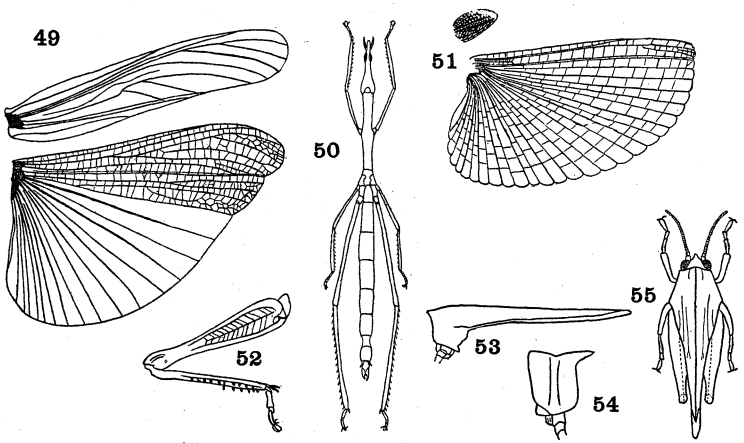
Hind tibiæ with two rows of fine serrulations, but without spines or thorns. (**Mogoplístes**, palæarc., ethiop., neotrop.; **Ornèbius**, widespr.; **Cyclóptilum**, Am.; **Ectadóderus**, widespr.). **MOGOPLISTÌNÆ**

e. Hind tibiæ not serrate, biseriately spinose and with five apical spurs. (**Trigonídium**, palæarc., ethiop., indomal.; **Cyrtóxiphus**, widespr.; **Homœóxiphus**, indomal.; **Anáxiphus**, neotrop.) ..... **TRIGONIDIÌNÆ**

Hind tibiæ serrate, bearing more or less numerous spines and six apical spurs. (**Eneóptera**, neotrop.; **Nísitra**, malay.; **Cardiodáctylus**, Austromal.; **Orócharis**, Am.) . . . **ENEOPTERÌNÆ**

9. Tarsal claws without a pad (arolium) between them; pronotum greatly lengthened, extending backwards to cover the entire

abdomen, fore wings vestigial, consisting of small scales at the base of the usually large hind wings; antennæ longer than the front femora. Grouse locusts. (**Tètrix** (Figs. 51, 53), **Paratéttix,** widespr.; **Neotéttix,** nearc.; **Mazarrèdia,** indoaustr.; **Tettigídea** (Fig. 55), Am.). (*TETTÍGIDÆ, ACRYDÌIDÆ*). **TETRÍGIDÆ**



Figs. 49–55. **Orthoptera**

49. **Dissosteira,** wings (accessory veins in part omitted) (Snodgrass) Acrididæ.
50. **Prosarthria** (Brunner) Proscopiidæ.
51. **Tetrix,** wings (Handlirsch) Tetrigidæ.
52. **Acrida,** hind leg (Lugger) Acrididæ.
53. **Tetrix,** side view of pronotum (Packard) Tetrigidæ.
54. **Caloptenus,** side view of pronotum (Packard) Acrididæ.
55. **Tettigidea** (Blatchley) Tetrigidæ.

Tarsal claws almost always with an arolium between them; pronotum small, not extending backwards over more than a small basal part of the abdomen; if exceptionally enlarged, the wings and antennæ not as above.....10

10. Body greatly lengthened and very slender, stick-like, with very long thin legs; wings absent or vestigial; head conical and greatly lengthened; prothorax tubular, not overlapping the mesonotum; antennæ eight-jointed; arolia sometimes small or indistinct. (Fig. 50). (**Proscòpia, Prosárthria, Apióscelis, Corynorhýnchus, Astròma,** neotrop.).... **PROSCOPÌIDÆ**

Of a different conformation.....11

11. Hind legs similar to the middle ones; their femora scarcely lengthened and not strongly thickened; body, especially the abdomen swollen or inflated; pronotum very large; green or brightly colored species. (**Pneùmora, Búlla, Cystocœlia,** S. Afr.). **PNEUMÓRIDÆ**

Hind legs very different from the middle ones, their femora large, greatly thickened at the base and lengthened; abdomen not noticeably swollen. Grasshoppers, Locusts, Short-horned locusts. (*LOCÚSTIDÆ, ACRIDÌIDÆ, ACRYDÌIDÆ*). **ACRÍDIDÆ**

This family includes the following subfamilies:

a. Prosternum simple, flat ..... b
Prosternum with a spine, swelling, or lamellate elevation anteriorlyg
b. Antennæ longer than the front femora c
Antennæ shorter than the front femora ..... f
c. Vertex and front forming together a rounded surface, the front vertical ..... d
Vertex and front meeting at an angle, the surfaces of the two forming an angle when seen in profile ..... e
d. Antennæ clavate, as long as the body; apterous species. (**Gomphomástax,** palæarc., ind.) ..... **GOMPHOMASTACÌNÆ**
Antennæ not clavate, shorter; usually winged species. A large cosmopolitan group. (**Œdípoda,** widespr.; **Árphia, Hippíscus,** Am.; **Locústa, Pachýtylus,** widespr.; **Dissosteìra** (Fig. 49), **Trimerótropis,** nearc.; **Acrótylus, Œdàleus,** old world). **ŒDIPODÌNÆ**
e. Impressions of vertex wanting; head horizontal, the front nearly horizontal; margins of antennæ serrate; apterous species. (**Psednùra,** Austr.) ..... **PSEDNURÌNÆ**
Impressions of vertex present, or if rarely wanting, the head is conical, with the front more sloping, and wings are present. (**Truxàlis,** Am.; **Stenóbothrus,** widespr.; **Gomphócerus,** palæarc., Am.; **Stauronòtus,** palæarc., ind.; **Mecostèthus,** palæarc.). (*TRYXALÌNÆ, TRUXALÌNÆ*) ..... **ACRIDÌNÆ**
f. Pronotum greatly flattened at the sides, roof-shaped and frequently with a median ridge; posterior femora dilated and compressed. (**Scirtótypus,** ethiop., indomal.; **Choræ̀typus,** indomal.; **Brachýtypus,** ethiop.) ..... **CHORŒTYPÌNÆ**
Pronotum not greatly flattened at the sides, and not ridged above; posterior femora slender. (**Eriánthus,** indoaustr.; **Teìchophrys, Eumástax, Masýntes,** neotrop.) ... **EUMASTACÌNÆ**
g. Impressions of the vertex large and shallow, forming the anterior end of the vertex where they are separated by a very narrow

groove; front very strongly oblique and forming an angle with the vertex. (**Maùra, Chrotógonus**, ethiop.; **Pyrgomórpha,** widespr.; **Monístria**, austr.; **Desmóptera**, austromal.; **Calámacris**, Am.) ..... **PYRGOMORPHÌNÆ**

Impressions of vertex not forming the anterior end of the vertex, placed above, at the sides or below, or obsolete..... h

h. Impressions of vertex dorsal in position and open behind; prosternum with a swelling, but rarely with a distinct thorn or tubercle. (**Pámphagus, Eurypóryphes, Acínipe**, palæarc.; **Lamarckiàna**, ethiop.) ..... **PAMPHAGÌNÆ**

Impressions of vertex lateral or inferior in position or obsolete; prosternum with a distinct sharply raised tubercle or spine. (**Melánoplus, Schistocérca**, Am.; **Acrýdium**, Afr.; indoaustr.; **Podísma**, holarc., **Cyrtacánthacrus**). (*ACRIDIÌNÆ. PODISMÌNÆ*)..... **CYRTACANTHACRÌNÆ**

LITERATURE ON ORTHOPTERA (*sens. lat.*), INCLUDING PHASMATODEA, DERMAPTERA, BLATTARIÆ AND MANTODEA

BLATCHLEY, W. S. Orthoptera of Illinois. 27th Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1902, pp. 123–471 (1903).

The Orthoptera of Northeastern America. Nature Pub. Co. (1920).

BRUNER, L. Preliminary Catalogue of the Orthopteroid Insects of the Philippines. Univ. Nebraska Studies, **15**, pp. 195–281 (1916).

BRUNNER, C. v. W. Prodromus der europäischen Orthopteren. Leipzig (1882).

Revision du Système des Orthoptères. Ann. Mus. Civ. Stor. Nat. Genova, **13**, pp. 1–230 (1893).

BURR, M. A Synopsis of the Orthoptera of Western Europe. London (1910).

CHOPARD, L. Orthoptères et Dermaptères. Faune de France. (1922).

FRÖHLICH, C. Die Odonaten und Orthopteren Deutschlands. Jena (1903).

FRUHSTORFER, H. Die Orthopteren der Schweiz. Arch. Naturg., Jahrg., 87A, Heft 5, pp. 1–262 (1921).

HEBARD, M. Studies on the Dermaptera and Orthoptera of Ecuador. Proc. Acad. Nat. Sci. Philadelphia, **76**, pp. 109–248 (1924).

Studies on the Dermaptera and Orthoptera of Colombia. Trans. American Entom. Soc., **52**, pp. 275–354 (1927).

The Orthoptera of Colorado. Proc. Acad. Nat. Sci., Philadelphia, **81**, pp. 303–425 (1929).

HOULEBERT, C. Thysanoures, Dermaptères et Orthoptères. In Encycl. Sci. (1924).

HUBBELL, T. H. Dermaptera and Orthoptera of Berrien Co., Michigan. Pap. Mus. Zoöl., Univ. Michigan, No. 116, 77 pp. (1922).

INNES, W. Revision des Orthoptères de l'Egypt. Mém. Soc. Entom. Egypte, **3**, pp. 5–176 (1929).

KARNY, H. Zur Systematik der Orthopteroiden Insekten. Treubia, **3**, p. 236 (1923).

KIRBY, W. F. A Synonymic Catalogue of the Orthoptera. Vols. 2 and 3. British Mus. Nat. Hist., London (1907–10).

LUCAS, W. J. Monograph of the British Orthoptera. London, Ray Soc., 264 pp. (1920).

MORSE, A. P. Manual of the Orthoptera of New England. Proc. Boston Soc. Nat. Hist., **35**, no. 6 (1920).

Orthoptera of Maine. Bull. Maine Agric. Sta., No. 296, 36 pp. (1921).

PIERS, H. The Orthoptera of Nova Scotia. Proc. Nova Scotia Inst., Halifax, **14**, pp. 201–351 (1918).

RAMME, W. Orthoptera, In Tierwelt Mitteleuropas, **4**, Lief. 2, pp. VI 1–22 (1928).

SAUSSURE, H. and others. Orthoptera. In Biologia Centrali-Americana, **1**, (1893–99).

SCUDDER, S. H. Guide to the Genera and Classification of North American Orthoptera. Cambridge, Mass. (1897).

Catalogue of Orthoptera of the United States. Proc. Davenport Acad. Nat. Sci., **8**, pp. 1–101 (1900).

Index to North American Orthoptera. Occas. Pap. Boston Soc. Nat. Hist., No. 6, pp. 1–436 (1901).

TÜMPEL, L. Die Geradeflügler Mitteleuropas, 2d edit. Gotha. 327 pp. (1907).

WALDEN, B. H. Orthoptera of Connecticut. Bull. State Geol. Nat. Hist. Surv. Connecticut, No. 16, pp. 48–169 (1911).

SUBORDER TETTIGONIODEA

BOLIVAR, J. Orthoptera palæarctica. Pycnogastrinæ. Eos, **2**, pp. 423–463 (1926).

BRUNER, L. Revision of Tropical American Tettigonoidea. Ann. Carnegie Mus., **9**, pp. 284–404 (1912).

BRUNNER, C. v. W. Monographie der Phaneropteriden. 399 pp., Vienna (1878).

Monographie der Stenopelmatiden und Gryllacriden. Verh. zool.-bot. Ges., Wien, **38**, pp. 247–394 (1888).

Additamenta zur Monographie der Phaneropteriden. Verh. zool.-bot. Ges., Wien, **41**, pp. 1–196 (1891).

Monographie der Pseudophylliden. 282 pp., Vienna (1895).

CAUDELL, A. N. Cyrtophili of the United States. Journ. New York Entom. Soc., **14**, pp. 32–45 (1906).

The Decticinæ of North America. Proc. U. S. Nat. Mus., **32**, pp. 285–410 (1907).

Locustidæ, Decticinæ. Gen. Insectorum, fasc. 72, 43 pp. (1908).

Locustidæ, Prophalangopsinæ. Gen. Insectorum, fasc. 120, 7 pp. (1911).

Locustidæ, Ephippigerinæ. Gen. Insectorum, fasc. 140, 10 pp. (1913).

Locustidæ; Meconeminæ, Phyllophorinæ, Tympanophorinæ, Phasgonurinæ, Phasmodinæ, Bradyporinæ. Gen. Insectorum, fasc. 138, 25 pp. (1913).

Locustidæ, Mecopodinæ. Gen. Insectorum, fasc. 171, 32 pp. (1916).
Locustidæ, Hetrodinæ. Gen. Insectorum, fasc. 168, 13 pp. (1916).
Locustidæ, Saginæ. Gen. Insectorum, fasc. 167, 8 pp. (1916).
The Genera of Rhaphidophorinæ of America North of Mexico. Proc. U. S. Nat. Mus., **49**, pp. 655–690 (1916).

CHOPARD, L. Revision of the Indian Gryllidæ. Rec. Indian Mus., **30**, pp. 1–36 (1928).

FULTON, B. B. Tree Crickets of New York. Tech. Bull. No. 42, New York Agric. Exp. Sta. (1915).

GIGLIO-TOS, F. Sulla posizione systematica del genere Cylindracheta. Ann. Mus. Civ. Genoa (3), **6**, pp. 81–101 (1914).

HEBARD, M. Review of North American Species of Myrmecophila. Trans. American Entom. Soc., **46**, pp. 91–111 (1920).
Studies on the Gryllidæ of Panama. Trans. American Entom. Soc., **54**, pp. 233–294 (1928).

KARNY, H. Revisio Conocephalidarum. Abh. zool.-bot. Ges., Wien, **4**, Heft 3, pp. 1–114 (1907).
Locustidæ, Listroscelinæ. Gen. Insectorum, fasc. 131, 20 pp. (1912).
Locustidæ, Conocephalinæ. Gen. Insectorum, fasc. 135, 17 pp. (1913).
Locustidæ, Copophorinæ. Gen. Insectorum, fasc. 139, 50 pp. (1913).
Locustidæ, Agrœciinæ. Gen. Insectorum, fase. 141, 47 pp. (1913).
Fauna Buruana, Orthoptera, Fam. Gryllacridæ. Treubia, **7**, pp. 41–84 (1925).
Revision of the South African Gryllacridæ. Ann. South African Mus., **29**, pp. 77–151 (1929).

KARSCH, F. Über die Hetrodiden. Berliner entom. Zeits., **31**, pp. 43–72 (1887).
Über die Orthopterenfamilie der Prochiliden. Entom. Nachr., **17**, pp. 97–107 (1891).

REDTENBACHER, J. Monographie der Conocephaliden. Verh. zool.-bot. Ges. Wien, **41**, pp. 315–562 (1891).

REHN, J. A. G. and HEBARD, M. Revision of the Orthopterous Group Insaræ (Phaneropterinæ). Trans. American Entom. Soc., **40**, pp. 37–184 (1914).

SAUSSURE, H. Mélanges Orthoptérologiques. Gryllides. 2 pts., Geneva (1887–78).
Revision du genre Tridactylus. Rev. Suisse Zool., **4**, pp. 407–419 (1897).

SAUSSURE, H. and ZEHNTER L. Monographie des Gryllotalpiens. Rev. Suisse Zool., **2**, pp. 403–430 (1894).

SCHIMMER, F. Monographie der Gryllodengattung Myrmecophila. Zeits. wiss. Zool., **93**, pp. 409–534 (1909).

SCUDDER, S. H. The North American Ceuthophili. Proc. American Acad. Arts Sci., **30**, pp. 17–113 (1894).
Stenopelmatinæ of the Western United States. Canadian Entom., **31**, pp. 113–121 (1899).

SHIRAKI, T. Monographie der Grylliden von Formosa und Japan. 129 pp. (1911).

TEPPER, J. G. O. The Phanopterinæ of Australia. Trans. Roy. Soc. South Australia, **15**, pp. 77–113 (1892).

TINDALE, N. B. Australasian Mole Crickets of the Family Gryllotalpidæ. Rec. South Australian Mus., **4**, pp. 1–42 (1928).

UVAROV, B. P. Revision of the Old World Cyrtacanthacrini. Ann. Mag. Nat. Hist. (9), **11** and **12** (several parts) (1923).

SUBORDER ACRIDODEA

BOLIVAR, J. Acrididæ, Pyrgomorphinæ. Gen. Insectorum, fasc. 90, 58 pp. (1909)

Acridiidæ, Pamphaginæ. Gen. Insectorum, fasc. 170, 40 pp. (1916).

BRUNER, L. Orthoptera, Acridiidæ. Biologia Centrali-Americana, **2** (1900–09).

Synoptic List of the Paraguayan Acrididæ. Proc. U. S. Nat. Mus., **30**, pp. 613–694 (1906).

South American Tetrigidæ. Ann. Carnegie Mus., **7**, pp. 89–143 (1910).

BRUNNER, C. v. W. Monographie der Proscopiden. Verh. zool.-bot. Ges., Wien, **40**, pp. 87–124 (1890).

BURR, M. Eumastacidæ. Gen. Insectorum, fasc. 15, 23 pp. (1904).

Essai sur les Eumastacides. Ann. Soc. España Hist. Nat., **28**, pp. 75–112; 253–304 (1899).

Monograph of the genus Acrida (=Truxalis). Trans. Entom. Soc. London, 1902, pp. 149–187 (1902).

CLAASSEN, P. W. The Grasshoppers of Kansas, Pts. 1 and 2. Bull. Dept. Entom. Univ. Kansas, No. 11, 126 pp. (1917).

FINOT, A. Sur le genre Acridium. Ann. Soc. Entom. France, **76**, pp. 247–354 (1907).

FLETCHER, T. B. Acrydidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 1 (1921).

HANCOCK, J. L. The Tettigidæ of North America. Chicago, 188 pp. (1902).

Acridiidæ, Tetriginæ. Gen. Insectorum, fasc. 79, 4 pp. (1906).

HEBARD, M. Key to the North American genera of Acridinæ. Trans. American Entom. Soc., **52**, pp. 47–59 (1926).

Studies in the Tettigoniidæ of Panama. Trans. American Entom. Soc., **53**, pp. 79–156 (1927).

KIRBY, W. F. Acrididæ. Fauna British India (1914).

MACNEILL, J. Revision of the Truxalidæ of North America. Proc. Davenport Acad. Sci., **6**, pp. 179–274 (1897).

REHN, J. A. G. North American Œdipodinæ. Trans. American Entom. Soc., **45**, pp. 229–255 (1919).

REHN, J. A. G. and HEBARD, M. Study of North American Eumastacinæ. Trans. American Entom. Soc., **44**, pp. 203–250 (1918).

SAUSSURE, H. Prodrome des Œdipodiens. Mem. Soc. Phys. Hist. Nat., Geneva **28**, No. 9, 254 pp. (1884).

SCUDDER, S. H. Revision of the Melanopli. Proc. U. S. Nat. Mus., **20**, pp. 1–421 (1897) and Proc. Davenport Acad. Sci., **7**, pp. 155–205 (1899).

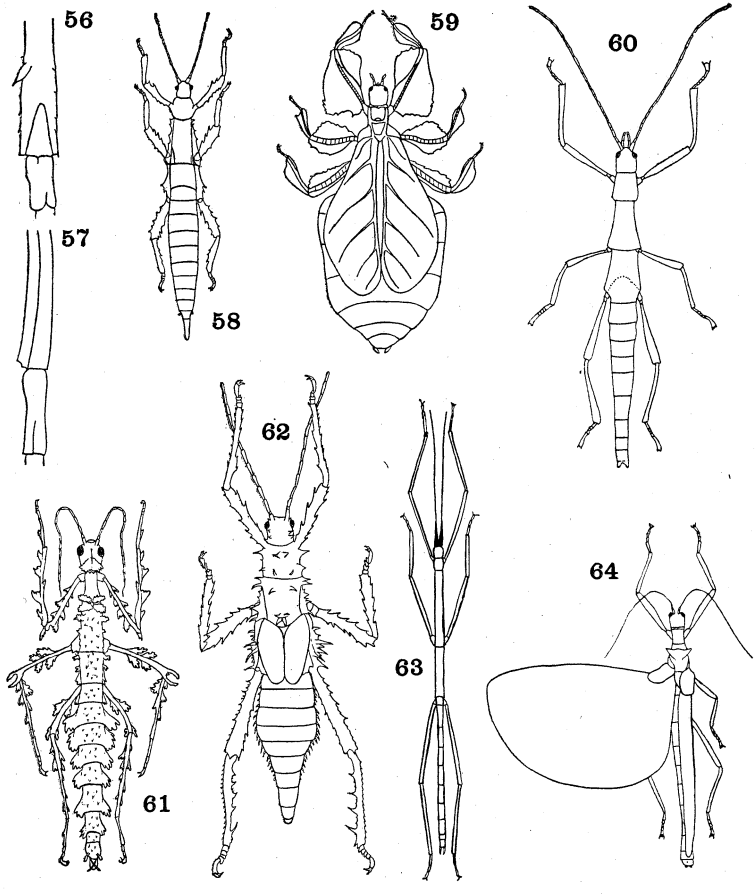
SHIRAKI, T. Acrididen Japans. Tokio, 90 pp. (1910).
SOMES, M. P. The Acrididæ of Minnesota. Bull. Minnesota Agric. Expt. Sta., No. 141, pp. 1–100 (1914).
THOMAS, C. Synopsis of the Acrididæ of North America. Rept. U. S. Geol. Surv. Terr., Washington Govt. Printing Office, 262 pp. (1873).
UVAROV, B. P. Revision of the Genus Locusta (= Pachytylus). Bull. Entom. Res., **12** (1921).
WILLEMSE, C. Revision of Acrididæ of Sumatra. Tijdschr. v. Entom., **73**, pp. 1–206 (1930).

ORDER **PHASMATÒDEA**

(*PHÁSMIDA, PHASMÒIDEA, PHASMÒDEA, GRESSÒRIA*)

Large or very large insects, generally with very slender body of cylindrical, stick- or twig-like form; rarely greatly flattened and leaf-like. Head more or less freely movable, usually with long slender antennæ; eyes well developed; ocelli often absent. Prothorax short or very short, even in the very elongate forms; mesothorax short or elongate; metathorax frequently long, very closely united with the first abdominal segment (median segment), the suture between them often obscured or effaced. Abdomen usually long, cylindrical or tapering, the segments similar; cerci unjointed. Legs nearly always long or very long, similar, the tarsi five-jointed. Wings very frequently entirely absent; when present the fore wings are usually very much smaller than the hind ones, of stouter consistency; hind wings when well developed with a narrow, stouter anterior portion and a very large delicate anal expansion or fan. Metamorphosis very slight and gradual; terrestrial and vegetarian in all stages. Mainly tropical species. Walking sticks, Stick insects, Leaf insects.

1. Four posterior tibiæ each with a triangular area on the underside at apex (Fig. 56), usually marked off by grooves, rarely ending in a spine. (*AREOLÀTÆ*). (Superfamily PHASMATÒIDEA) . 2
   Four posterior tibiæ simple, without a triangular area below at tip (Fig. 57). (*ANAREOLÀTÆ*). (Superfamily BACTERIÒIDEA) 4
2. Median segment (first abdominal segment) as long as or longer than the metanotum; often winged, with the fore wings reduced in size 3
   Median segment distinct from the metanotum, but often much shorter; always wingless; species with extremely long, slender body . . . . . **BACÍLLIDÆ**



Figs. 56–64. **Phasmatodea**

56. **Heteropteryx,** tip of hind tibia (Brunner) Phasmatidæ.
57. **Bacteria,** tip of hind tibia (Brunner) Bacteriidæ.
58. **Heterocopus** (Brunner) Bacillidæ.
59. **Phyllium** (Brunner) Phyllidæ.
60. **Anisomorpha** (Caudell) Phasmatidæ.
61. **Trychopeplus** (Hebard) Bacteriidæ.
62. **Heteropteryx** (Brunner) Phasmatidæ.
63. **Pseudomeryle** (Caudell) Phasmatidæ.
64. **Pomposa** (Brunner) Bacteriidæ.

This family includes three groups, conveniently regarded as subfamilies, separable as follows:

a. Prosternum with two roughened tubercles between the front coxæ; antennæ often as long as or longer than the front legs, always much longer than the front femora. (Fig. 58). (**Óbrimus, Heterocòpus, Tisámenus, Hoploclònia, Dátames, Dòres,** malay.). **OBRIMÌNÆ**

Prosternum without roughened tubercles (except *Pseudodatames* which has short antennæ) ..... b

b. Antennæ much shorter than the front legs, rarely (*Xylica*) as long; old world species. (**Pseudodátames, Círsia, Antongília,** Madagascar; **Xýlica,** ethiop.; **Bacíllus,** palæarc.). **BACILLÌNÆ**

Antennæ as long as or longer than the front legs; mainly new world species. (**Pygirhýnchus, Céroys, Acanthocolònia, Mirophásma, Canulèius,** neotrop.; **Oròbia,** Madagascar). **PYGIRHYNCHÌNÆ**

3. Antennæ long in the male, many jointed, very short in the female, with few joints; mesonotum quadrate or transverse; fore wings of female covering the greater part of the abdomen; entire sides of abdomen broadly dilated into leaf-like extensions. (Fig. 59). Leaf insects. (**Phýllium,** ethiop., indomal.; **Chitoníscus,** polynes.; **Nanophýllium,** New Guinea)..... **PHYLLÌIDÆ**

Antennæ long in both sexes; mesonotum longer than wide; abdomen simple, or at most not with the entire sides thus expanded. (Fig. 63)..... **PHASMÁTIDÆ**

Four subfamilies are recognized, separable by the following key:

a. Tarsal claws simple; fore wings, when present, lobate, very rarely filiform ..... b

Tarsal claws pectinate; fore wings when present filiform or stalked. (**Aschiphásma** (=*Ascepásma*), **Dìna,** malay.; **Prebístus, Abrosòma,** indomal.). (*ASCEPASMÌNÆ*). **ASCHIPHASMATÌNÆ**

b. Body and legs armed with numerous spines (rarely the male not spiny); femora quadrate, not compressed, above with an apical spine; apical area of tibia produced into a spine. (Fig. 56). (**Anisacántha, Parectatosòma,** Madagascar; **Leócrates,** malay.; **Heterópteryx,** indoaustr.) . . **HETEROPTERYGÌNÆ**

Body and legs armed with sparse teeth or spines; femora above without apical spine; apical area of tibia unarmed. c

c. Sixth abdominal segment quadrate (male), or transverse (female), rarely elongate; legs unarmed; femora not compressed nor with

leaf-like dilatations; almost always wingless (Fig. 60). (**Tímena,** nearc.; **Anisomórpha,** nearc., neotrop.; **Agathomèra, Autólyca, Decídia,** neotrop.) . . . . . **ANISOMORPHÌNÆ**

Sixth abdominal segment more elongate, much longer than wide (male) or quadrate (female); front femora either compressed or with leaf-like dilatations. (**Donùsa, Eùcles, Strátocles, Brizòides, Phásma, Prexáspes, Prísopus,** neotrop.; **Phæophásma,** malay.; **Damasippòides,** Madagascar).

PHASMATÌNÆ

4. Median segment short, transverse or but little longer than wide, much shorter than the metanotum; wingless species.

BACUNCÙLIDÆ

This family is divisible into the following subfamilies:

a. Antennæ distinctly shorter than the front legs; old world species. (**Clitúmnus, Cuniculìna,** indomal.; **Pachymórpha,** indoaustr.; **Gratídia,** ethiop., ind.; **Árphax**) . . . . . **CLITUMNÌNÆ**

Antennæ as long as or longer than the front legs. . . . . b

b. Last dorsal segment of male more or less bilobed; operculum (eighth sternite of female) usually compressed, boat-shaped. (**Menóxemus, Prómachus, Lonchòdes, Caraùsius,** indoaustr.; **Dixíppus,** indomal.; **Prosomèra,** malay.).

LONCHODÌNÆ

Last dorsal segment of male truncate; operculum vaulted, lanceolate. (**Bacúnculus,** Am.; **Diapheromèra,** N. Am.; **Libèthra, Ocnóphila, Dỳme,** neotrop.) . . . . . **BACUNCULÌNÆ**

Median segment as long as or longer than the metanotum, or at least much longer than wide; body frequently winged.

BACTERÌIDÆ

This family may be divided into three subfamilies as follows:

a. Antennæ shorter than or about equal in length to the front legs. . b

Antennæ much longer than the front legs, very thin and indistinctly jointed. (Fig. 64). (**Necróscia, Diárdia, Pompòsa, Ásceles, Marmessòidea,** malay.; **Aruanòidea,** indomal.; **Sipylòidea,** indoaustr.) . . . . . **NECROSCIÌNÆ**

b. Front femora unarmed above or similarly dentate on both sides, or not three-sided. (Fig. 61). (**Bactrídium, Cleonístria, Bóstra, Bactèria,** neotrop.; **Palòphus,** ethiop.; **Dimorphòdes,** malay.; **Eurycántha,** Austr.). (*PHIBALOSOMÌNÆ*).

BACTERIÌNÆ

Front femora three-sided, spinose-dentate on the inner side above; cerci frequently large, leaf-like. (**Hermárchus, Acrophýlla,**

Vetíllia, Austr.; **Pharnàcia**, indomal.; **Eurycnèma**, malay., Austr.) ..... **ACROPHYLLÌNÆ**

LITERATURE ON PHASMATODEA

See also Orthoptera (*sens. lat.*), p. 57

BRUNNER, C. v. W. and REDTENBACHER, J. Die Insekten-familie der Phasmiden. Parts I–III., 589 pp. Leipzig. (1906–08).

CAUDELL, A. N. The Phasmidæ or Walking Sticks of the United States. Proc. U. S. Nat. Mus., **26**, pp. 863–885 (1903).

GÜNTHER, K. Die Phasmoiden Neuguineas. Mitt. zool. Mus. Berlin, **14**, pp. 599–746 (1928).

KIRBY, W. F. A Synonymic Catalogue of the Orthoptera, Vol. 1. British Mus. Nat. Hist., London (1904).

SHELFORD, R. Phasmidæ, in Biologia Centrali-Americana, **2** (1909).

WESTWOOD, J. O. Catalogue of the Insects in the British Museum. Phasmidæ. London, British Mus., 195 pp., 48 pls. (1859).

ORDER **DERMÁPTERA**

Moderate-sized or small, more or less depressed insects, of elongate form, with the abdomen terminating in a pair of strong, movable forceps. Head free; antennæ filiform, with from 10 to 30, rarely more, joints; mandibles large, always (except *Arixenia*) fitted for biting. Prothorax free, more or less quadrate. Meso- and metathorax clearly separated; fore wings (elytra) short, leaving the abdomen exposed, heavily chitinized; hind wings (Fig. 79) large, orbicular or broadly oval, at base with two or three cells surrounded by heavy veins; anal fan very large, with a number of radiating veins; radially folded from near the center, and when at rest almost entirely covered by the elytra; sometimes one or both sexes apterous. Abdomen long, very flexible, with from eight to ten exposed segments; cerci forming the anal forceps; one-jointed, except in the nymphs of a few genera, where they are multiarticulate. Legs rather short; tarsi three-jointed, with claws. Metamorphosis slight and gradual; terrestrial in all stages. Earwigs.

1. Mandibles well developed, fitted for chewing; cerci heavily chitinized and opposable like the blades of a pair of forceps; eyes well developed; usually winged; not ectoparasitic; the body shining, rarely noticeably pubescent. (Suborder FORFICULÌNA) .. 2

   Mandibles not fitted for chewing, toothed at tips and fringed with bristles along the inner margin; cerci weakly chitinized; eyes much reduced; apterous species, the body strongly pubescent,

living as ectoparasites on bats. (Suborder ARIXENÌNA). (**Arixènia**, malayan) ..... **ARIXENÌIDÆ**

2. Metapygidium and telson present as two small plates behind the pygidium, or else all three are fused together with the tenth tergite to form a large horizontal plate (squamopygidium); pygidium simple, never with complex processes; ædœagus of male double 3

Metapygidium and telson not developed or vestigial; pygidium well developed, often with complex processes; ædœagus of male a single median piece. (*EUDERMÁPTERA*) 16

3. Squamopygidium absent, the pygidium, metapygidium and telson all present as separate plates; body not strongly flattened (except Platylabiidæ). (*PROTODERMÁPTERA*) 4

Squamopygidium developed; hind wing with an oblique branch in the large basal cell; body very strongly flattened; a large scutellum visible between the elytra at base. (If elytra and scutellum are absent, see *Gonólabis*, couplet 13). (**Apáchyus** (Figs. 68, 74) indomal., Austr.; **Dendròiketes**, ind.). (Superfamily APACHYÒIDEA) (*PARADERMÁPTERA*) ..... **APACHŸIDÆ**

4. Metapygidium and telson not reduced, nearly as large as the relatively small pygidium; head depressed, truncate or concave and not emarginate behind; femora compressed and generally keeled. (Superfamily PYGIDICRANÒIDEA) (*PYGIDICRANÀLES*) 5

Metapygidium and telson much reduced in size, greatly smaller than the pygidium which is relatively very large; femora not compressed or keeled. (Superfamily LABIDURÒIDEA) (*LABIDURÀLES*) 10

5. Femora keeled 6

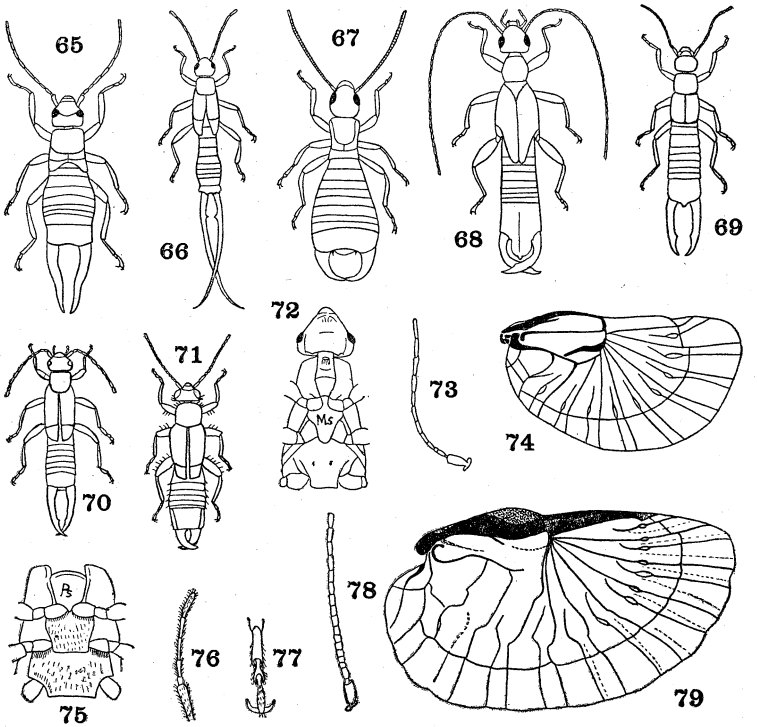
Femora not keeled 9

6. Antennæ with from 15 to 25 joints, the fifth and sixth joints elongate (Fig. 73) 7

Antennæ with 25 to 35 joints, the fifth and sixth short, transverse or quadrate (Fig. 78) 8

7. Both elytra and hind wings absent; metasternum truncate behind; nymphs with forceps-like cerci. (**Anatèlia** (Fig. 73), Canary Isl.; **Châllia**, North China) ..... **ANATELÌIDÆ**

Elytra always, and hind wings usually perfect; metasternum sinuate or excavated behind; nymphs with long, many-jointed cerci, not forceps-like. (**Díplatys**, tropicopol.). **DIPLATŸIDÆ**



Figs. 65–79. **Dermaptera**

65. **Burriola** (Burr) Cheliduridæ.
66. **Timomenus** (Burr) Ancistrogastridæ.
67. **Esphalmenus** (Burr) Esphalmenidæ.
68. **Apachyus** (Burr) Apachyidæ.
69. **Labidura** (Burr) Labiduridæ.
70. **Doru** (Burr) Forficulidæ.
71. **Propyragra** (Burr) Pyragridæ.
72. **Allostethus,** underside of head and thorax (Burr) Allostethidæ.
73. **Anatelia,** antenna (Burr) Anateliidæ.
74. **Apachyus,** wing (Tillyard) Apachyidæ.
75. **Esphalmenus,** underside of thorax (Burr) Esphalmenidæ.
76. **Ancistrogaster,** base of antenna (Burr) Ancistrogastridæ.
77. **Mesasiobia,** tarsus (Burr) Anechuridæ.
78. **Karschiella,** antenna (Burr) Karschiellidæ.
79. **Forficula,** wing. Forficulidæ.

8. Antennæ unusually thick; fourth to sixth joints transverse (Fig. 78); nymphs with jointed cerci. (**Karschiélla, Bormánsia,** ethiop.) ..... **KARSCHIÉLLIDÆ**

Antennæ not very thick; fourth to sixth segments short, but not transverse; cerci of nymphs forceps-like, not jointed. (**Pygidicràna,** neotro.p; **Kalocrània,** malay.; **Dicràna,** ethiop., indoaustr.; **Cranopýgia,** ind.) ..... **PYGIDICRÁNIDÆ**

9. Prosternum convex, more or less acute anteriorly; new world species, the body pubescent. (Fig. 71). (**Pyràgra, Pyragrópsis, Echinopsàlis, Propyràgra,** neotrop.).... **PYRÁGRIDÆ**

Prosternum not acute anteriorly; old world species, the body clothed with short, stiff bristles. (**Echinosòma,** ethiop., indoaustr.) ..... **ECHINOSOMÁTIDÆ**

10. Body not very strongly flattened; forceps (cerci) not flattened nor sickle-shaped 11

Body very strongly flattened; forceps strongly flattened and sickle-shaped; elytra perfectly developed, the hind wings short; antennæ 19–20 jointed. (**Platylàbia,** indomal.). (*PALÍCIDÆ*) ..... **PLATYLABÌIDÆ**

11. Mesosternum strongly narrowed behind (Fig. 72); stout species, sometimes without elytra and wings. (**Allostèthus, Gonolabidùra, Allostethélla,** malay.) ..... **ALLOSTÉTHIDÆ**

Mesosternum not strongly narrowed behind..... 12

12. Prosternum not narrowed behind..... 13

Prosternum narrowed behind (Fig. 75); without wings or elytra; abdomen of male much widened apically (Fig. 67). (**Esphálmenus,** neotrop., ethiop.; **Gonolabìna,** neotrop.). **ESPHALMÉNIDÆ**

13. Mesosternum rounded behind; rather stout species, winged or apterous. (**Anisólabis,** cosmop.; **Psàlis, Gonólabis, Euboréllia,** neotrop., ethiop., ind.). (*PSÁLIDÆ, ANISOLÁBIDÆ*) **PSALÍDIDÆ**

Mesosternum truncate behind..... 14

14. Antennæ with more than twenty-five joints; elytra always and wings usually present. (Fig. 69). (**Labidùra,** cosmop.; **Nàla,** old world; **Forcípula,** widespr.; **Tomopỳga,** indomal.). **LABIDÙRIDÆ**

Antennæ with ten to fifteen joints; without elytra or wings..... 15

15. Last dorsal segment truncate. (**Idolopsàlis,** neotrop.; **Pseudisólabis,** indoaustr.; **Parisólabis,** Austr.).. **PARISOLÁBIDÆ**

Last dorsal segment bifid; slender species with long legs. (**Cten-**

isólabis, Brachýlabis, Antisólabis, ethiop., Austr.; **Nannisólabis,** ind.; **Metisólabis,** ethiop., ind.; **Leptisólabis,** widespr.) ..... **BRACHYLÁBIDÆ**

16. Second joint of tarsi simple, not lobed nor dilated. (Superfamily LABIÒIDEA) (*LABIÀLES*) 17
Second joint of tarsi lobed or dilated. (Superfamily FORFICULÒIDEA) (*FORFICULÀLES*) 23

17. Elytra with a sharp keel or a row of minute tubercles near the lateral margin 18
Elytra not thus keeled 21

18. Tarsi long and very slender; elytra granulose, the keel formed by a row of minute tubercles. (**Pericòmus,** neotrop.). **PERICÓMIDÆ**
Tarsi short and relatively thick; elytra smooth, with a sharp keel 19

19. Antennæ with the joints cylindrical 20
Antennæ with the joints enlarged apically or clavate. (**Nesogáster,** malay., Austr.) ..... **NESOGÁSTRIDÆ**

20. Abdomen of male with the sides parallel; elytra entire, not abbreviated; antennæ 16-to 20-jointed; old world species of slender form. (**Vándex,** ethiop.) ..... **VANDÍCIDÆ**
Abdomen of male broadened at the middle; antennæ with 12–15 joints; elytra abbreviated; new world species of stout form. (**Strongylopsàlis,** neotrop.).... **STRONGYLOPSALÍDIDÆ**

21. Body not strongly flattened 22
Body strongly flattened. (**Sparátta, Parasparátta, Prosparátta,** neotrop.; **Auchénomus,** ethiop., malay.). **SPARÁTTIDÆ**

22. Head transverse, the median and frontal sutures strong and deep; eyes large and prominent. (**Spongíphora, Pùrex,** neotrop.; **Vóstox,** Am.; **Spongovóstox,** tropicopol.; **Márava,** austromal.) ..... **SPONGIPHÓRIDÆ**
Head narrow, the sutures weak or obsolete; eyes small, no longer than the first joint of the antennæ. (**Làbia,** cosmop.; **Prolàbia,** tropicopol.; **Làrex,** neotrop.; **Chætospània,** ethiop., indoaustr.; **Ándex,** Austr.) ..... **LABÌIDÆ**

23. Second joint of tarsi with a narrow lobe produced beneath the third joint; moderately stout or robust species. (**Chelisódoches,** ethiop., indoaustr.; **Énkrates, Pròreus,** indomal.; **Solenosòma,** ind.; **Kleidùchus,** Austr.) ..... **CHELISODÓCHIDÆ**
Second joint of tarsi with a dilated lobe on each side (Fig. 77)... 24

24. Sternal plates strongly transverse; elytra much reduced in size; abdomen depressed and dilated; pygidium transverse. (Fig. 65). (**Chelidùra, Burrìola,** palæarc., **Mesochelidùra,** palæarc., ethiop.) ..... **CHELIDÙRIDÆ**

Sternal plates not very decidedly transverse 25

25. Antennal joints not very long and slender, the fourth often much shorter than the third and the first much shorter than the head 26

Antennal joints all long and slender; fourth not shorter than the third; first longer and thicker than the others (Fig. 76) 29

26. Meso- and metasternum and pygidium broad; forceps remote, not depressed; elytra entire or abbreviated. (Fig. 77). (**Anechùra, Mesasiòbia,** palæarc., neotrop.; **Pseudochelidùra,** palæarc.; **Pterýgida, Allodáhlia,** indomal.). **ANECHÙRIDÆ**

Meso- and metasternum quadrate or narrow; pygidium narrow. 27

27. Abdomen cylindrical, not depressed 28

Abdomen depressed; forceps flattened or cylindrical; mesosternum rounded posteriorly; antennæ with 12–15 joints; elytra rarely shortened. (Fig. 70). (**Forfícula,** holarc., ethiop., indomal. (*F. auriculària,* European earwig); **Chelidurélla, Apterýgida,** palæarc., ethiop.; **Dòru,** Amer., Austr.; **Skalístes,** neotrop.; **Hypúrgus,** indomal.) ..... **FORFICÙLIDÆ**

28. Elytra entire, not shortened; mesosternum rounded posteriorly; old world species. (**Eudóhrnia,** ind.; **Kosmètor,** indomal.). **EUDOHRNÌIDÆ**

Elytra abbreviated; nusosternum truncate. (**Neolobóphora,** neotrop.; **Árchidux,** ethiop.) ..... **NEOLOBOPHÓRIDÆ**

29. Sternal plates generally transverse, at least relatively broad; metasternum truncate; abdomen and forceps depressed; new world species. (Fig. 76). (**Ancistrogáster, Vláx, Pràos, Tristanélla, Paracósmia,** neotrop.) ..... **ANCISTROGÁSTRIDÆ**

Sternal plates narrow; metasternum narrow, excavated posteriorly 30

30. Abdomen but little depressed, surface rather convex; legs long and slender; pygidium narrow; forceps remote, slender. (Fig. 66). (**Dìnex,** neotrop.; **Timómenus, Epárchus, Córdax,** indomal.; **Opisthocósmia,** ethiop., malay.; **Thalpèrus,** ethiop.). **OPISTHOCOSMÌIDÆ**

Abdomen depressed and rather dilated; legs short; pygidium strongly transverse. (**Diaperásticus,** ethiop.). **DIAPERASTÍCIDÆ**

LITERATURE ON DERMAPTERA

See also Orthoptera (*sens. lat.*), p. 57

BORMANS, A. and KRAUSS, H. Dermaptera. Das Tierreich, Lief. 11 (1900).

BURR, M. Revision of Forficulidæ and Chelisodochidæ. Trans. Entom. Soc. London, 1907, pp. 91–134 (1907).

Dermaptera. Fauna of British India. London (1910).

Revision of the Labiduridæ. Trans. Entom. Soc. London, 1910, pp. 161–203 (1910).

Dermaptera. Gen. Insectorum, fasc. 122, 112 pp. (1911).

Revision of the Genus Diplatys. Trans. Entom. Soc. London, 1911, pp. 21–47 (1911).

BURR, M. and JORDAN, K. On Arixenia, a Suborder of Dermaptera. Trans. 2d Entom. Congr. (1913).

CHOPARD, L. Orthoptères et Dermaptères. Faune de France (1922).

GÜNTHER, K. Die Dermapteren der deutschen Kaiserin-Augusta-Flusse-Expedition. Mitt. zool. Mus. Berlin, **15**, pp. 55–83 (1929).

KIRBY, W. F. A Synonymic Catalogue of the Orthoptera, vol. 1. British Mus. Nat. Hist., London (1904).

REHN, J. A. G. The Dermaptera of the American Museum Congo Expedition with a Catalogue of the Belgian Congo Species. Bull. American Mus. Nat. Hist., **49**, pp. 349–413 (1924).

WALDEN, B. H. Dermaptera of Connecticut. Bull. State Geol. Nat. Hist. Surv. Connecticut, No. 16, pp. 44–47 (1911).

ZACHER, F. Studien über das System der Protodermapteren. Zool. Jahrb. Abth. f. Syst., **30**, pp. 303–400 (1911).

ORDER **DIPLOGLOSSÀTA**

(*DERMODERMÁPTERA*)

Moderate-sized, flattened, wingless species living as external parasites of rodents. Head horizontal, semicircular, with the mouth opening below. Mandibles strong, dentate; maxillæ and labium well developed, their palpi five- and three-jointed respectively. Antennæ rather short, filiform, with the basal joint greatly elongated. Thoracic segments expanded laterally into flattened plates; prothorax large, free. Legs similar, stout and short; coxæ small, separated; tarsi three-jointed, with claws. Cerci long, filiform, but unsegmented. Metamorphosis imperceptible, the females viviparous; living as external parasites of rodents.

One family. (**Hemímerus**, South Africa)..... **HEMIMÉRIDÆ**

LITERATURE ON DIPLOGLOSSATA

HANSEN, H. J. On the Structure and Habits of *Hemimerus talpoides*. Ent. Tidskr., **15**, pp. 65–93 (1894).

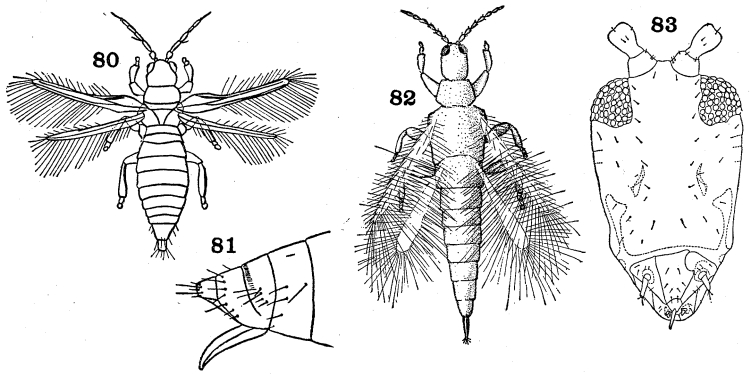
JORDAN, K. Anatomy of Hemimerus. Novitat. Zool., **16**, pp. 327–330 (1909).

KRAUSS, H. Forficulidæ. Das Tierreich, Lief. 11, pp. 130–132 (1900).

ORDER **THYSANÓPTERA**

(*PHYSÓPODA*)

Small or minute, usually depressed, slender insects with the wings often reduced in size, and frequently capable of jumping, feeding generally on plant sap, or more rarely on animal juices. Head vertical, free; eyes well developed; usually three ocelli; mouthparts fitted for sucking, inferior, asymmetrical, consisting of a triangular clypeus fused



Figs. 80–83. **Thysanoptera**

80. **Heliothrips** (Russell) Thripidæ.
81. **Euthrips,** apex of abdomen of female, showing ovipositor (Russell).
82. **Thrips** Thripidæ.
83. **Cephalothrips,** head. (Peterson).

with the bases of the maxillæ to form a sheath that encloses the mandibular and maxillary setæ. Prothorax free; wings four, similar, narrow, with few or no veins, closely fringed with long bristles, often vestigial or absent. Legs similar; tarsi one- or two-jointed, with one or two claws, and with a bladder-like or hoof-like enlargement at tip. Abdomen with ten visible segments; terminal one frequently tubular; basal one often closely attached to the thorax. Ovipositor present or absent, when present consisting of four more or less parallel, often

strongly curved pieces. Metamorphosis gradual, the nymphs very similar to the adult; wings developing externally; penultimate instar often quiescent.

1. Wing surface microscopically hairy; wings usually present, fore wing with a marginal vein and at least one longitudinal vein attaining the wing tip; last abdominal segment rarely tubular, in the female usually conical and longitudinally divided beneath, in the male usually rounded at tip; ovipositor present, saw-like, composed of four pieces. (Suborder TEREBRÁNTIA).....2

   Wing surface bare, without pubescence; fore wing veinless, or at most with a single, abbreviated median vein, wings often absent; last abdominal segment tubular in both sexes and not divided beneath; no ovipositor. (Suborder TUBULÍFERA).....10

2. Ovipositor curved upwards; wings usually broad, with the tips rounded; body not flattened; antennæ nine-jointed.....3

   Ovipositor curved downwards; wings when present narrower and almost always pointed at tips; body more or less flattened; antennæ six- to nine-jointed. (THRIPÒIDEA).....6

3. Labial palpi with fewer joints than the maxillary palpi; all joints of antennæ usually freely movable.....4

   Labial palpi with the same number of joints as the maxillary palpi, or with one more joint; last three to five joints of antennæ closely united, not freely movable.....5

4. Maxillary palpi with seven or eight joints; labial palpi with three to five joints. (**Désmothrips,** Austr.; **Órothrips,** nearc.; **Stomátothrips**) ..... **OROTHRÍPIDÆ**

   Maxillary palpi with three joints; labial palpi with two joints. (**Melánothrips,** palæarc.; **Ánkothrips,** widespr.; **Cránothrips,** Austr.) ..... **MELANOTHRÍPIDÆ**

5. Antennæ extremely long and slender, the third joint at least ten times as long as thick and as long as the head (Fig. 84), joints three and four without elongated sensory areas; fore wing slender, without crossveins; anterior ocellus absent or very small. (**Franklínothrips,** nearc., ethiop.; **Corynothripòides,** ethiop.). **FRANKLINOTHRÍPIDÆ**

   Antennæ much shorter; joints three and four with elongated sensory areas; wings broader, the fore wing with distinct crossveins; three well developed ocelli. (**Æólothrips, Archæólothrips, Rhipídothrips**). (*COLEOPTRÁTIDÆ*). **ÆOLOTHRÍPIDÆ**

6. Antennæ nine-jointed, sometimes apparently ten-jointed, without an apical stylus; front tarsus with a claw-like projection at the base of the second joint; third and fourth joints of antennæ enlarged, conical. (**Hetérothrips**, Am.).
HETEROTHRÍPIDÆ

Antennæ six- to eight-jointed, rarely with the second joint divided by a suture so that the antennæ appear to be nine-jointed; antennæ usually with a one- or two-jointed style at apex (Fig. 88); front tarsus simple, without appendage on second joint; third and fourth joints of antennæ not conical. 7

7. Antennæ not moniliform, six- to eight-jointed, always with apical style; pronotum simple above, without longitudinal sutures; front and hind femora slender; ovipositor almost always well developed. 8

Antennæ moniliform (Fig. 85), eight-jointed, without apical style; pronotum with a longitudinal suture at each side; front and hind femora greatly thickened (Fig. 87); ovipositor much reduced. (**Mèrothrips**, nearc., neotrop.). . **MEROTHRÍPIDÆ**

8. Sixth joint of antennæ well developed, usually as large as or larger than the fifth (Fig. 88) 9

Sixth or sixth and seventh joints of antennæ very small, style-like, very much smaller than the fifth. (**Cerátothrips**, palæarc.).
CERATOTHRÍPIDÆ

9. Last abdominal segment in female cylindrical, very heavily chitinized, ninth and tenth segments with extremely long, stout, thorn-like bristles. (**Panchætothrips**, India; **Dinùrothrips**, **Macrùrothrips**) . . . . . **PANCHÆTOTHRÍPIDÆ**

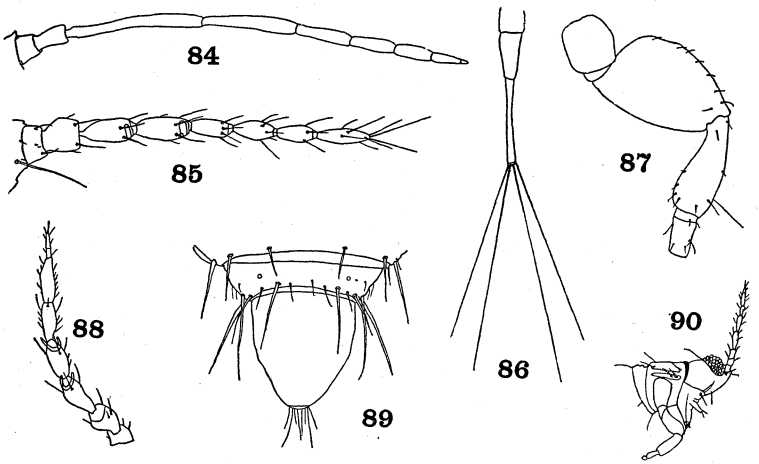
Last abdominal segment in female conical, weakly chitinized, rarely more heavily chitinized than the preceding segments; ninth and tenth segments never with large thorn-like bristles. (Figs. 80, 88, 90). (**Helìothrips**, **Thrips**, **Frankliniélla**, **Anáphothrips**, **Phỳsothrips** and many other genera). (*STENOPTÉRIDÆ*) . . . . . **THRÍPIDÆ**

10. Maxillary palpi two-jointed; antennæ with seven or eight, usually eight joints; middle coxæ further apart than the other pairs 11

Maxillary palpi one-jointed; antennæ with four to seven joints; hind coxæ further apart than the other pairs. (Fig. 86). (**Ùrothrips**, ethiop.; **Stephánothrips**, ethiop., neotrop.; **Brádythrips**, neotrop.; **Bebélothrips**, palæarc.). (UROTHRIPÒIDEA) . . . . . **UROTHRÍPIDÆ**

11. Eighth segment of abdomen without peg-shaped projections on the posterior edge 12

Eighth abdominal segment with long, posteriorly directed, peg-shaped projections along the posterior edge; last segment of abdomen extremely short and stout. (**Chirothripòides**). **CHIROTHRIPÒIDIDÆ**



Figs. 84–90. **Thysanoptera**

84. **Franklinothrips,** antenna (Hood) Franklinothripidæ.
85. **Merothrips,** antenna (Hood) Merothripidæ.
86. **Bradythrips,** apex of abdomen of female (Hood) Urothripidæ.
87. **Merothrips,** leg (Hood) Merothripidæ.
88. **Frankliniella,** antenna (Karny) Thripidæ.
89. **Pygothrips,** apex of abdomen of female (Hood) Pygothripidæ.
90 **Thrips,** head and anterior part of thorax (Shaw) Thripidæ.

12. Head not produced anteriorly in front of eyes; vertex not sharply conical, rarely prominently overhanging the base of the antennæ 13

Head more or less produced in front of the eyes; vertex conical, usually prominently overhanging the base of the antennæ and bearing the front ocellus at its extremity; usually with a strong bristle in front of the eye. (**Idólothrips, Gigántothrips, Actínothrips**) ..... **IDOLOTHRÍPIDÆ**

13. Male with a stout tubular projection at each side of the sixth abdominal segment. (**Mégathrips, Bacíllothrips, Megálothrips**) ..... **MEGATHRÍPIDÆ**

Sixth abdominal segment of male simple, without a tubular projection laterally 14

14. Last abdominal segment greatly elongated, about as long as the remainder of the abdomen and three or four times as long as the head. (**Hystrícothrips, Holùrothrips**). **HYSTRICHOTHRÍPIDÆ**

Last abdominal segment much shorter, never greatly lengthened. 15

15. Last abdominal segment short, swollen, rounded on the sides; preceding segments very much shorter than wide (Fig. 89). (**Pỳgothrips,** Austr.) ..... **PYGOTHRÍPIDÆ**

Last abdominal segment tubular, slightly narrowed apically, preceding segments not transversely linear, the ninth usually but little wider than long 16

16. Third joint of antennæ with a strong crest-like ring of large sense cones at apex. (**Ecacánthothrips,** Indomal.; **Órmothrips**). **ECACANTHOTHRÍPIDÆ**

Sense organs of third joint no more strongly developed than those of the other joints 17

17. Sensory cones of antennæ unusually long and acute, each with an accessory cone or a long, slender bristle, the joints which bear the cones much swollen; eyes very much enlarged, contiguous. (**Eupátithrips, Sedùlothrips**) ..... **EUPATITHRÍPIDÆ**

Sensory cones not remarkably developed; eyes much smaller. (**Phlœothrips, Tríchothrips, Lìothrips, Acánthothrips, Zỳgothrips,** and many others) ..... **PHLŒOTHRÍPIDÆ**

LITERATURE ON THYSANOPTERA

BAGNALL, R. S. Synopsis of Æolothripidæ. Trans. 2d Congress Ent., **2**, pp. 394–397 (1913).

The Genus Melanothrips. Entom. Monthly Mag., **60**, pp. 9–11. (1924).

HINDS, W. E. Monograph of Thysanoptera of North America. Proc. U. S. Nat. Mus., **26**, pp. 79–242 (1902).

HOOD, J. D. Subfamilies of Thysanoptera. Proc. Biol. Soc. Washington, **28**, pp. 53–60 (1915).

Keys to Genera and North American Species of Urothripidæ. Bull. Brooklyn Entom. Soc., **24**, pp. 314–321 (1929).

HOOD, J. D. and WILLIAMS, C. B. Synopsis of Urothripidæ. Ann. Entom. Soc. America, **20**, pp. 1–9 (1927).

KARNY, H. Synopsis der Megathripidæ. Neue Beiträge zur systematischen Insektenkunde, Berlin, **1**, pp. 105–110; 113–118 (1919).

Beiträge zur Malayischen Orthopteren-fauna, III. Thysanoptera. Treubia, **1**, pp. 211–261 (1921).

Studies on Indian Thysanoptera. Mem. Dept. Agric. India, **9**, pp. 187–239 (1926).

KNECHTEL, W. K. Thysanoptere din Romania. Studin Monografic. Bulet. Agric., Bucarest, **2–3**, pp. 1–235 (1923).

MOULTON, D. Synopsis, Catalogue and Bibliography of North American Thysanoptera. Bull. Bur. Entom. U. S. Dept. Agric., Tech. Ser. No. 21 (1911).

PRIESNER, H. Die Thysanopteren Europas. Four parts. Vienna, Fritz Wagner (1926–28).

Thysanoptera. In Tierwelt Mitteleuropas, **4**, Lief. 2, pp. VIII 1–18 (1928).

UZEL, H. Monographie der Thysanopteren. 472 pp. Königgrätz (1895).

WATSON, J. R. Synopsis and Catalogue of North American Thysanoptera. Florida Agric. Expt. Sta., Tech. Bull. No. 168, 100 pp. (1923).

ORDER **BLATTÀRIÆ**

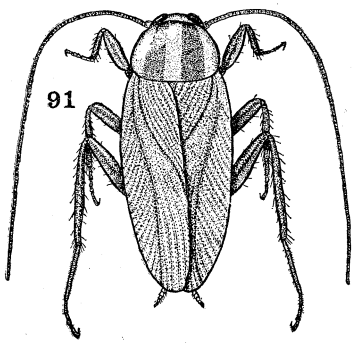
(*OOTHECÀRIA, CURSÒRIA, BLATTÒIDEA*)

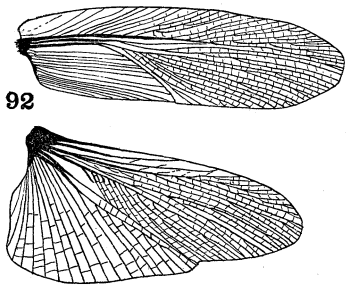
Moderate-sized or large, sometimes very large, rarely very small, broadly oval, flattened, quick-running insects. Head free but inflexed so as to be nearly or quite concealed beneath the pronotum, the mouth posterior or nearly so. Mandibles strong, toothed; maxillæ well developed, bilobed, with five-jointed palpi; labial palpi three-jointed; eyes usually well developed, usually two ocelli; antennæ long, filamentous, many-jointed. Prothorax large, movable, usually transverse; meso- and metathorax subequal, not freely movable. Wings often absent or much reduced in size; when present, overlapped on the abdomen; fore wings parchment-like, containing many veins; hind wings with a large anal lobe, clearly separated from the rest of the wing and radially folded. Legs strong, similar, coxæ large; tibiæ usually strongly spinose; tarsi five-jointed. Abdomen with ten tergites of nearly equal size, broadly attached at the base and not very freely movable; cerci prominent and jointed. Metamorphosis slight. Roaches.

1. Middle and hind femora, or at least the hind femora, with several evident marginal spines beneath.....2

   Middle and hind femora unarmed beneath, or furnished only with hairs and bristles, or with one or two apical or subapical spines.....8

2. Females with the seventh ventral segment divided posteriorly to form a valvular apparatus.....3
   Seventh ventral segment of female large, undivided, and rounded.4
3. Moderate to large, heavily pigmented species, with eyes; tenth dorsal segment of the male more or less quadrangular, often impressed, or emarginate behind. Mainly tropical. (**Blátta,** cosmop. (*B. orientàlis,* Oriental cockroach); **Eurýcotis,** neotrop.; **Polyzostèria,** austr.; **Méthana,** ethiop., indoaustr.; **Deropéltis,** ethiop.; **Periplanèta** (Fig. 92) cosmop. (*P. americàna,* American cockroach, *P. australàsiæ,* Australian cockroach). (*PERIPLANETÌNÆ*) ..... **BLÁTTIDÆ**





Figs. 91–92. **Blattariæ**

91. **Blatella.** Phyllodromiidæ.
92. **Periplaneta,** wings. Blattidæ.

   Small, colorless, cave-inhabiting species, with the eyes vestigial or absent; wings reduced or absent; tenth dorsal segment of the male elongate triangular and emarginate behind. (**Noctícola, Spelæoblátta,** indomal.) ..... **NOCTICÓLIDÆ**
4. Moderate to large species, not living in ant nests; antennal joints short 5
   Very small, wingless or subapterous species, 2 to 5 mm. in length, living in ant nests; entire body covered with loose hairs; legs stout, the tibiæ heavily spined; antennal joints much longer than wide. Neotropical. Ant guests. (**Attáphila** (Figs. 98, 99)). **ATTAPHÍLIDÆ**
5. Tenth dorsal segment of both sexes usually transverse and narrow; hind wings when present with an apical field; fore wings with the

branches of M and Cu strongly oblique and leading toward the hind margin; hind femora usually sparsely armed with spines beneath. (**Ectòbia,** cosmop.; **Anaplécta, Pseudectòbia,** neotrop., ethiop., indomal.; **Hololámpra,** holarc., ethiop.).

ECTOBÌIDÆ

Tenth dorsal segment of both sexes more or less produced, triangular or emarginate; hind femora usually strongly spined beneath 6

6. Tenth dorsal segment of both sexes triangular and entire, the cerci distinctly projecting 7

Tenth dorsal segment of the male more or less quadrate, with obtuse angles, that of the female broadly rounded or lobate, the cerci not projecting; tarsi with distinct pulvilli. (**Calolámpra,** widespr.; **Epilámpra,** neotrop.; **Leuroléstes, Phlebonòtus, Phoráspis, Hyrophicnòda** (Fig. 97), neotrop.; **Homalópterus,** indomal., neotrop.; **Heterolámpra,** ethiop., indoaustr.). (*PHORASPÍDIDÆ*) ..... **EPILÁMPRIDÆ**

7. Pronotum and fore wings smooth; hind wings with the radial vein usually emitting several parallel costal veins; pulvilli absent. (**Caloblátta, Pseùdomops,** neotrop.; **Blatélla** (*B. germánica,* Crotonbug) (Figs. 91, 95), **Ischnóptera, Lobóptera, Phyllodròmia, Temnópteryx,** cosmop.; **Ellipsídion,** austr.).(*PSEUDOMÓPIDÆ*)..... **PHYLLODROMÌIDÆ**

Pronotum and fore wings covered with a silky pile; hind wings with the radial vein emitting irregular costal veins; pulvilli present; usually large species. Neotropical. (**Megaloblátta, Nyctíbora, Heminyctíbora**) ..... **NYCTIBÓRIDÆ**

8. Abdomen with the seventh segment normal, not enclosing the terminal segments, the cerci and at least the tenth dorsal segment free 9

Abdomen with the seventh segment of both sexes broadly rounded, triangular and enclosing the terminal segments and also the cerci; tibiæ short and strongly bristly; wingless and greatly convex species. (**Cryptocércus** (Fig. 94), nearc.).

CRYPTOCÉRCIDÆ

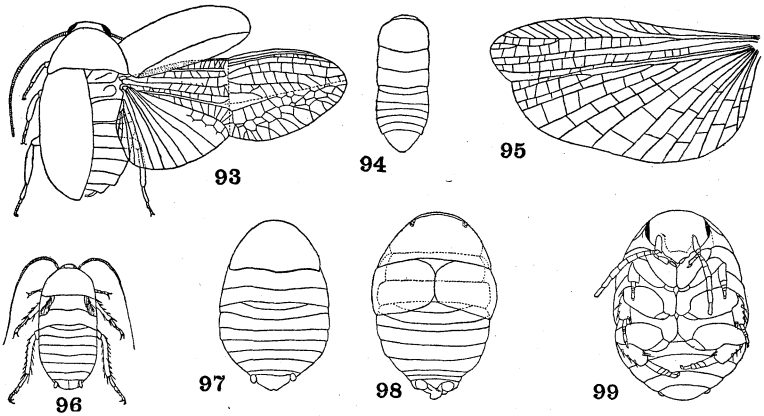
9. Hind wings twice as long as the fore wings, with a transverse fold at the middle through which the veins continue to the apex, folded in repose; fore wings elytra-like, with weak venation; insects resembling dytiscid beetles. (**Diplóptera** (Fig. 93) austromal.) ..... **DIPLOPTÉRIDÆ**

Hind wings without a middle transverse fold through which the

veins continue to the apex, sometimes with an apical triangular field 10

10. Tenth dorsal segment semicircular, broadly produced, its hind margin more or less strongly dentate; last ventral segment of the male very small, without styles; legs robust, the front pair fossorial, tibiæ strongly spinose, tarsi relatively short, without arolia; costal margin of the fore wings split, wings often reduced. (**Panésthia, Salgànea,** indoaustr.; **Geoscâpheus,** austr.). **PANESTHIIDÆ**

Last dorsal segment without produced and dentate hind margin. 11



Figs. 93–99. **Blattariæ**

93. **Diploptera** (Tillyard) Diplopteridæ.
94. **Cryptocercus,** dorsal outline (Hebard) Cryptocercidæ.
95. **Blatella,** hind wing. Phyllodromiidæ.
96. **Cocoblatta** (Saussure) Blaberidæ.
97. **Hyporhicnoda** (Hebard) Epilampridæ.
98. **Attaphila,** dorsal view (Wheeler) Attaphilidæ.
99. **Attaphila,** ventral view (Wheeler) Attaphilidæ.

11. Hind wings with an area between Cu and A capable of being folded, the anal fold large; small species 12

Hind wings without a cubital fold or at most with an indication of one, or the wings reduced 13

12. Fore wings with the branches of M and Cu directed toward the hind margin, anal area small, with few veins extending to the

margin, costal area short. (**Chorisoneùra,** Am.; **Chorístima,** austr.; **Anáptycha, Hemiptérota,** neotrop.).

CHORISONEÙRIDÆ

Fore wings with the branches of M and Cu directed toward the apical margin, costal area usually long and narrow. (**Areolària,** malay.; **Hypnórna, Plectóptera,** neotrop.).

AREOLARÌIDÆ

13. Very small species, 5 to 7 mm. in length, living in nests of ants. . 14
Larger species, not myrmecophilous. 15
14. Flattened, narrow, winged species; fore wings pubescent, with weak venation, the branches of M and Cu parallel; tibiæ with long bristles; cerci long and jointed. Neotropical. (**Nothoblátta**) . . . . . **NOTHOBLÁTTIDÆ**
Rather convex insects with abbreviated fore wings and no hind wings; tibial spines weak; cerci short and broad. Ant guests. Neotropical. (**Attícola**) . . . . . **ATTICŌLIDÆ**
15. Female with the seventh ventral segment divided behind to form a pair of valves. 16
Female with the seventh ventral segment not forming a pair of valves 19
16. Large species; prothorax elongate-trapezoidal, not tomentose; legs very long, the tibial bristles weak; anal areas of the hind wings of the fully winged forms large and plaited several times in repose; fore wings with the costal cell narrow and without crossveins, subcosta long, reaching the middle of the wings. (**Archiblátta, Cátara,** malay.) . . . . . **ARCHIBLÁTTIDÆ**
Insects not conforming to the preceding description; anal area of the fully winged forms smaller, folded only once or twice. 17
17. Small species with pubescent thorax; hind wings with a pronounced thickening surrounding the ends of the shortened subcosta. Widespread, tropical. (**Compsòdes, Euthýrrhapha, Holocómpsa**) . . . . . **EUTHYRRHÁPHIDÆ**
Hind wings without nodal thickening at the end of the subcosta. 18
18. Small, delicate species; tibial bristles weak; cerci long; veins simple or few-branched. (**Latíndia,** neotrop.).

LATINDÌIDÆ

Large species; tibial bristles strong; cerci short; veins many-branched. (**Homœogàmia,** Am.) . . . . . **HOMŒOGAMÌIDÆ**
19. Tarsal claws without arolia, or with a minute arolium; tenth dorsal segment of the male abdomen more or less deeply notched. . . 20
Tarsal claws with a distinct arolium between them. 22

20. Prothorax smooth; anal field of the hind wings of the fully winged forms large and folded fan-like; large, robust, but not greatly convex species. (**Archimandrìta, Blâberus, Cacoblátta** (Fig. 96), **Bláptica,** neotrop.) ..... **BLABÉRIDÆ**

Prothorax hairy; anal field of the hind wings of the fully winged forms smaller, folded only once or twice..... 21

21. Tenth dorsal segment of the male abdomen transverse, often constricted at the middle; large, broadly convex species. (**Polýphaga,** palæarc., indomal., ethiop.) ..... **POLYPHÁGIDÆ**

Tenth dorsal segment more or less produced, its hind margin notched; broad beetle-like, showy insects. (**Corýdia,** indomal.). **CORYDÌIDÆ**

22. Dorsal segments of the abdomen with protruding lateral angles; tenth dorsal segment quadrangular and medially notched behind. (**Panchlòra,** neotrop., ethiop.; **Gỳna,** ethiop.; **Leucophæa,** ind.; **Nauphòeta,** ethiop., neotrop.; **Pucnoscéllus,** ind.; **Oniscosòma,** austr.) ..... **PANCHLÓRIDÆ**

Abdominal segments without projecting lateral angles; tenth dorsal segment transverse, its hind margins straight or rounded. . 23

23. Hind wings more or less pointed or with a much produced apical field into which the cubital branches do not enter. (**Oxyháloa,** ethiop., neotrop.) ..... **OXYHALÒIDÆ**

Hind wings with rounded tip and no specialized apical field. (**Elliptoblátta, Stenopilèma,** ethiop.; **Hormética,** Am.; **Perisphæria,** indomal.; **Parasphæria,** neotrop.). **PERISPHÆRÌIDÆ**

LITERATURE ON BLATTARIÆ

See also Orthoptera (*sens. lat.* p. 57)

BRUNNER, C. Nouveau Système des Blattaires. 426 pp. Vienna (1865).

CHOPARD, L. Orthoptères et Dermaptères. Faune de France (1922).

Blattidæ de la Nouvelle-Caledonie. Nova Caledonia, Berlin, A, Zool., **3**, pp. 301–336 (1924).

HANITSCH, R. Malayan Blattidæ. Journ. Roy. Asiatic Soc., Straits Branch, **69**, pp. 17–178 (1915).

HEBARD, M. The Blattidæ of North America North of the Mexican Boundary. Mem. American Entom. Soc., No. 2 (1917).

The Blattidæ of Panama. Mem. American Entom. Soc., 4, pp. 1–148 (1919).

The Blattidæ of French Guiana. Proc. Acad. Nat. Sci. Philadelphia, **78**, pp. 135–244 (1926).

Studies in Malayan Blattidæ. Proc. Acad. Nat. Sci., Philadelphia, **81**, pp. 1–109 (1929).

KARNY, H. H. Monographie der Phyllophorinen. Treubia, **5**, suppl. 142 pp. (1924).

KIRBY, W. F. A Synonymic Catalogue of the Orthoptera. Vol. 1, British Mus. Nat. Hist. London (1904).

MORSE, A. P. Manual of the Orthoptera of New England. Proc. Boston Soc. Nat. Hist., **35**, No. 6 (1920).

RAMME, W. Monographie des Blattiden-Genus Ectobius. Arch. Naturg. (1923).

REHN, J. G. and HEBARD, M. The Orthoptera of the West Indies: Blattidæ. Bull. American Mus. Nat. Hist., **54**, pp. 1–320 (1927).

SAUSSURE, H. Mélanges Orthoptérologiques, fasc. 2, Blattidæ. Geneva(1865).

Revision de la tribu des Hétérogamiens. Rev. Suisse Zool., **1**, pp. 289–318 (1890).

Revision de la tribu des Périsphériens. Rev. Suisse Zool., **3**, pp. 1–59, (1895).

Revision de la tribu des Panesthiens et Épilampriens. Rev. Suisse Zool., **3**, pp. 299–361 (1895).

SHELFORD, R. Studies of the Blattidæ. Trans. Entom. Soc. London (1906–07) (several parts).

Blattidæ, Ectobiinæ. Gen. Insectorum, fasc. 55, 15 pp. (1907).

Blattidæ, Phyllodrominæ. Gen. Insectorum, fasc. 73, 29 pp. (1908).

Blattidæ, Nyctiborinæ. Gen. Insectorum, fasc. 74, 5 pp. (1908).

Blattidæ, Epilamprinæ. Gen. Insectorum, fasc. 101, 21 pp. (1910).

Blattidæ, Blattinæ. Gen. Insectorum, fasc. 109, 27 pp. (1910).

TEPPER, J. G. O. The Blattariæ of Australia and Polynesia. Trans. Roy. Soc. South Australia, **17**, pp. 25–130; **18**, pp. 169–189 (1893–94).

ORDER **MANTÒDEA**

(*MANTÒIDEA*)

Moderate-sized or large insects of predatory habits; the front legs very long, with the femora and tibiæ usually heavily spined and capable of being folded closely together to grasp the prey. Body elongate, sometimes very slender and usually flattened. Head freely movable, not inserted in the prothorax; eyes prominent, usually three ocelli; mandibles strong, the mouthparts inferior, rarely turned forwards; antennæ long and filamentous, many-jointed, rarely pectinate in certain males. Prothorax long or very long, freely movable, sometimes with the sides expanded; meso- and metathorax shorter, of about equal length, not freely movable. Four wings, overlapping on the abdomen, sometimes much reduced or absent, especially in the female; venation complex, fore wings usually considerably smaller than the hind pair and

of stouter consistency. Tarsi almost always five-jointed, terminating in two claws; femora and tibiæ sometimes with expanded margins. Abdomen elongate oval or long and cylindrical, the terminal segments not abbreviated, tenth tergite forming a supra-anal plate; cerci usually jointed, never very long. Metamorphosis incomplete; habits similar throughout development. Praying mantids, Soothsayers.

A single family ..... **MÁNTIDÆ**[1]

1. Front tibiæ without an apical hook, with two rows of spines below; cerci very long, many-jointed; small, winged species with freely movable head and simple posterior legs. (Fig. 109). (**Chæteéssa**, neotrop.) ..... **CHÆTEESSÌNÆ**

   Front tibiæ with apical hook 2

2. Front tibiæ with one or two long teeth on the dorsal side before the apical hook, otherwise with only very few spines; cerci simple; small slender species. (Fig. 105). (**Bántia, Pseudomusònia** (=*Mìonyx*), **Bactromântis, Olígonyx**, neotrop.; **Haania**, malay.) ..... **OLIGONYCHÌNÆ**

   Front tibiæ without teeth above 3

3. Front tibiæ without rows of strong spines below, or with only the inner row distinctly developed 4

   Front tibiæ with two rows of well developed spines below 5

4. Head with the mandibles directed forwards, the part behind the eyes well developed, usually long; slender, elongate species. (Fig. 107). (**Compsothêspis**, ethiop., Austr.; **Cliomântis**, Austr.) ..... **COMPSOTHESPÌNÆ**

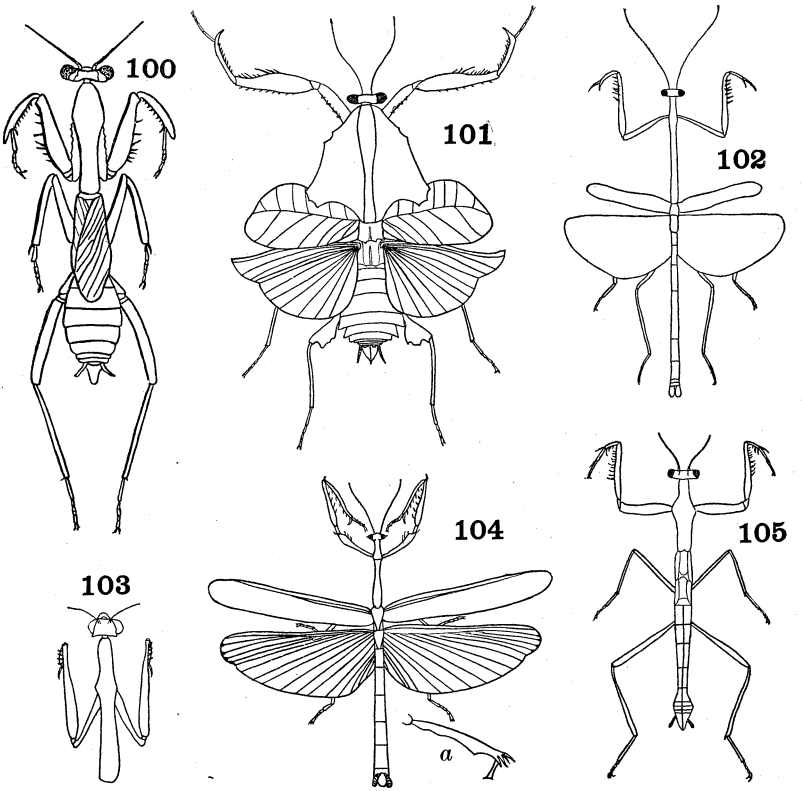
   Head of normal form, with protuberant eyes; jaws not directed forwards; stouter species with the thorax comparatively short. (**Perlamántis**, palæarc.; **Amorphóscelis**, ethiop., As., Austr.). (*AMORPHOSCELÌNÆ*) ..... **PERLAMANTÌNÆ**

5. Front femora with the spines of the internal row equal or alternately long and short 6

   Front femora with the spines of the internal row arranged so that the long spines are separated from one another by a series of three short ones. Usually large species, with the antennæ bipectinate in the male and the vertex prolonged into a more or less conical protuberance. (Fig. 106). (**Empùsa**, palæarc.; **Idolomórpha**, ethiop.; **Blepharópsis**, ethiop. As.; **Blepharòdes, Idòlum**, ethiop.) ..... **EMPUSÌNÆ**

[1] The Mantidæ include an extensive series of very diverse forms and have been grouped into a large number of subfamilies by Giglio-Tos whose divisions have been generally accepted. These together with several others of equal importance may be distinguished by the following key which follows the arrangement of Giglio-Tos. It seems probable that the Mantodea will soon be regarded as comprising several families.

6. Hind tibiæ carinate above, or bearing several ridges.....7
Hind tibiæ smooth, not carinate or ridged.....8



Figs. 100–105. **Mantodea**

100. **Stagmomantis** (Rehn and Hebard) Mantidæ.
101. **Deroplatys** (Westwood) Mantidæ.
102. **Angela** (Saussure and Pictet) Mantidæ.
103. **Hoplocorypha** (Rehn) Mantidæ.
104. **Toxodera.** *a*, hind femur of same (Westwood) Mantidæ.
105. **Oligonyx** (Saussure and Pictet) Mantidæ.

7. Hind tibiæ bearing three ridges; body brilliantly metallic; front femora short and broad, with a very stout basal spine; stout species with short prothorax. (Fig. 108). (**Metallýticus**, indomal.).....**METALLYTICÌNÆ**

Hind and middle tibiæ with one or two carinæ above, except rarely in the male; prothorax long. (Fig. 111). (**Oxyópsis, Pseudóxyops, Vàtes, Stagmatóptera,** neotrop.; **Stenovàtes, Pòpa,** ethiop.; **Æthalóchroa, Ceratocrània,** indomal.) . . **VATÌNÆ**

8. Front femora externally with a series of five to seven spines. 9
Front femora with four spines in the external row. 19

9. Front femora with the first discoidal spine longer than the second; very long bodied, slender species. (**Schizocéphala,** indomal.; **Euchomenélla,** Ind.; **Agrionópsis,** ethiop.; **Ángela** (Fig. 102), neotrop.). (*ANGELÌNÆ*) . . . . . **SCHIZOCEPHALÌNÆ**
Front femora with the first discoidal spine shorter than the second 10

10. Cerci flattened, dilated apically and more or less leaf-like; very elongate, slender species, with the front femora thin. (Fig. 104). (**Toxódera, Eùthyphleps, Loxomántis,** indomal.; **Calamothéspis, Belomántis,** ethiop.; **Stenophýlla,** neotrop.). **TOXODERÌNÆ**
Cerci conical or compressed, not leaf-like. 11

11. Front femora with three discoidal spines. 12
Front femora with four discoidal spines. 14

12. Front tibiæ with more than eleven spines in the outer row; front femora with five external and three discoidal spines; small species. (**Acontísta, Tithròne, Astóllia, Callíbia,** neotrop.). **ACONTISTÌNÆ**
Front tibiæ with from eight to eleven spines in the outer row. . . 13

13. Frontal shield transverse; pronotum at least as long as the front coxæ, ovally dilated or sometimes with the sides more or less parallel. (**Brunnèria, Macromántis, Photìna, Orthoderélla,** neotrop.; **Ìris,** widespr.) . . . . . **PHOTINÌNÆ**
Frontal shield subquadrate. (See couplet 23). **EREMIAPHILÌNÆ,** part

14. Supra-anal plate very long, lanceolate; hind femora and tibiæ with a few small spines beneath; body slender; pronotum as long as the front coxæ. (**Bolivària, Geomántis, Rivetìna** (=*Fischeria*), palæarc.; **Deíphobe,** indoaustr.; **Ischnomántis, Omomántis,** ethiop.). (*FISCHERIÌNÆ*) . . . . . **RIVETÌNÆ**
Supra-anal plate short. 15

15. Front tibiæ with six to eleven spines in the outer row. 16
Front tibiæ with more than eleven spines in the outer row. 17

16. Front femora very broad, elliptical, with the upper margin strongly arcuate; vertex conically elevated with a tubercle on each side next to the eye; pronotum shorter than the front coxæ or barely as long, with conical tubercles on the disk; small species. (**Oxypìlus, Euoxypìlus,** ethiop.; **Pachymántis, Ceratomántis, Pseudoxypìlus,** indomal.) . . . . . **OXYPILÌNÆ**

Front femora narrower, more or less triangular; pronotum with rounded lateral dilatations that give it a trifoliate appearance; small species. (**Dystácta, Gonypetélla, Achlæna, Telomántis,** ethiop.) ..... **DYSTACTÌNÆ**

17. Eyes acuminate, or the hind femora lobate; moderate-sized species colored like dry leaves. (**Metília, Decímia, Acánthops, Epaphrodìta,** neotrop.; **Phyllocrània,** ethiop.; **Parablépharis,** mal.) ..... **EPAPHRODITÌNÆ**

Eyes rounded, or the hind femora simple 18

18. Frontal shield transverse (see couplet 13) .. **PHOTINÌNÆ,** part
Frontal shield subquadrate (see couplet 23).
EREMIAPHILÌNÆ, part

19. Front coxæ with a minute apical lobe at the front margin 20
Front coxæ without apical lobe 21

20. Front femora triangular, broad, not more than three times as long as wide; small species, the female often wingless. (**Pseudomiópteryx, Mantíllica, Diabántia, Miobántia,** neotrop.).
PSEUDOMIOPTERYGÌNÆ
Front femora slender, more than three times as long as broad; pronotum long and narrow, not noticeably dilated; small slender species. (Fig. 103). (**Musoniélla, Musònia, Diamusònia, Théspis,** neotrop.; **Hoplocórypha,** ethiop.).... **THESPÌNÆ**

21. Front femora with the two intermediate spines of the outer row longer than the others; pronotum longer than the front coxæ; fore wings long in the male, short in the female; body usually very slender. (See couplet 9) .. **SCHIZOCEPHALÌNÆ,** part
Front femora with the two intermediate spines of the outer row not longer than the others 22

22. Front tibiæ with four or five spines in the outer row 23
Front tibiæ with more than five spines in the outer row 25

23. Front femora with the groove that receives the tibial claw remote from the base 24
Front femora with the claw groove close to the base. (**Eremiáphila,** palæarc.; **Tarachòdes, Galépsus, Tarachódula,** ethiop.; **Parepiscòpus, Didymocórypha,** indomal.). (*ORTHODERÌNÆ, TARACHODÌNÆ*) ..... **EREMIAPHILÌNÆ**

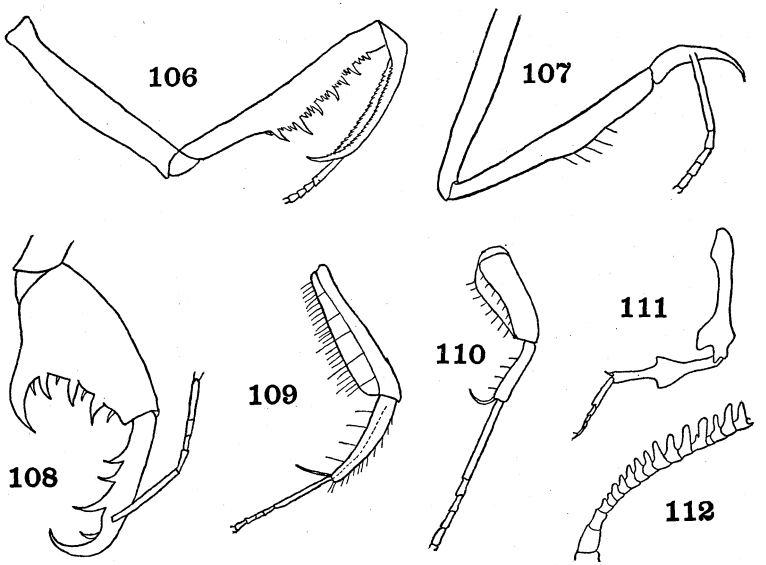
24. Vertex not produced (see couplet 20) ..... **THESPÌNÆ,** part
Vertex produced into an elongate, triangular process. (**Pyrgomántis,** ethiop.) (see couplet 23).. **EREMIAPHILÌNÆ,** part

25. Lateral margins of pronotum parallel or divergent in front (see couplet 23). (**Humbertiélla, Theopómpula,** indomal.; **Elæa, Theopómpa,** ethiop.) ..... **EREMIAPHILÌNÆ,** part
Lateral margins of pronotum more or less convergent in front.. 26

26. Front tibiæ with the spines in the outer row erect and remote from one another 27

Front tibiæ with the spines in the outer row decumbent and very close together.....50

27. Front femora with from one to three discoidal spines.....28
Front femora with four discoidal spines.....29



Figs. 106–112. **Mantodea**

106. **Empusa,** front leg (Westwood) Mantidæ.
107. **Compsothespis,** front leg (Westwood) Mantidæ.
108. **Metallyticus,** front leg (Westwood) Mantidæ.
109. **Chæteessa,** front leg (Westwood) Mantidæ.
110. **Mantoida,** front leg (Westwood) Mantidæ.
111. **Vates,** hind leg (Saussure and Pictet) Mantidæ.
112. **Vates,** base of antenna of male (Saussure and Pictet) Mantidæ.

28. Internal apical lobes of the front coxæ divergent, not dilated into a small lobe at the tip; small species. (**Tarachìna, Bólbula, Enicophlæbia,** ethiop.; **Bólbe, Ciulfìna,** Austr.; **Haplopèza, Iridópteryx, Fulciniélla, Eomántis,** indomal.).
IRIDOPTERYGÌNÆ

Internal apical lobes of the front coxæ contiguous. (See couplet 14)
RIVETÌNÆ, part

29. Front femora with a well marked fovea or pit between the first and second spines of the outer row.....30
Front femora without such a fovea.....34

30. Front femora with the discoidal spines forming a sinuous line; species of moderate size, with short, stout body, the pronotum broad and depressed. (**Gonatísta, Liturgùsa,** neotrop.; **Dactylópteryx,** ethiop.; **Gonatistélla,** Austr.).
LITURGUSÌNÆ

Front femora with the discoidal spines placed in a straight line. .31

31. Spines of outer row on front femora very long and curved. 32
Spines of outer row on front femora shorter, straight; slender-bodied species, with the wings well developed in both sexes. (**Árria,** malay.; **Sibýlla, Presibýlla,** ethiop.). . **SIBYLLÌNÆ**

32. Pronotum with two tubercles near the base of its posterior portion 33
Pronotum simple, without tubercles; slender or very slender species, with well developed wings in both sexes. (**Calìris,** Ind.; **Leptomántis,** malay.; **Deromántis,** ethiop.).
CALIRIDÌNÆ

33. Hind femora with a small lobe or tooth below near tip; more or less stout and short-bodied species with strongly prominent eyes. (**Majánga,** ethiop.; **Majangélla,** malay.). . . . **MAJANGÌNÆ**
Hind femora simple, without such projection; body slender, flattened, the eyes moderately prominent. (**Mellìera,** neotrop.; **Mellieriélla,** Austr.). . . . . **MELLIERÌNÆ**

34. Vertex produced into an elongate process (see couplet 6).
OXYPILÌNÆ, part
Vertex not elongated or produced. 35

35. Four posterior tibiæ or their femora minutely spinulose below. .36
Four posterior tibiæ and femora with the lower edge smooth. . .37

36. Frontal shield transverse; discoidal portion of hind wings not banded. (See couplet 14) . . . . . **FISCHERIÌNÆ,** part
Frontal shield scarcely broader than high; discoidal portion of hind wings with black cross-bands; pronotum at least as long as the front coxæ. A cosmopolitan group. (Fig. 100). (**Mántis,** palæarc., Austr.; **Stagmomántis,** Am. (*S. carolìna,* Carolina mantis); **Auromántis, Uromántis,** neotrop.; **Calidomántis, Sphodromántis,** ethiop.; **Tenódera** (*T. sinénsis,* Chinese mantis), **Polyspolòta,** widespr.; **Sphodrópoda,** Austr.).
MANTÌNÆ

37. Lateral margins of pronotum strongly expanded, leaf-like. 38
Lateral margins of pronotum not expanded. 40

38. Posterior femora simple. 39
Posterior femora lobed; large, brown, leaf-like species with conspicuous foliaceous expansions at the sides of the pronotum and at the tips of the four posterior femora. (Fig. 101). (**Deróplatys,** E. As.; **Brancsíkia,** Madagasc.).
DEROPLATÌNÆ

39. Hind metatarsi simple, not carinate; large species with the pronotum bearing leaf-like expansions at the sides. (**Chœradòdis,** neotrop., indomal.).....**CHŒRADODÌNÆ**
Hind metatarsi carinate. (See couplet 36) .... **MANTÌNÆ,** part
40. Eyes produced laterally to form a conical, spiniform process; body very slender, filiform. (**Oxyothéspis,** ethiop., As.; **Heterochætula,** malay.) .....**OXYOTHESPÌNÆ**
Eyes rounded laterally 41
41. Fore wings and antennæ of the male ciliate.....42
Fore wings and antennæ of the male not ciliate.....44
42. Pronotum linear or extremely slender; small species; the female apterous. (**Miópteryx, Promiópteryx, Chloromiópteryx,** neotrop.) ..... **MIOPTERYGÌNÆ**
Pronotum more or less expanded.....43
43. Pronotum almost trilobed, the angulations of the expansions somewhat acuminate; fore wings of male broad (see couplet 16). **DYSTACTÌNÆ,** part
Pronotum more or less elliptical, the angulations of the expansions rounded; elytra narrow. (See couplet 45) ... **AMELÌNÆ,** part
44. Pronotum shorter than the front coxæ.....45
Pronotum as long as or longer than the front coxæ.....46
45. Hind wings not colored; small species. (**Ámeles, Pseudoyersínia** palæarc.; **Yersínia, Litaneùtria,** neotrop.; **Amántis, Myrcìnus, Gonýpeta,** indomal.; **Metentélla, Ligària,** ethiop.). **AMELÌNÆ**
Hind wings brightly colored, otherwise similar to the Amelinæ. (**Compsomántis, Opsomántis,** malay.). **COMPSOMANTÌNÆ**
46. Front tibia with the sixth spine from the apex in the outer row longer than the fifth. (See couplet 32).. **CALIRIDÌNÆ,** part
Front tibia with the sixth spine not longer than the fifth.....47
47. Eyes produced laterally to form a conical, spiniform process. (See couplet 40)..... **OXYOTHESPÌNÆ,** part
Eyes not thus spined.....48
48. Front femora with the first spine in the discoidal row not shorter than the second; large species of elongate form; wings large in male, short in female. (**Archimántis, Rheomántis, Pseudomántis,** Austr.) .....**ARCHIMANTÌNÆ**
Front femora with the first discoidal spine shorter than the second 49
49. Supra-anal plate very long, lanceolate; large species with the pronotum much longer than the front coxæ. (**Solýgia,** ethiop.). **SOLYGIÌNÆ**
Supra-anal plate short. (See couplet 36).... **MANTÌNÆ,** part
50. Pronotum slender, as long as the front coxæ.....51

Pronotum more or less broadened, shorter than the front coxæ; body more or less short and stout; wings well developed in both sexes. (**Odontomántis, Hestiásula, Creobròter**, Ind.; **Otomántis, Panúrgica, Harpagomántis**, ethiop.). (*CREOBROTÌNÆ*) ..... **HYMENOPODÌNÆ**

51. Margins of pronotum broadly laminate (see couplet 17). **EPAPHRODITÌNÆ**, part

Margins of pronotum not broadly laminate; species of moderate size, with slender pronotum which is at least as long as the front coxæ. (**Anaxárcha, Acromántis, Citharomántis**, indomal.; **Theomántis, Sigérpes, Anasigérpes**, ethiop.). **ACROMANTÌNÆ**

LITERATURE ON MANTODEA

GIGLIO-TOS, E. Mantidi Esotici, I–XII. Boll. Soc. Entom. Italiana (1911–17). (Various parts.)

Saggio di una nuova classificazione dei Mantidi. Boll. Soc. Entom. Italiana, **49**, pp. 50–87 (1919).

Mantidæ, Perlamantinæ. Gen. Insectorum, fasc. 144, 13 pp. (1913).

Mantidæ, Eremiaphilinæ. Gen. Insectorum, fasc. 177, 36 pp. (1921).

Mantidæ. Das Tierreich, Lief. 50, 707 pp. (1927).

KIRBY, W. F. A Synonymic Catalogue of the Orthoptera. Vol. 1. British Mus. Nat. Hist., London (1904).

REHN, J. A. G. Mantidæ. Vatinæ. Gen. Insectorum, fasc. 119, 28 pp. (1911).

SAUSSURE, H. Essai d'un Système des Mantides. Mittheil. schweiz. Entom. Ges., **3**, pp. 49–73 (1869).

TINDALE, N. B. Review of Australian Mantidæ. Rec. South Australian Mus., **2**, pp. 425–457 (1923).

WESTWOOD, J. O. Revisio Mantidarum. London (1889).

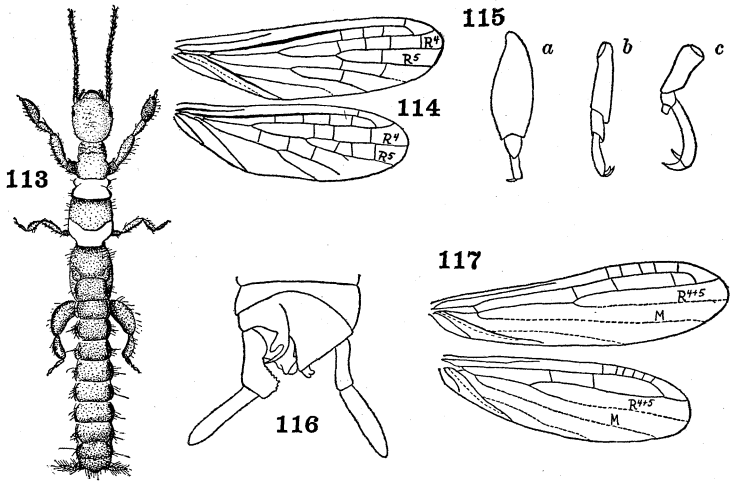
ORDER **EMBIÒDEA**

(*EMBIIDÌNA, EMBIÒIDEA, EMBIÓPTERA, OLIGONEÙRA, ÆTIÓPTERA*)

Elongate, slender, feeble insects of small or moderate size. Head large, elongate; eyes small or of moderate size; ocelli absent; antennæ slender, many-jointed (16–32). Thorax elongate; prothorax large, free; meso- and metathorax each about as large as the prothorax; males usually winged, females always wingless. Wings similar, pubescent, elongate, the media and cubitus much reduced; no anal fan or lobe. Wings lying flat on the abdomen when at rest. Abdomen ten-segmented; long, narrow and with parallel sides; tip of abdomen and cerci usually strongly asymmetrical in the male; cerci two-jointed.

Tarsi three-jointed; first joint of front tarsi swollen, containing glands for spinning a silken web in which the insects live.

Metamorphosis gradual, incomplete. A small group, restricted to the tropics and subtropics.



Figs. 113–117. **Embiodea**

113. **Oligotoma,** female (Melander) Oligotomidæ.
114. **Donaconethis,** wings (Enderlein) Embiidæ.
115. **Rhagadochir.** *a*, front tarsus; *b*, middle tarsus; *c*, hind tarsus (Silvestri) Embiidæ.
116. **Rhagadochir,** apex of abdomen of male (Enderlein) Embiidæ.
117. **Oligotoma,** wings (Enderlein) Oligotomidæ.

1. Posterior branch of the radial sector forked in both wings, or at least in the hind wing, *i.e.* both R_4 and R_5 developed (Figs. 114, 115, 116); sternite of first abdominal segment of female large. (**Émbia, Haploémbia,** widespr.; **Rhagádochir,** ethiop., neotrop.; **Antipalùria, Clothòda,** neotrop.; **Donaconèthis,** ethiop.). (including *OLÝNTHIDÆ*) . . . . . **EMBÌIDÆ**

Posterior branch of the radial sector simple in both wings, *i.e.* R_4 and R_5 fused (Fig. 117); sternite of first abdominal segment of female greatly reduced in size. (Fig. 113). (**Oligótoma,** cosmop. ;**Teratémbia,** neotrop.). (Including *TERATEMBÌIDÆ*). **OLIGOTÓMIDÆ**

LITERATURE ON EMBIODEA

ENDERLEIN, G. Embiidinen. Coll. Zool. Selys-Longchamps, fasc. 3 (1912).

HAGEN, H. A Monograph of the Embidina. Canadian Entom., **17**, pp. 142–155 (1885).

KRAUSS, H. A. Monographie der Embien. Zoologica, Heft 60, 78 pp. (1911).

NAVÁS, L. Embiópteros de la America meridional. Brotéria, **16**, pp. 85–110 (1919).

TILLYARD, R. J. The Embioptera or Web-spinners of Western Australia. Journ. Roy. Soc. West Australia, **9**, pp. 61–68 (1923).

VERHOEFF, K. W. Zur vergleichende Morphologie und Systematik der Embiiden. Act. Acad. Leopold. Carol., **82**, pp. 145–204 (1904).

ORDER **ISÓPTERA**

Small or medium-sized, elongate, feeble insects living in large colonies and occurring as winged sexual individuals and wingless workers and soldiers; usually with weak chitinization, especially in the sterile castes which are soft-bodied and white, except for the heavily chitinized head. Head large, free, rather vertical; eyes and two ocelli usually present in the winged forms, or absent in the workers. Mandibles strong, often very large; antennæ filamentous, more or less moniliform. Prothorax free, but much smaller than the head. Legs similar, formed for running or walking; tarsi four- or rarely five-jointed, with well developed claws. Wings similar, long and narrow, deciduous soon after maturity at a preformed transverse suture near the base; long and narrow, superimposed over the abdomen, the hind pair very rarely with an anal area; venation almost always much reduced and without crossveins. Cerci short, one- to three-, rarely eight-jointed. Metamorphosis very incomplete. White ants, Termites.

Males and Females

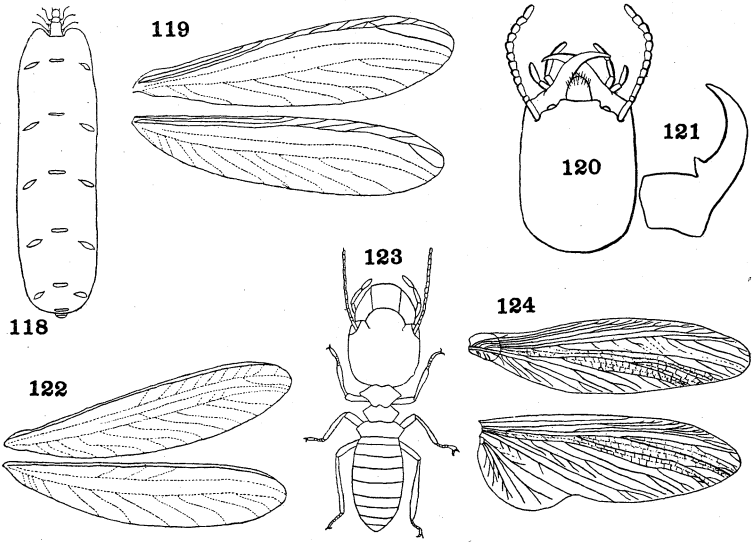
1. Tarsi four-jointed in all castes, sometimes with the indication of a fifth joint; fore and hind wings similar, narrow, the hind pair without anal lobe; transverse basal suture present on all four wings 2

   Tarsi five-jointed; hind wing with a well developed anal area which is capable of being folded beneath the remainder of the wing; transverse basal suture present only on fore wing. (**Mastotérmes**, Austr.) (Fig. 124) ..... **MASTOTERMÍTIDÆ**

2. Radius with one or more superior branches forming a costal field; clypeus not divided by a median line; fontanel (the opening of the frontal gland on the face) absent 3

Radius simple, not branched; clypeus divided by a median line; fontanel usually present 4

3. Ocelli present; empodium present between the tarsal claws; pronotum large, wider than the head; wing stubs of the front wing much larger than those of the hind wing and overlapping them;



Figs. 118–124. **Isoptera**

118. **Termes,** queen (Hegh) Termitidæ.
119. **Calotermes,** wings (Calotermitidæ).
120. **Eutermes,** head of worker. Termitidæ.
121. **Eutermes,** mandible of worker. Termitidæ.
122. **Reticulitermes,** wings (Banks) Rhinotermitidæ.
123. **Termes,** worker (Hegh) Termitidæ.
124. **Mastotermes,** wings (Desneux) Mastotermitidæ.

antennæ with 13 to 23 joints; tibiæ with three apical spines. (**Calotérmes** (Fig. 119), **Neotérmes, Cryptotérmes,** cosmop.). (*PROTERMÍTIDÆ,* part) ..... **CALOTERMÍTIDÆ**

Ocelli absent; empodium absent; pronotum narrower than the head; wing stubs of fore wings shorter, not overlapping those of the hind pair; antennæ with 23 to 27 joints; usually more than three (3–5) apical spines on the tibiæ. (**Hodotérmes,** ethiop.;

Anacanthotérmes, palæarc., Indo-malay.; **Termópsis**, nearc.). (*PROTERMÍTIDÆ*, part)..... **HODOTERMÍTIDÆ**

4. Wings transparent, without hairs, their margins not ciliate; venation in posterior part of wing indistinct, more or less reticulate; front wing stub large. (**Rhinotérmes**, neotrop.; **Coptotérmes, Schedorhinotérmes**, widespr.; **Reticulitérmes** (Fig. 122), holarc., Indo-malay.). (*MESOTERMÍTIDÆ*). **RHINOTERMÍTIDÆ**

Wings more or less opaque, their outer and hind margins ciliate, or at least the wing membrane hairy near the margin; venation distinct on posterior portion of wing; front wing stub never large. (**Microtérmes, Amitérmes, Microcerotérmes, Nasutitérmes**, widespr.; **Térmes**, ethiop., Indo-malay.; **Procubitérmes**, ethiop.; **Capritérmes**, Indo-malay.; **Neocapritérmes**, neotrop., ethiop.). (Figs. 118, 120, 121, 123). (*METATERMÌTIDÆ*) ..... **TERMÍTIDÆ**

Soldiers

1. Tarsi distinctly five-jointed ..... **MASTOTERMÍTIDÆ**
   Tarsi four-jointed, rarely with an indistinct fifth joint.....2
2. Fontanel absent; eyes present; mandibles often with very strong teeth 3
   Fontanel present; eyes entirely absent or rarely slightly indicated.....4
3. Compound eyes usually very distinct, black, rarely not pigmented; antennæ with 23 to 31 joints; legs rather long and weak, extending well beyond body; cerci prominent, usually with three or more joints ..... **HODOTERMÍTIDÆ**
   Compound eyes present as white, rarely pigmented, finely faceted spots; antennæ with 10 to 20 joints; cerci very short, with two, or rarely, three joints..... **CALOTERMÍTIDÆ**
4. Pronotum flat, without separated lobes in front; head not nasute; mandibles not toothed ..... **RHINOTERMÍTIDÆ**
   Pronotum saddle-shaped, with distinct lobes in front; head either nasute or with toothed mandibles..... **TERMÍTIDÆ**

LITERATURE ON ISOPTERA

BANKS, N. Antillean Isoptera. Bull. Mus. Comp. Zoöl., Harvard, **62**, pp. 475–489 (1919).

A Revision of the Nearctic Termites. Bull. U. S. Nat. Mus., No. 108 (1920).

DESNEUX, J. Termitidæ. Gen. Insectorum, fasc. 25, 52 pp. (1905).

EMERSON, A. E. Termites of Kartabo, British Guiana. Zoölogica, New York, **6**, pp. 291–459 (1925).

FROGGATT, W. W. Australian Termitidæ. Proc. Linn. Soc. New South Wales, **10–12** (1895–97) (several parts).

FULLER, C. The Termites of South Africa. South African Journ. Nat. Hist., **3**, pp. 14–52; 70–130 (1921–22).

HEGH, E. Les Termites. Brussels, 756 pp. (1922). Republished with additions in Bull. Agric. Congo Belge, Brussels, **11–14** (1920–23).

HOLMGREN, N. Termitenstudien. I–IV. König. Svensk. Vet. Akad. Handl., **44**, **46**, **48**, **50** (1909–13).

HOZAWA, S. Revision of the Japanese Termites. Journ. Coll. Agric. Tokyo, **35**, pt. 7, 161 pp. (1915).

SILVESTRI, F. Termiti e termitofili dell' America meridionale. Redia, **1**, pp. 1–234 (1903).

Termiti e termitofili dell' Eritrea. Redia, **3**, pp. 341–359 (1906).

Termitidi e termitofili dell' Africa occidentale. Boll. Lab. Zool. Agrar. Portici, **9**, **12** and **14** (1914–20).

SJÖSTEDT, Y. Monographie der Termiten Afrikas. Svensk. Vet. Akad. Handl., **34** and **38** (1900–04).

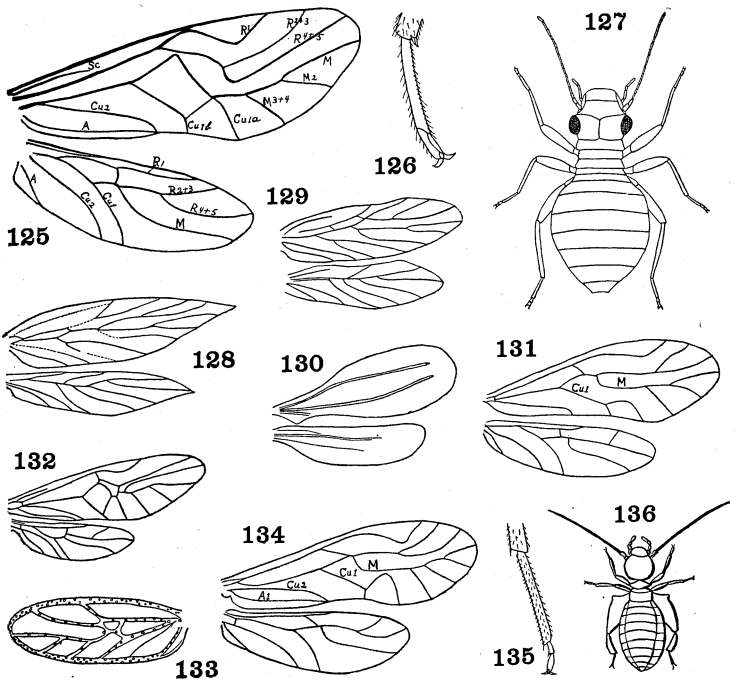
Revision der Termiten Afrikas. K. Svenska Vet. Akad. Handl., (3), **3**, 419 pp. (1926).

ORDER **CORRODÉNTIA**

(*PSOCÓPTERA, COPEÓGNATHA*)

Usually small or minute insects, rarely of moderate size, with short, soft body and usually winged. Head large, free, vertical, with a strong Y-shaped suture above; eyes large and prominent, except in a few wingless forms; three ocelli generally present; antennæ long and slender, filiform or bristle-like, many (13–50) jointed; mandibles strong, toothed and with a grinding surface. Prothorax almost always very small; mesothorax and metathorax usually separated, although rarely completely fused. Wings usually ample, sometimes much reduced or entirely absent; when at rest generally held in a sloping position, folded backwards over the body; fore pair larger than the hind pair, sometimes scaly or hairy; venation reduced, with few or no crossveins; one or several of the veins frequently strongly curved. Abdomen usually short, with nine or ten segments; cerci absent. Legs similar, fitted for running, the coxæ close together; tarsi two- or three-jointed, the first joint very long; two tarsal claws. Metamorphosis incomplete, the nymph similar to the adult form; terrestrial in all stages. Psocids, Book lice, Bark lice.

1. Tarsi three-jointed. (Fig. 135). (TRÍMERA).....2
   Tarsi two-jointed. (Fig. 126). (DÍMERA).....10



Figs. 125–136. **Corrodentia**

125. **Psocus,** wings (Comstock and Needham) Psocidæ.
126. **Cæcilius,** tarsus (Tillyard) Cæciliidæ.
127. **Lepinotus** (Tillyard) Atropidæ.
128. **Oxypsocus,** wings (Tillyard) Lepidopsocidæ.
129. **Perientomum,** wings (Enderlein) Perientomidæ.
130. **Embidotroctes,** wings (Kolbe) Troctidæ.
131. **Cæcilius,** wings (Tillyard) Cæciliidæ.
132. **Thyrsophorus,** wings (Enderlein) Thyrsophoridæ.
133. **Vulturops,** wings (Corbett and Hargreaves) Psoquillidæ.
134. **Mesopsocus,** wings (Tillyard) Mesopsocidæ.
135. **Myopsocus,** tarsus (Tillyard) Myopsocidæ.
136. **Troctes** (Marlatt) Troctidæ.

2. Thorax composed of three distinct parts, the mesothorax separated from the metathorax by a suture; usually winged, rarely with the wings reduced or absent.....3

Thorax composed of two parts, the meso- and metathorax fused and without suture between them; wings usually entirely absent, if present without forked veins; second joint of palpi without clubbed sense organs. (Figs. 130, 136). (**Tróctes** (= *Lipóscelis*) (*T. divinatòrius*, Book louse, Cereal psocid), cosmop.; **Tropùsia**, widespr.; **Pachytróctes**, palæarc.; **Embidopsòcus**, neotrop.; **Embidotróctes**, ethiop.). (*LIPOSCÉLIDÆ*) . . . **TRÓCTIDÆ**

3. Wings present; prothorax much smaller than the mesothorax. . . 4
Fore wings absent or very small and without venation; hind wings entirely absent; prothorax larger than the mesothorax. (**Átropos** (= *Tròpium*) (*A. pulsatòria*, Death watch), widespr.; **Lepinòtus** (Fig. 127), **Lepidílla, Leprólepis, Hypéretes**). (Including *LEPIDÍLLIDÆ, TROGÌIDÆ*) . . . . . **ATRÓPIDÆ**

4. Wings fully formed, with complete venation. 5
Venation of wings incomplete, the fore wings oval or rounded and much thickened; the veins usually very broad; hind wings reduced or absent; without scales. (**Psoquílla**, holarc.; **Psocinélla, Vúlturops**, Am.) (Fig. 133) . . . . . **PSOQUÍLLIDÆ**

5. Second branch of cubitus and first anal vein in fore wing meeting or closely approaching each other at apex (Fig. 134). 7
Second branch of cubitus and first anal vein in fore wing divergent toward apex, or at least not approaching each other; body and wings clothed with hairs or scales; wings more or less pointed; antennæ with more than thirteen joints (Fig. 128). 6

6. Hind wings with a very narrow closed cell at the base between the media and cubitus; wing scales of symmetrical form, similarly curved on their two sides; antennæ with 20 to 25 joints. (Fig. 129). (**Periéntomum**, Ind.) . . . . . **PERIENTÓMIDÆ**
Hind wings without a closed cell; wing scales usually asymmetrical; antennæ with 26 to 47 joints. (Fig. 128). (**Lepidopsòcus, Echinopsòcus, Echmépteryx, Oxypsòcus**). (*EMPHERÌIDÆ*) . . . . . **LEPIDOPSÓCIDÆ**

7. Antennæ 13-jointed. 8
Antennæ with 22 to 25 joints; body and wings not scaled; media two- or three-branched; prothorax visible from above. (**Phyllipsòcus, Psylloneùra, Deipnopsòcus, Rhyopsòcus**). **PHYLLIPSÓCIDÆ**

8. No scales on body or wings; only one anal vein in the fore wing. . 9
Body and wings scaled; two anal veins in the fore wing. (**Amphiéntomum**, ethiop., ind.; **Tineomórpha**, ind.; **Stigmatópathus, Cymatopsòcus**, indomal.) . . . **AMPHIENTÓMIDÆ**

9. Apex of cubitus in fore wing bent forward into a loop toward the media, but not touching it (Fig. 134); very small species. (**Hemineùra, Elipsòcus, Philotársus, Mesopsòcus, Psilopsòcus, Actenotársus**) ..... **MESOPSÓCIDÆ**

Cubital loop in fore wing either just touching the media, or fusing with it for a short distance (Figs. 134, 135); larger species. (**Myopsòcus, Propsòcus, Pentácladus, Photòdes, Lichenomìma, Tricladéllus**) ..... **MYOPSÓCIDÆ**

10. Prothorax well developed, visible from above; wings reduced in the female; of full size in the male, but with the venation incomplete. (**Archipsòcus,** Ind.) ..... **ARCHIPSÓCIDÆ**

Prothorax very small, not visible from above.....11

11. Apex of cubitus in fore wing not bent forward into a loop, or if thus bent the loop does not meet the media. (Figs. 126, 131). A cosmopolitan group. (**Cæcílius, Amphipsòcus, Callistóptera, Epipsòcus, Pterodèla**)..... **CÆCILÌIDÆ**

Apical part of cubitus bent forward into a loop that touches the media or fuses with it for a short distance.....12

12. Second branch of radial sector (R_{4+5}) fused with the media or connected with it by a crossvein (Fig. 132); third and fourth antennal joints lengthened, thicker and more densely hairy than the joints beyond; large species. (**Thyrsóphorus, Dictyopsòcus, Ischnópteryx,** neotrop.) .... **THYRSOPHÓRIDÆ**

Second branch of the radial sector free from the media; third and fourth antennal joints similar to the apical ones; moderate-sized or rather large species. An extensive and cosmopolitan group. (**Ceratipsòcus, Amphigeróntia, Eremopsòcus, Hemipsòcus, Lasiopsòcus, Psòcus, Tæniostígma**) (Fig. 125) ..... **PSÓCIDÆ**

LITERATURE ON CORRODENTIA

ENDERLEIN, G. Die Psocidenfauna Perus. Zool. Jahrb., Abth. f. Syst., **14**, pp. 133–160 (1900).

Morphologie, Gruppierung und systematische Stellung der Corrodentien. Zool. Anz., **26** (1903).

Die Copeognathen des indoaustralischen Faunengebietes. Ann. Mus. Hist. Nat. Hungarici, **1**, pp. 179–344 (1903).

Morphologisches System und Biologie der Atropinen und Troctinen. Jægerskiöld Zool. Exped. Egypt, No. 18, 58 pp. (1905).

Die australischen Copeognathen. Zool. Jahrb., Abth. f. Syst., **23**, pp. 401–412 (1906).

Die Copeognathenfauna Japans. Zool. Jahrb., Abth. f. Syst., **23**, pp. 243–256 (1906).

The Scaly-winged Copeognatha. Spolia Zeylandica, **4**, pp. 39–122 (1906).

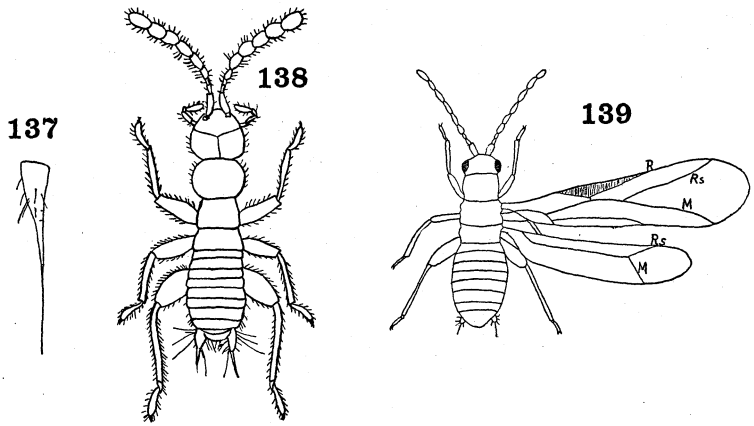
Copeognatha. In Tierwelt Mitteleuropas, **4**, Lief. 2, pp. VII 1–16 (1928).

KOLBE, H. Monographie der deutschen Psociden. Jahresber. zool. Sect. Westf. Ver., **8**, 1879–80, pp. 74–142 (1880).

TILLYARD, R. J. Monograph of Psocoptera or Copeognatha of New Zealand. Trans. New Zealand Inst., **54**, pp. 170–196 (1923).

ORDER **ZORÁPTERA**

Minute, terrestrial species of social habits, living in colonies; dimorphic, both sexes represented by winged and wingless individuals. Body depressed. Head free, somewhat inclined. Antennæ moniliform



Figs. 137–139. **Zoraptera**

137. **Zorotypus,** cercus (Karny) Zorotypidæ.
138. **Zorotypus** (Silvestri) Zorotypidæ.
139. **Zorotypus,** winged form (Caudell) Zorotypidæ.

or filiform, nine-jointed, the second and often also the third joint smaller than the others. Mandibles well developed, toothed and fitted for biting. Eyes and ocelli present in the winged form, absent in the wingless one. Thorax large, but no wider than the head; prothorax free, not concealing the head nor expanded laterally; meso- and metathorax distinctly separated. Abdomen elongate-oval, never much

longer than the thorax, with ten strongly transverse segments; cerci short, oval, one-jointed, with a bristle-like appendage at tip. Legs similar, formed for running; hind femora stout, armed beneath with several spiny bristles; tarsi two-jointed, the first joint short. Metamorphosis gradual, the nymph similar to the adult, especially to the wingless form. Winged form with narrow, membranous wings, the fore pair larger; venation greatly reduced; wings commonly falling off after maturity, leaving a stub attached to the body, but not separating at a preformed suture; body of winged form more heavily chitinized than in the wingless one.

One family. (**Zorótypus**, nearc., neotrop., indomal., ethiop., Hawaii). (Figs. 137, 138, 139) ..... **ZOROTÝPIDÆ**

LITERATURE ON ZORAPTERA

CAUDELL, A. N. Zoraptera not an Apterous Order. Proc. Entom. Soc. Washington, **22**, pp. 84–97 (1920).

SILVESTRI, F. Descrizione di un nuova ordine di insetti. Boll. Zool. Gen. Agrar. Portici, **7**, pp. 193–209 (1913).

ORDER **MALLÓPHAGA**

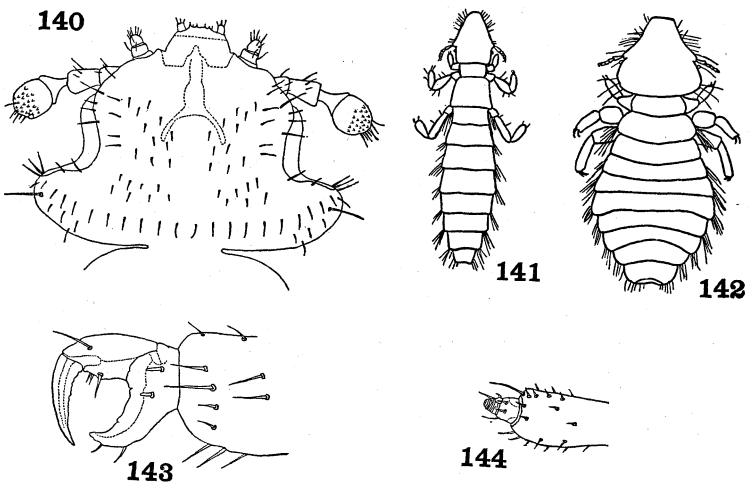
(*LIPÓPTERA*)

Small wingless insects averaging two mm. and very rarely over five mm. in length. Body oval, or elongate, very strongly flattened; usually strongly chitinized and generally with a conspicuous color pattern of pale or yellowish markings contrasting with spots or bands of dark brown or black. Mouth inferior, mandibles strong; antennæ three- to five-jointed; prothorax free, rarely fused with the mesothorax; legs short, no cerci. Metamorphosis very incomplete. External parasites of birds, more rarely of mammals, during entire life, feeding on feathers, fur or skin. Bird lice, Biting lice.

1. Palpi present, two- to four-jointed; antennæ usually four-jointed and generally more or less distinctly clavate or capitate (Fig. 140), concealed in a groove on the underside of the head; mandibles horizontal; meso- and metathorax usually separated by a suture. (Suborder AMBLÝCERA) 2

   Palpi absent; antennæ three- or five-jointed, filiform, not concealed; mandibles vertical; meso- and metathorax fused. (Suborder ISCHNÓCERA) 7

2. Tarsi with two claws; species usually infesting birds.....3
Tarsi with at most a single claw on the middle and hind legs, and usually on the front pair also, although these rarely bear two claws; claw rarely wanting (Fig. 144); some of the legs almost always modified to form hair claspers. (**Gỳropus, Protogỳropus, Monogỳropus, Glirícola,** on guinea pigs and other rodents, mainly neotropical)..... **GYRÓPIDÆ**



Figs. 140–144. **Mallophaga**

140. **Gyropus,** head (Ewing) Gyropidæ.
141. **Lipeurus** (Paine) Philopteridæ.
142. **Philopterus** (Paine) Philopteridæ.
143. **Gyropus,** tip of front leg (Ewing) Gyropidæ.
144. **Gliricola,** tip of front leg (Ewing) Gyropidæ.

3. Antennæ strongly clubbed, five-jointed; legs long and slender; body clothed with stiff, slender spines; species infesting Australian kangaroos and wallabies. (**Boòpia, Heterodóxus, Latumcéphalum**) ..... **BOOPÌIDÆ**
Antennæ not strongly clubbed, four-jointed.....4
4. Prothorax appearing like the metathorax inverted, usually fused with the mesothorax; only five abdominal segments with spiracles. (**Triménopon, Philandèsia, Cummíngsia**; neotropical on rodents)..... **TRIMENOPÓNIDÆ**
Prothorax not appearing like the metathorax inverted.....5

5. Head evenly expanded behind, broadly triangular and strongly enlarged on the temples. (**Ménopon**, widespr. (*M. gallìnæ*, Chicken louse); **Colpocéphalum, Myrsídea, Trinòton**, widespr.; on birds) ..... **MENOPÓNIDÆ**

Head not evenly expanded and broadly triangular, not enlarged on the temples 6

6. Sides of head with a strong lateral swelling in front of the eye; spiracles on abdominal segments three to eight. (**Læmobóthrion**, holarc., ethiop., neotrop.; on birds). **LÆMOBOTHRÌIDÆ**

Head with the sides straight or concave; spiracles on abdominal segments two to seven. (**Rìcinus** (=*Leiótheum*), widespr.; **Trochilœcètes**, Am.; on birds). (*LEIOTHÈIDÆ*). **RICÍNIDÆ**

7. Tarsi with one claw; antennæ three-jointed; species infesting mammals. (**Trichodéctes, Eutrichóphilus**, widespr.). **TRICHODÉCTIDÆ**

Tarsi with two claws; antennæ five-jointed 8

8. Species infesting birds 9

Species infesting mammals; head heavily chitinized at the sides and armed with strong hooks; last joint of antennæ somewhat swollen or clubbed. (**Trichophilópterus**). **TRICHOPHILOPTÉRIDÆ**

9. Meso- and metathorax clearly separated by a suture; eyes deeply constricted. (**Nesiotìnus**, Kerguelen Is., on penguins). **NESIOTÍNIDÆ**

Meso- and metathorax not separated by a distinct suture. (**Goniòdes, Goniocòtes, Lipeùrus** (Fig. 141), **Philópterus** (Fig. 142), **Degeeriélla, Esthiópterum**, widespr.; **Apterícola**, N. Zeal.; on birds) ..... **PHILOPTÉRIDÆ**

LITERATURE ON MALLOPHAGA

DENNY, H. Monographia Anoplurorum Brittanniæ. London (1842).

ENDERLEIN, G. Mallophaga. In Tierwelt Mitteleuropas, **4**, Lief. 2, pp. VII 17–24 (1928).

EWING, H. E. Taxonomy, Biology and Distribution of Gyropidæ. Proc. U. S. Nat. Mus., **63**, art. 20, pp. 1–42 (1924).

FERRIS, G. F. The Mallophagan Family Trimenoponidæ. Parasitology, **14**, pp. 75–86 (1922).

The Mallophagan Family Menoponidæ. I. Parasitology, **16**, pp. 55–66 (1924).

FULMEK, L. Die Mallophagen. Mitt. naturw. Ver. Univ. Wien, **5**, pp. 1–50 (1907).

GIEBEL, C. G. A. Insecta Epizoa. 308 pp. Leipzig (1874).

HARRISON, L. The Genera and Species of Mallophaga. Parasitology, **9**, pp. 1–156 (1916).

KELLOGG, V. L. Mallophaga. Gen. Insectorum, fasc. 66, 87 pp. (1908).

KELLOGG, V. L. and FERRIS, G. F. Anoplura and Mallophaga of North American Mammals. Leland Stanford Jr. Univ. Pub. (1915).

MJÖBERG, E. Studien über Mallophagen und Anopluren. Ark. f. Zool., **6**, No. 13, 297 pp. (1910).

A New Family and Three New Genera of Mallophaga. Entom. Tidskr., **40**, pp. 93–96 (1919).

TASCHENBERG, O. Die Mallophagen. Halle (1882).

ORDER **ANOPLÙRA**

(*SIPHUNCULÀTA, PSEUDORHYNCHÒTA, PARASÌTA, PHTHIRÁPTERA, ELLIPÓPTERA*)

Small, more or less flattened, wingless ectoparasites of mammals. Head free, horizontal; eyes reduced or absent; mouth anterior, comprising an unjointed, fleshy beak; antennæ short, simple. Thoracic segments fused. Legs very stout; tarsi single-jointed, forming a claw at the end of the tibia. No cerci. Metamorphosis very slight. True lice, Sucking lice, Cooties.

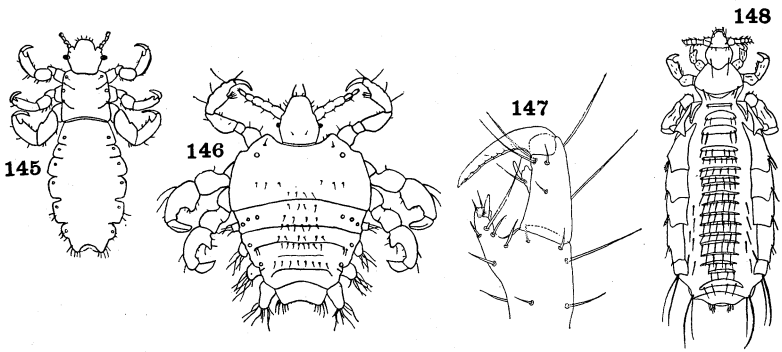
1. Body with spines or hairs arranged in definite rows, rarely also with scales; body flattened; spiracles only at each side of the mesothorax and on abdominal segments three to eight; antennæ three or five-jointed; living exclusively on terrestrial mammals 2

   Body thickly clothed with stout, thorn-like bristles or with spines and scales; body thick and stout; mesothorax and metathorax each with a pair of spiracles as well as abdominal segments two to eight; eyes absent; antennæ four- or five-jointed; living exclusively on marine mammals. (**Echinophthírius, Lepidophthírius, Antarctophthírius**) .. **ECHINOPHTHIRÌIDÆ**

2. Head rounded in front, not tubularly produced; tibiæ of at least one pair of legs below with a large tooth or thumb-like process opposing the claw-like tarsus 3

   Head tubularly produced anteriorly to form a beak longer than the remainder of the head; tibiæ without such a process opposing the tarsus. (**Hæmatomỳzus,** on elephants, Afr., E. Ind.). **HÆMATOMÝZIDÆ**

3. Eyes present, large, convex and almost always distinctly pigmented; proboscis short; tibia and tarsus without a distinct sclerite between them; pleural plates usually well developed. .4
Eyes absent or very indistinct; proboscis very long; legs with a chitinized sclerite between the tibia and tarsus; parasitic on a great variety of mammals but not on man. 5



Figs. 145–148. **Anoplura**

145. **Pediculus** (Patton and Cragg) Pediculidæ.
146. **Phthirius** (Patton and Cragg) Phthiriidæ.
147. **Pediculus,** tip of leg (Ewing) Pediculidæ.
148. **Hoplopleura** (Ferris) Hæmatopinidæ.

4. Segments three to five of abdomen fused as indicated by three pairs of spiracles on this apparent segment; sides of abdomen with segmentally placed lateral lobes; front legs much more slender than the others. (**Phthírius** (Fig. 146), on man (*P. pùbis,* Pubic or Crab louse)). . . . . **PHTHIRÌIDÆ**
Abdominal segments all free, as indicated by the position of their spiracles; sides of abdominal segments without such lateral lobes; front legs similar to the others, and scarcely more slender. (**Pedículus** (Figs. 145, 147), on man. Cooties. (*P. humànus,* Head louse; *P. vestiménti,* Body louse); **Pedícinus, Phthiripedícinus,** on monkeys) . . . . . **PEDICÙLIDÆ**
5. Antennæ five-jointed. (**Hæmatópinus,** on ungulates (*H. sùis,* Hog louse); **Hoplopleùra** (Fig. 148), on Rodentia; **Linógnathus,** on Artiodactyla and dogs; **Pólyplax,** on Rodentia and Insectivora) . . . . . **HÆMATOPÍNIDÆ**
Antennæ three-jointed. (**Hæmatopinòides,** on Geomys; **Hamophthírius,** on monkeys) . . . . . **HÆMATOPINÒIDIDÆ**

LITERATURE ON ANOPLURA

DALLA TORRE, K. W. Anoplura. Gen. Insectorum, fasc. 81, 22 pp. (1908).

DENNY, H. Monographia Anoplurorum Britanniæ. London (1842).

ENDERLEIN, G. Läuse-Studien. Zool. Anz., **27**, pp. 220–223 (1904); **28**, pp. 626–638 (1905).

EWING, H. E. Revision of the American Lice of the Genus Pediculus. Proc. U. S. Nat. Mus., **68**, Art. 19, pp. 1–30 (1926).

FERRIS, G. F. A Catalogue and Host List of the Anoplura. Proc. California Acad. Sci., (4) **6**, pp. 129–213 (1916).

Sucking Lice, a Monograph. Pt. I., Leland Stanford Jr. Univ. Pub. Univ. Ser. (1919); Pt. II., Stanford Univ. Pub. Univ. Ser. Biol. Sci., **2**, No. 2 (1921); Pt. III., No. 3 (1922); Pt. IV., No. 14 (1923).

GIEBEL, C. G. A. Insecta Epizoa. Leipzig, 308 pp. (1874).

KELLOGG, V. L. and FERRIS, G. F. Anoplura and Mallophaga of North American Mammals. Leland Stanford Jr. Univ. Pub. Univ. Ser. (1915).

NUTTALL, G. H. F. Classification of Anoplura. Parasitology, **11**, pp. 329–346 (1919).

PIAGET, E. Les Pédiculines. I., 714 pp. (1880); II., 162 pp. (1885) Leiden.

ORDER **HOMÓPTERA**

(*RHYNCHÒTA*, part)

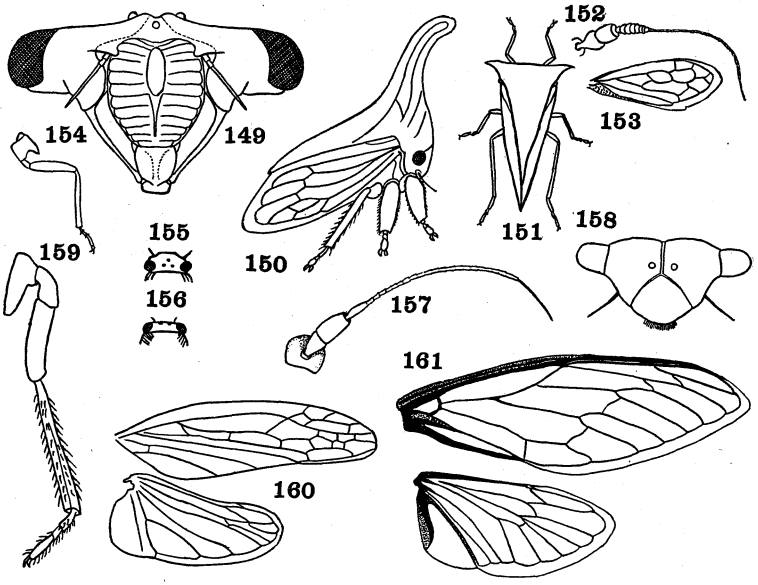
An assemblage of very diverse insects, difficult to define in a general way; usually of moderate or small size, rarely large; in the active forms four wings are present in both sexes; in the scale insects only the males are winged, and they have the hind wings absent; wings usually sloping over the sides of the body; fore wings never modified into a heavy basal and thinner apical portion; mouthparts forming a jointed beak, inserted at hind edge of the head and extending between the front coxæ, the basal joints very short, rarely the beak is absent in the males. Beak formed of the stylet-shaped mandibles and maxillæ which are enclosed in the labium. Cerci wanting. Metamorphosis usually incomplete, sometimes complete in the male or at least with a pupal stage in the male scale insects, rarely so in the female; all the species vegetarian.

1. Beak plainly arising from the base of the head; tarsi, at least of middle and hind legs, three-jointed, antennæ very short, with a small terminal bristle; active, free-living species. (Suborder AUCHENORRHÝNCHA) 2

   Beak appearing to arise between the front coxæ, rarely absent in male coccids and some aphids; tarsi two- or one-jointed; an-

tennæ usually well developed and thread-like, sometimes atrophied or absent, without conspicuous terminal bristle; species often incapable of moving, or inactive in the female sex. (Suborder STERNORRHÝNCHA). (*GULARÓSTRIA*)...41

Beak arising from the prothorax, sheathed at base by propleural structures; antennæ very short. (Suborder *COLEORRHÝNCHA*) 59



Figs. 149–161. **Homoptera**

149. **Cicada,** front view of head (Berlese) Cicadidæ.
150. **Entylia** (Branch) Membracidæ.
151. **Ceresa** (Marlatt) Membracidæ.
152. **Ceresa,** antenna (Marlatt) Membracidæ.
153. **Ceresa,** fore wing (Marlatt) Membracidæ.
154. **Cicada,** hind leg (Kolbe) Cicadidæ.
155. **Cicada,** dorsal view of head (Maxwell-Lefroy) Cicadidæ.
156. Leaf hopper, dorsal view of head (Maxwell-Lefroy) Jassidæ.
157. **Entylia,** antenna (Branch) Membracidæ.
158. **Entylia,** front view of head (Branch) Membracidæ.
159. **Entylia,** hind leg (Branch) Membracidæ.
160. **Gypona,** wings (Metcalf) Gyponidæ.
161. **Cicada,** wings. Cicadidæ.

2. Ocelli (rarely absent) placed between the eyes on the vertex, on the front margin of the head, or on the front; middle coxæ short and close together, hind coxæ movable; tegulæ absent; fore wings with the two anal veins more or less parallel, or the second absent 3

   Ocelli (rarely absent) placed beneath or near the eyes, usually in cavities of the cheeks; middle coxæ elongate, widely separate, hind coxæ immovable, fused externally with the metathorax; tegulæ present as a scale between the base of the fore wing and the side angle of the pronotum; fore wings usually with the two anal veins joining apically to form a Y-vein. (Superfamily FULGORÒIDEA. Classification from F. Muir, 1930)..... 24

3. Three ocelli, placed close together on the disk of the vertex; antennæ with short basal joint, terminated by a hair-like process which is divided into about five joints; front femora thickened and generally spined beneath, hind legs not fitted for jumping; empodia absent; male almost always with a sound-producing structure on each side at the base of the abdomen; comparatively large species with entirely membranous wings; nymphs subterranean. Cicadas, "Locusts," Harvest-flies. (Figs. 149, 154, 155, 161). (**Cicàda** (*C. septéndecim*, Periodical Cicada or Seventeen-year locust), **Tibìcen, Platypèdia**). **CICÁDIDÆ**

   Two ocelli, rarely absent; empodia large; jumping species..... 4

4. Pronotum not prolonged over the base of the abdomen 5

   Pronotum prolonged backward into a hood or process of variable form, usually much elevated and more or less concealing the scutellum and extending over the abdomen, often the prothorax is grotesquely enlarged and ornamented; head vertical, cheeks not dilated, ocelli located between the eyes, antennæ inserted between and in front of the eyes. Tree hoppers. (**Membràcis,** neotrop.; **Cerèsa,** Am. (*C. bùbalis*, Buffalo tree hopper, Figs. 151, 152, 153); **Centròtus,** palæarc., ethiop., indomal.; **Enchenòpa,** Am.; **Entýlia** (Figs. 157, 158, 159), Am.; **Górgora,** ethiop., indomal.; **Tricéntrus,** indomal., **Telamòna,** Am.). **MEMBRÁCIDÆ**

5. Hind coxæ short, conical, not laterally dilated; tibiæ cylindrical, smooth, the hind pair usually armed with one or two stout solid spines and with a cluster of spinules at apex; ocelli placed on the vertex, rarely absent; flagellum composed of a large pear-shaped base and a very slender seta; nymphs usually producing a mass of froth in which they live on the stems of various plants.

Spittle insects, Frog hoppers. (Superfamily CERCOPÒIDEA. Classification from C. F. Baker) 6

Hind coxæ transverse, reaching the side margins of the sternum; hind tibiæ ridged, with a double series of articulated spines or seriately bristly (hairy in Æthalionidæ); cheeks dilated. Leaf hoppers, Sharp shooters. (Superfamily JASSÒIDEA) 9

6. Scutellum comparatively small and short (longer than pronotum only in Clastopteridæ); hind wings with outer fork of radius always present (sometimes broken at apex), thus forming a supernumerary (first) apical cell, the cubitus apically forked or simple; fore wings with claval veins when present usually distant and without connecting crossvein 7

Scutellum as long as or longer than pronotum, either simply long acuminate, or greatly elevated posteriorly and with a strongly curved, free, apical spine projecting backward; hind wings with outer fork of radius always absent, therefore no supernumerary (first) apical cell; fore wings with both claval veins when present fused at middle or before, or with a connecting crossvein. Tube-forming spittle insects. Austr., indomal., ethiop. (Figs. 163, 167) ..... **MACHÆRÒTIDÆ**

a. Scutellum not raised apically or with free apical spinous appendage; anterior margin of pronotum strongly extended between eyes; head usually obtuse-angulate; cubitus of hind wing apically forked. (**Conmachæròta**; **Híndola, Enderleinia,** malay.; **Neuromachæròta,** ethiop.). (*ENDERLEINIÌNÆ*). **HINDOLÌNÆ**

Scutellum usually greatly raised apically, always with a free apical spinous appendage extended backward; anterior margin of pronotum but very slightly extended between eyes; head strongly swollen and extended in front of eyes; cubitus of hind wing not forked ..... b

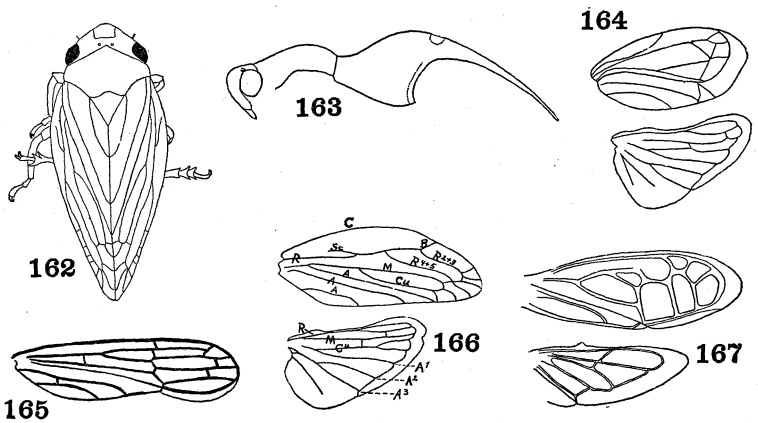
b. Form slender, body of scutellum high, arched posteriorly, with strong dorsal furrow; pronotum without laminately extended lateral angles, the anterior margin somewhat angulate between eyes. (**Machæròta**) ..... **MACHÆROTÌNÆ**

Form very thick and stout; body of scutellum nearly flat and with dorsal furrow subobsolete; pronotum with lateral angles produced into high, thin, spreading laminæ; anterior margin of pronotum broadly, gently arcuate between eyes. **MAXUDEÌNÆ**

7. Pronotal margin between eyes usually straight or slightly arcuate, pronotum commonly strongly enlarged and much broader than

the head and with the anterolateral margins usually as long as or longer than the posterolateral; front commonly more or less swollen apically; head with thickened and lobate ridges above the antennæ. (**Tomáspis**)..... **TOMASPÍDIDÆ**

Pronotal margin between the eyes usually strongly arcuate or subangulate, the pronotum never greatly enlarged and rarely



Figs. 162–167. **Homoptera**

162. Spittle insect (Stearns) Cercopidæ.
163. **Machærota,** profile of head, pronotum and scutellum (Baker) Machærotidæ.
164. **Clastoptera,** wings (Metcalf) Clastopteridæ.
165. **Oncometopia,** fore wing (Ball) Cicadellidæ.
166. **Aphrophora,** wings (Metcalf) Cercopidæ.
167. **Machærota,** wings (Baker) Machærotidæ.

much wider than head, the anterolateral margins usually much shorter than the posterolateral; front usually swollen basally, if at all; supra-antennal ridges not lobate nor greatly thickened.....8

8. Fore wings with clavus obliquely truncate at apex; corial appendix, the apical portion of the wing, divided into two very broad subequal portions, these at rest infolded at end of the stout and broad body to overlap; fork of radius in hind wings forming a very short first apical cell considerably before apex; cubitus of hind wings not forked apically; corium with three apical cells

and two or less subapicals; scutellum longer than pronotum. (**Clastóptera** (Fig. 164)) ..... **CLASTOPTÉRIDÆ**

Fore wings with the clavus narrowly acute or subacute apically; corial appendix either a narrow continuous membranous margin, or wanting, never bent inward beyond the clavus to overlap at end of body; corial venation various but never as in the Clastopteridæ. (**Cercòpa, Ptỳelus, Aphróphora,** cosmop.; **Monécphora,** widespr.; **Phymatostètha,** indomal.; **Cosmoscárta,** palæarc., indomal. (Figs. 162, 166)). ... **CERCÓPIDÆ**

9. Pronotum enlarged, swollen and with a median ridge, almost concealing the head and roundly produced over the base of the acute scutellum. (**Æthiàlion,** neotrop.; **Dárthula,** India). **ÆTHIALIÓNIDÆ**

Pronotum not thus modified to cover the head, although sometimes with lateral protuberances. (JASSIDÆ, in the broad sense. Classification from C. F. Baker, Philippine Jour. Sci., 1923.) 10

10. Upper part of front strongly raised and produced, its posterior portion forming a large part of the superior surface of the head (crown); the true vertex confined to basal portion of crown, the ocelli thus on posterior disk of crown, usually remote from eyes and not visible in facial view.....11

Upper part of front confined entirely to face, except sometimes for a narrow border; ocelli visible in facial view.....15

11. Lateral sutures of front distinctly continued over the obtuse anterior margin of the crown to near the position of the ocelli, as in the Cercopidæ; antennæ between and near the eyes; body usually elongate, cylindrical, head often angulate, face large, strongly convex, the cheeks rather long and narrow. (**Cicadélla, Dræculacéphala, Graphocéphala, Kólba, Oncometòpia** (= *Procònia*) (Fig. 165), **Tylozỳgus**). (*PROCONÌIDÆ, TETTIGONIÉLLIDÆ, TETTIGONÌIDÆ*)... **CICADÉLLIDÆ**

Lateral sutures of front obsolete beyond antennæ or beyond anterior border of crown.....12

12. Antennæ not far removed from eyes and near but never above level of eyes; lateral margins of front obsolete beyond scrobes.13

Antennæ situated entirely above and far removed from eyes; head anteriorly transversely thin and leaf-like, often concave beneath 14

13. Head acutely angled between crown and face, the face of narrow proportions; lateral sutures of front entering and terminating

in antennal scrobes, the face shallowly concave or weakly convex, the cheeks moderately swollen; body long, ovate, usually flattened. (**Gýpona** (Fig. 160), **Xerophlœ̀a**).

GYPÓNIDÆ

Head obtusely rounded between the strongly declivous crown and face, strongly overhanging the latter, which is deeply concave; lateral sutures of front passing mesad of antennæ; face very short, far broader than long. . . . . **PENTHIMÌIDÆ**

14. Outlined lower part of front short and broad.

THAUMASTOSCÓPIDÆ

Outlined lower portion of front long and narrow; large, brownish species. Principally indo-australian. (**Lèdra, Ledrópsis**).

LĒDRIDÆ

15. Vertex entirely superior, occupying nearly all or all of crown, the junction with the front occurring on anterior border of crown, the ocelli on or near anterior border of head, rarely, in some Typhlocybidæ and Ulopidæ, the ocelli indistinguishable 16

Head very short, sometimes very broad, the vertex more or less roundly curved on to face and broadly visible in facial view; ocelli facial and between or above the eyes; basal suture of front, when present, far anterior to base of face; that portion of vertex visible from above usually very short and broad. (**Bythoscòpus, Aceratogállia, Agállia, Eurýmela, Idiócerus, Ìpo, Macrópsis, Oncópsis**). . . . . **BYTHOSCÓPIDÆ**

16. Basal suture of front distinct and entire, centrally at least, approaching more or less closely the anterior margin of vertex; when subobsolete above, its position always marked by a fold or carina; in the latter case, the remaining portion of frontal suture is always directed toward the base of front and not toward ocellus; anterior border of vertex usually marked by a sharp margin or carina. 17

Basal suture of front usually obsolete, the basal lateral sutures running to and terminating at or near ocelli; vertex usually clearly connate with the front, only in highly specialized groups with a sharp edge or with transverse carinæ on anterior border; ocelli on anterior border of head or above it. (Fig. 156).

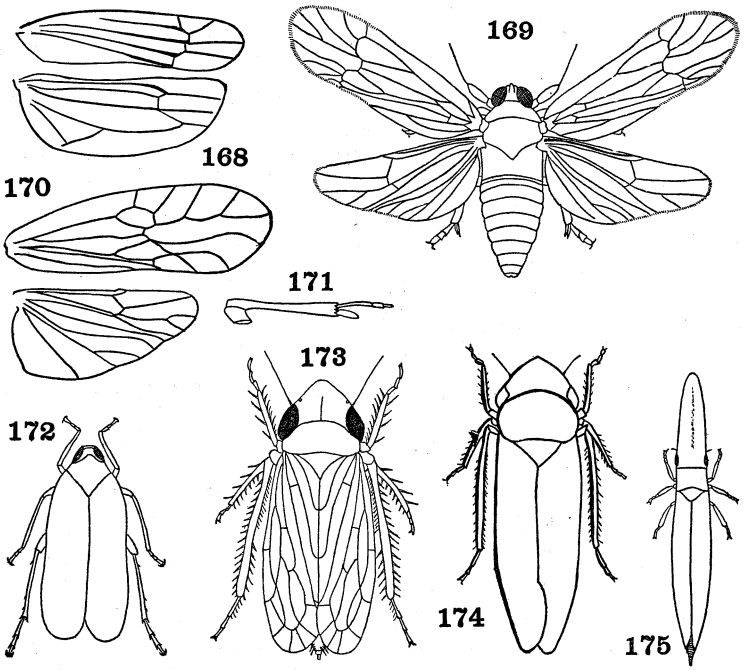
JÁSSIDÆ

a. Fore wings with well developed veins; head variously formed but not excessively long and narrow. . . . . b

Fore wings leathery, with obliterated venation; head very long

and gradually tapering in front, body slender; tibiæ weakly spinose; Australian. (**Cephalèlus** (Fig. 175), **Paradorýdium**).

CEPHALELÌNÆ



Figs. 168–175. **Homoptera**

168. **Typhlocyba,** wings. Jassidæ.
169. **Sogata** (Misra) Fulgoroidæ.
170. **Liburnia,** wings (Metcalf) Delphacidæ.
171. **Liburniella,** hind leg (Garman) Delphacidae.
172. **Cixius** (Metcalf) Cixiidæ.
173. **Deltocephalus** (DeLong) Jassidæ.
174. **Tettigoniella** (Ball) Cicadellidæ.
175. **Cephalelus** (Tillyard) Jassidæ.

b. Fore wings with veins branching on the disk so that they form a series of preapical cells; ocelli present.....c

Fore wings with veins, often weak at base, not branching on the disk, branching only near apex to form the apical cells; ocelli vestigial or wanting. (**Typhlócyba** (Fig. 168) (*T. austràlis*, Australian apple leaf-hopper), **Dicraneùra, Empòa** (*E. ròsæ*,

Rose leaf-hopper), **Empoásca** (*E. màli*, Apple leaf-hopper), **Erythroneùra** (*E. còmes*, Grape leaf-hopper). (*EUPTERÝGIDÆ*) ..... **TYPHLOCYBÌNÆ**

c. Ocelli on vertex near margin, or between vertex and front, and remote from eyes. (**Acucéphalus, Niònia, Strongylocéphalus, Xestocéphalus**) ..... **ACUCEPHALÌNÆ**

Ocelli on margin between vertex and front, usually very close to eyes. (**Jássus** (=*Cœlídia*), **Chlorotéttix, Cicádula, Deltocéphalus** (Fig. 173), **Eùscelis, Eutéttix, Phlépsius, Platymetòpius, Scaphòideus, Thamnotéttix**). (*CŒLÍDIDÆ*). **JASSÌNÆ**

17. Anterior border of vertex sharply laminately expanded, distinctly overhanging upper part of front; antennæ situated far mesad of eyes; ocelli, when distinguishable, lying between extended margin of vertex and basal margin of front in a transversely triangular (rarely linear) ocellar area and very remote from eyes 18

Anterior border of vertex sharply marked (head may be laminately extended between eyes) but never with this margin extended beyond and overhanging upper part of front; usually with clearly marked subtriangular ocellar areas at sides between vertex and front; these areas are commonly occupied by the ocelli, though the latter may occur near by on upper surface of crown, then usually on or outside the carinate or raised lateral margin of vertex; antennæ situated close to interior line of eyes 21

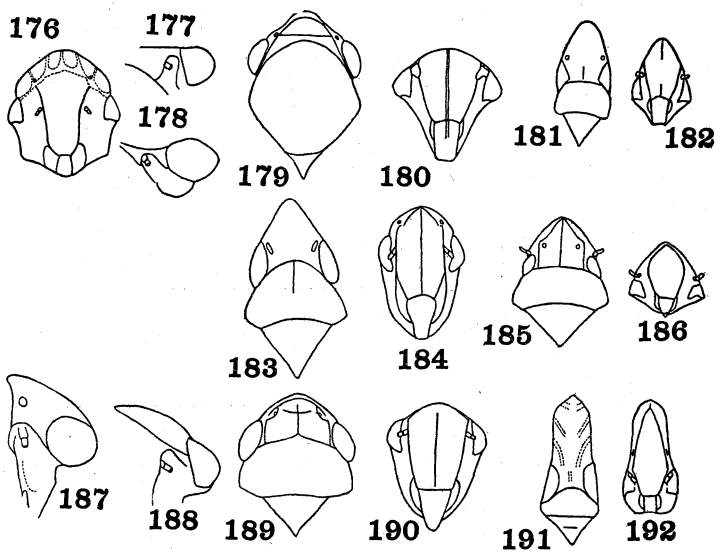
18. Pronotum extended between and in front of eyes; vertex very short, transverse and deeply concave 19

Pronotum not abnormally extended between eyes; vertex not very short and widely transverse, the width of the vertex not more than twice the length; ocelli a little nearer to eyes than to median line, or indistinguishable 20

19. Tegmina normally veined; genæ narrower than front; front strongly excavate, with high raised margins; clypeus little exserted; ocellar area very broad; hind tibiæ with very few small spines and hairs on apical half; sculpture characterized by a deep thimble pitting. (**Paròpia** (=*Megophthálmus*) (Figs. 187, 188), **Mesoparòpia**, malay.). (*MEGOPHTHÁLMIDÆ*). **PAROPÌIDÆ**

Tegmina with numerous supernumerary veins; genæ wider than front; front convex; clypeus long exserted; ocellar area narrow,

bounded beneath by a shallow fold; hind tibiæ with stout spinose teeth, few in number but distributed along entire length; sculpture characterized by coarse striations and wrinkles. (**Stenocòtis**)..... **STENOCÓTIDÆ**



Figs. 176–192. **Homoptera**

176. **Koebelea,** face (Baker) Koebeleidæ.
177. **Ulopa,** face in frontal view (Baker) Ulopidæ.
178. **Ulopa,** face in lateral view (Baker) Ulopidæ.
179. **Signoretia,** head and pronotum, dorsal view (Baker) Signoretiidæ.
180. **Signoretia,** face (Baker) Signoretiidæ.
181. **Nirvana,** head and pronotum, dorsal view (Baker) Nirvanidæ.
182. **Nirvana,** face (Baker) Nirvanidæ.
183. **Pythamus,** head and pronotum, dorsal view (Baker) Pythamidæ.
184. **Pythamus,** face (Baker) Pythamidæ.
185. **Stenotortor,** head and pronotum, dorsal view (Baker) Nirvanidæ.
186. **Stenotortor,** face (Baker) Nirvanidæ.
187. **Paropia,** face, lateral view (Baker) Paropiidæ.
188. **Paropia,** face, frontal view (Baker) Paropiidæ.
189. **Euacanthus,** head and pronotum, dorsal view (Baker) Euacanthidæ.
190. **Euacanthus,** face (Baker), Euacanthidæ.
191. **Stenometopius,** head and pronotum, dorsal view (Baker) Nirvanidæ.
192. **Stenometopius,** face (Baker) Nirvanidæ.

20. Genæ longer than broad, flat or concave, outwardly emarginate, normally bordering the loræ to the clypeus; scrobes very shallow and lacking strong supra-antennal ledges (as in Stenocotidæ); pronotum with very short lateral margins, converging anteriorly, ocelli distinct. (**Koebèlea**, nearc.). (Fig. 176). **KOEBELÈIDÆ**

Genæ broader than long, strongly convex, not passing loræ (at level of face), their apical margins roundly curved inward to meet the front above the loræ, leaving outer margin of latter fully exposed in facial view; scrobes very deep, under strongly overhanging and curved supra-antennal ledges; head wider than prothorax; pronotum with very long lateral margins, usually converging posteriorly; ocelli sometimes indistinguishable; all tibiæ ridged and feebly spined. (**Ulòpa** (Figs. 177, 178), **Mesárgus, Moonia**) ..... **ULÓPIDÆ**

21. Upper margin of front a little extended beyond margin of vertex and plainly visible in dorsal view at least at sides, the lateral and anterior submarginal carinæ of vertex usually distinct, often very strong..... 22

Upper margin of face not at all extended beyond margin of vertex and not visible in dorsal view, or only a little so just in front of eyes; ocelli on anterolateral border of head or just above or below it; loræ very small and narrow; tegmina usually without anteapical cells and venation usually indistinct; antennæ situated above the eyes in facial view, rarely on upper line of or between eyes, in which case the head is long-produced... **NIRVÁNIDÆ**

a. Antennæ situated at upper angle of eyes (in facial view) or above this; lateral carinæ of vertex more or less distinct; ocelli always visible from above, on upper portion of lateral border, or on anterolateral portion of crown; eyes prominent; posterior border of pronotum more or less distinctly incurved..... b

Antennæ situated at middle of eye margin (in facial view); lateral carinæ of vertex wanting; ocelli below anterior border of crown and not visible from above; head (from above) long spatulate, but not thin dorsoventrally; eyes not prominent, deeply set in vertex; pronotum subtruncate posteriorly; tegmina with two subapical cells. (**Stenometòpius** (Figs. 191, 192)). **STENOMETOPIÌNÆ**

b. Antennæ situated in deep transverse, sharp-margined scrobes; face about as broad as long or broader; eyes small; vertex short, half-ovate. (**Macroceratogònia, Balbíllus, Stenotórtor** (Figs. 185, 186)) ..... **MACROCERATOGONIÌNÆ**

Antennæ in shallow scrobes of ordinary type; face usually much longer than broad; vertex long; eyes large; tegmina without subapical cells, the veins of corium usually indistinguishable except by transmitted light. (**Nirvàna** (Figs. 181, 182), **Kàna, Ophiùchus, Pseudonirvàna**) ..... **NIRVANÌNÆ**

22. Pronotum very long, strongly produced and outcurved behind, largely covering the scutellum; head with eyes broader than pronotum; vertex with a very strong, thickened, basal transverse ridge; supra-antennal ledge callously thickened and lobed over frontal margin; clypeus truncate or notched apically and little or not exserted; sides of front not sinuate at scrobes; ocelli in marginal areas and visible from above and below; loræ very small and short. (**Signorètia,** indoaustr. (Figs. 179, 180); **Prèta**) ..... **SIGNORETÌIDÆ**

Pronotum not produced behind over the very large scutellum, the hind border truncate or concave; head more or less distinctly narrower than pronotum; vertex without strongly thickened basal ridge; supra-antennal ledge neither strongly callous nor lobed over frontal margin; antennæ between the eyes near middle of their inner margins..... 23

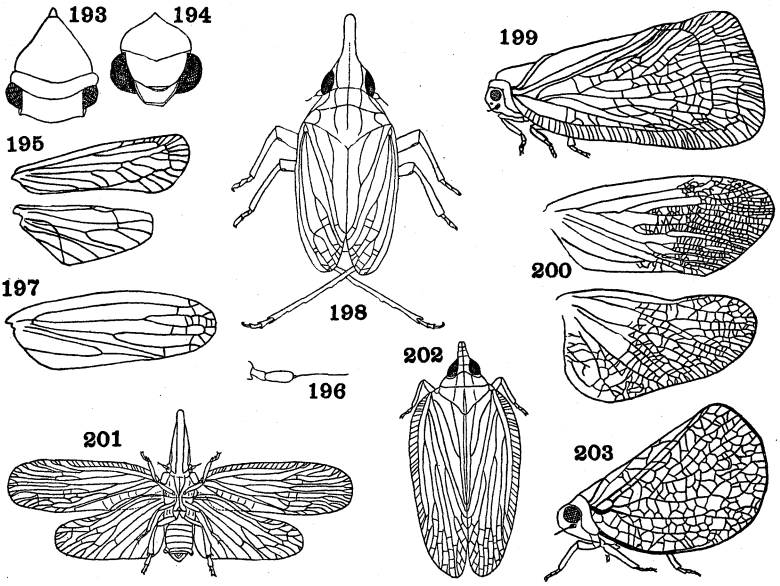
23. Pronotum short, broad, broadly rounded anteriorly, the head but slightly narrower; vertex very broad, nearly twice as broad as long; width of head greater than length of head and pronotum together; ocelli situated a little within anterior margin of crown, but outside the anterolateral carina of vertex, and invisible in facial view. (**Euacánthus** (Figs. 189, 190); **Búndera**, India). **EUACÁNTHIDÆ**

Pronotum more or less narrowly rounded anteriorly, the head very distinctly narrower, vertex always much less than twice as broad as long; width of head always much less than length of head and pronotum together; ocelli in or very near lateral areas, and usually visible both in dorsal and facial views. (**Pýthamus** (Figs. 183, 184), **Oniélla, Onùkia**). **PYTHÁMIDÆ**

24. Flagellum of antennæ segmented; hind tibiæ without mobile spur; lateral ocelli on the front, the front reaching from eye to eye without lateral ridges dividing off a small area around the eyes; sides of face (loræ) plainly visible in front view and forming a continuous curve with the clypeus. (**Tettigomètra, Egròpa, Hílda, Euphyonártex**)..... **TETTIGOMÉTRIDÆ**

Flagellum of antennæ not segmented; lateral ocelli outside the

lateral ridges of the front, generally beneath the eyes; sides of face (loræ) not visible in front view, or forming an angle with the clypeus..... 25



Figs. 193–203. **Homoptera**

193. **Acanalonia,** head (Metcalf) Acanaloniidæ.
194. **Aphelonema,** head (Metcalf) Issidæ.
195. **Otiocerus,** wings (Metcalf) Derbidæ.
196. **Liburniella,** antenna (Garman) Delphacidæ.
197. **Scolops,** fore wing (Metcalf) Dictyopharidæ.
198. **Scolops** (Garman) Dictyopharidæ.
199. **Acanalonia** (Swezey) Acanaloniidæ.
200. **Poiocera,** wings (Metcalf).
201. **Pyrilla** (Misra) Lophopidæ.
202. Tropiduchid.
203. **Ormenis** (Swezey) Flatidæ.

25. Second joint of hind tarsi not very small, the apex truncate or emarginate and with a row of small spines; fore wing without costal area, or with only a small one without crossveins.....26
Second joint of hind tarsus small or very small, the apex generally

rounded or pointed and without spines or with only one at each side; costal area present or absent. 34

26. Claval veins not granulate; or if so, the last joint of the labium short, not longer than wide. 27

One or both claval veins granulate; apical joint of labium much longer than wide. Abdomen compressed, the sixth to eighth tergites with wax secreting pores; median ocellus usually present. (**Meénoplus, Ánigrus, Sùva, Kermèsia**).
MEENÓPLIDÆ

27. Sixth, seventh and eighth abdominal tergites without wax pores. 28

Sixth, seventh and eighth tergites with wax-secreting pores; ovipositor reduced, incomplete. (**Kínnara, Eparmène, Prosótropis, Œclídius, Atopocíxius**) . . . . . **KINNÁRIDÆ**

28. Anal area of hind wings reticulate, with many crossveins; clypeus with lateral carinæ; head often greatly prolonged. (**Fúlgora,** indomal.; **Lanternària,** neotrop.; **Ámycle, Cyrpóptus, Pỳrops**) . . . . . **FULGÓRIDÆ**

Anal area of hind wing not reticulate. 29

29. Last joint of labium distinctly longer than wide. 30

Last joint of labium about as long as wide. (**Dérbe, Anòtia, Lamènia, Otiócerus** (Fig. 195), **Rhotàna, Venàta, Zoràida**).
DÉRBIDÆ

30. Claval vein entering the apex of the clavus. 31

Claval vein not reaching the apex of the clavus, entering commissure before apex. 32

31. Base of abdomen on each side with one or two short processes bearing three pits or depressions; body compressed, wing membranes not overlapping. (**Achilíxia,** malay.; **Bebaiòtes,** neotrop.) . . . . . **ACHILIXÌIDÆ**

Base of abdomen without lateral processes; body usually flattened, the wing membranes overlapping. (**Achìlus, Agandécca, Catònia, Elidóptera, Favéntia**) . . . . . **ACHÍLIDÆ**

32. Hind tibiæ with a strong, movable spur at the apex; fore wings without costal area; ovipositor well developed; often brachypterous. (**Délphax, Libúrnia** (Fig. 170), **Perkinsiélla** (*P. saccharicìda,* Sugarcane hopper), **Pissonòtus, Stenócranus**).
DELPHÁCIDÆ

Hind tibiæ without apical movable spur. 33

33. Head prolonged in front, sometimes greatly so, or if not the front bears two or three carinæ, or the tegulæ are absent and the claval suture obscure; no median ocellus. (**Dictyóphara, Clády-**

pha, Dichóptera, Orgámara, Orgèrius, Scòlops (Figs. 197, 198)) ..... **DICTYOPHÁRIDÆ**

Head not prolonged in front, or only moderately so, the front with only a median carina, in addition to the lateral margins; tegulæ present; median ocellus often present. (**Cíxius** (Fig. 172), **Bothriócera, Koroàna, Mýndus, Oliàrus**). **CIXÌIDÆ**

34. Second joint of hind tarsi with a spine on each side; claval vein nearly always extending to and ending in the apex of the clavus 35

Second joint of hind tarsus small, without spines 39

35. Mesonotum with the hind angles marked off by a groove or fine line; fore wings with the costal area absent, or very small and without crossveins, or with crossveins; basal joint of hind tarsi usually long, rarely padded below. (**Tropidùchus, Alcéstis, Monópsis, Tambínia, Neurómeta**) .... **TROPIDÙCHIDÆ**

Mesonotum with the hind angles not marked off by a groove or line; first joint of hind tarsus usually short or very short.... 36

36. Fore wings with a crossveined costal area; without granules on the clavus; clypeus nearly always with lateral carinæ. (**Nogodìna**) ..... **NOGODÍNIDÆ**

Fore wings without a crossveined costal area, or if with such the clavus is granulate or the clypeus is without lateral carinæ.. 37

37. Clavus not granulate; base of costa not strongly curved..... 38

Fore wings with a crossveined costal area and with the clavus granulate, or the base of the costa strongly curved. (**Flàta, Cerýnia, Flatòides, Nephèsa, Órmenis** (Fig. 203), **Phántia, Phỳma**) ..... **FLÁTIDÆ**

38. Fore wings large, held steeply against the sides of the body; head about as wide as thorax; pronotum with hind edge slightly roundly emarginate, sometimes straight; mesonotum large, long; hind tibiæ without spines; ovipositor incomplete. (**Acanalònia** (=*Amphiscèpa*) (Figs. 193, 199), **Chloróchara**). (*AMPHISCÉPIDÆ*) ..... **ACANALONÌIDÆ**

Fore wings generally smaller, in Caliscelinæ very short, or very narrow, parchment-like; head usually as wide as thorax or wider; pronotum with hind margin straight, sometimes slightly concave or convex; mesonotum short, not more than twice the length of the pronotum, with a transverse ridge parallel to the pronotal suture dividing it into two parts of differing sculpturing, the anterior covered by the pronotum; hind tibiæ spined; claval suture present (Issinæ) or absent and fore wings thick,

convex, and venation obscured (Hemisphæriinæ). (**Bruchomórpha, Aphelónema** (Fig. 194), **Calíscelis, Hemisphærius, Íssus**) ..... **ÍSSIDÆ**

39. Fore wings wide on apical margin, steeply held against the sides of the body, with a crossveined costal area; clavus long; head as wide or nearly as wide as the thorax; hind trochanter directed downward; first joint of hind tarsi at least moderately short. (**Ricània, Armàcia, Euricània, Privèsa**) ..... **RICANÌIDÆ**

Fore wings not so wide on the apical margin and not held so steeply, or the head is distinctly narrower than the thorax; clavus shorter; hind trochanter directed backward; first joint of hind tarsi at least moderately long..... 40

40. Front wider than long, the sides angulate; clypeus without lateral carinæ and front without longitudinal carinæ or with only a very obscure one. (**Eurýbrachys, Messèna, Platýbrachys, Théssitus**) ..... **EURYBRÁCHIDÆ**

Front rarely as wide as long and often without angular margins, nearly always with one or three longitudinal carinæ. (**Lòphops,** indomal.; **Pyrilla** (Fig. 201), malay.; **Elasmóscelis,** ethiop., indomal.; **Kasseròta,** indoaustr.) ..... **LOPHÓPIDÆ**

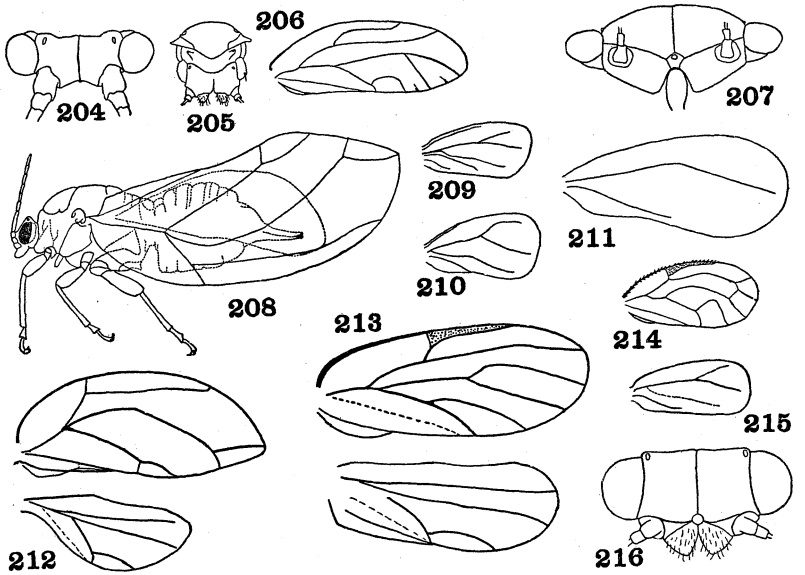
41. Tarsi two-jointed, the basal joint sometimes reduced, the outer joint with two claws; wings, when present, four in number, with few veins, at rest usually held in a sloping position over the abdomen; sutures between body segments distinct; mouthparts usually well developed in both sexes, labium usually long... 42

Tarsi one-jointed (in some Monoplebidæ and in the male cochineal insect there is an additional minute basal joint) and with a single claw; females stout-bodied, always wingless, often without legs so that they rarely move after maturity, remaining sessile on the host plant, rarely without mouthparts; males delicate, usually with mesothoracic wings alone developed, which are gauzy and almost veinless and lie flat, overlapping on the abdomen when at rest; antennæ of female absent or with as many as eleven joints, of male with ten to twenty-five joints; body of female and nymphal males scale-like, gall-like, or covered with waxy powder, tufts or scales, the sutures between the segments often indistinct. (Superfamily COCCÒIDEA) ... 47

42. Non-jumping insects, legs long and slender; both pairs of wings membranous or opaque whitish; antennæ three- to six-jointed. 43

Jumping insects, the femora thickened; antennæ long, five to ten-jointed, usually ten-jointed, the last joint with two fine apical

bristles; fore wings somewhat thicker, often more or less leathery; pad between the tarsal claws (empodium) present, bilobed. Jumping plant-lice. (*PSÝLLIDÆ*) ..... **CHÉRMIDÆ**



Figs. 204–216. **Homoptera**

204. **Freysiula,** head (Crawford) Chermidæ.
205. **Trioza,** head (Crawford) Chermidæ.
206. **Carsidara,** fore wing (Crawford) Chermidæ.
207. **Paurocephala,** head (Crawford) Chermidæ.
208. **Trioza** (Peterson) Chermidæ.
209. **Udamoscelis,** fore wing (Quaintance and Baker) Aleyrodidæ.
210. **Aleurodicus,** wing (Quaintance and Baker) Aleyrodidæ.
211. **Aleurocanthus,** wing (Quaintance and Baker) Aleyrodidæ.
212. **Trioza,** wings (Patch) Chermidæ.
213. **Pachypsylla,** wings (Patch) Chermidæ.
214. **Ceriacremum,** fore wing (Crawford) Chermidæ.
215. **Aleyrodes,** fore wing (Quaintance and Baker) Aleyrodidæ.
216. **Pachypsylla,** head (Crawford) Chermidæ.

a. Head deeply cleft, with the antennæ attached to the truncate anterior ends on each side of the cleft (Fig. 204); cheeks seldom produced into conical processes; media not dichotomously

forked (Fig. 206); hind tibiæ often without a spur at base. Indomalayan and neotropical. (**Carsídara, Epicársa, Nesiòpe, Rhinopsýlla**) ..... **CARSIDARÌNÆ**

Head of a different form; if apparently cleft, this is due to the genal cones, which do not bear the antennæ.....b

b. Front not covered by the genæ (Fig. 207), which are not produced into conical processes (except *Calophya*); anterior ocellus at the upper extremity of the front.....c

Front covered by the genæ (Fig. 216) which are usually produced below into conical processes; front ocellus at the junction of the front and genæ.....d

c. Vertex flat, horizontal; the front beneath it in the form of a narrow, usually elongate piece that extends from the clypeus to the anterior ocellus; wings often more or less thickened and spotted. (**Aphálara, Aphalaròida, Lívia, Rhinócola**) .... **LIVIÌNÆ**

Vertex not horizontal, its surface curved downwards anteriorly; front forming a small sclerite level with the vertex and genæ; wings usually membranous. (**Calóphya**, Am.; **Leptynóptera**, indomal.; **Heteropsýlla, Paurocéphala, Pauropsýlla**, widespr.).....**PAUROPSYLLÌNÆ**

d. Fore wing with more than two marginal cells, the radial sector branched or connected to the media by a crossvein near the tip of the wing (Fig. 214). (**Ceriacrèmum**, neotrop.). **CERIACREMÌNÆ**

Fore wing with only two marginal cells, formed by the furcation of the media and cubitus (Fig. 212), the radial sector not branched and not connected with the media by a crossvein...e

e. First joint of hind tarsi with two black, claw-like spines at tip; radius, media and cubitus not arising at the same point from the basal vein, the media and cubitus stalked; wings rarely angulate at apex. (**Arytàina, Euphálarus**, widespr.; **Epipsýlla, Euphyllùra, Pachypsýlla** (Figs. 213, 216); **Chérmes** (=*Psylla*) cosmop. (*C. pyrícola*, Pear psylla). (*PSYLLÌNÆ*). **CHERMÌNÆ**

First joint of hind tarsi simple, without such spines at tip; radius, media and cubitus usually arising at a common point, the media and cubitus not stalked; wings usually angulate at apex. (**Ceropsýlla**, neotrop.; **Megatrìoza**, widespr.; **Paratrìoza**, neotrop.; **Trìoza**, cosmop.). (Figs. 205, 208, 212). **TRIOZÌNÆ**

43. Wings transparent, though sometimes colored, the hind wings smaller than the fore pair; tarsi with the basal joint sometimes much reduced, empodium greatly reduced or absent; body not mealy but sometimes with waxy wool; life cycle very compli-

cated, including agamic and sexual generations, of dissimilar appearance. Plant lice, Aphids. (Superfamily APHIDÒIDEA) 44

Wings usually opaque, whitish, clouded, or mottled with spots or bands, the two pairs of wings subequal in size; the two tarsal joints subequal, usually a pad-like or spine-like process (empodium) between the tarsal claws; body of adult more or less mealy with fine, white powdery wax, body of the scale-like legless nymphs not covered with powder, but often with marginal plates of wax. White flies ..... **ALEYRÓDIDÆ**

a. Empodium absent; fore wings with veins R_1, Rs, M, Cu and A present. (**Udamóselis**, S. Am. (Fig. 209)). **UDAMOSELÌNÆ**

Empodium present; fore wings with either M or Cu and A veins absent ..... b

b. Empodium spine-like; fore wings with vein Cu undeveloped. (**Aleuródicus** (Fig. 210), **Dialeuródicus, Leonárdius, Paraleyròdes**) ..... **ALEURODICÌNÆ**

Empodium blade-like; fore wings with vein M undeveloped. (**Aleyròdes** (Figs. 215, 219, 220), **Aleurochìton, Aleurocánthus** (Fig. 211), **Neomaskiélla**) ..... **ALEYRODÌNÆ**

44. Fore wings with outer part of stigma bounded behind by vein R_1, the radial sector separate (Fig. 222); sexual females oviparous, summer parthenogenetic females viviparous; new-born with anterior pronotal pleural bristles absent 45

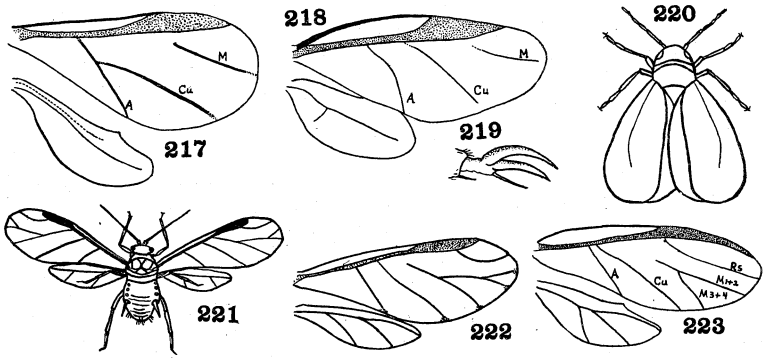
Fore wings with outer part of stigma bounded behind by the fused vein R_1 + Rs (Figs. 217, 218), both the sexual and agamic females oviparous; first tarsal joint with two bristles; cornicles wanting; newly born with three-jointed antennæ and with anterior pronotal pleural bristle present 46

45. Parthenogenetic and oviparous females and usually males also with functional rostrum, able to suck sap and to defecate; oviparous females producing two or more eggs, rarely one; cornicles rarely absent ..... **APHÍDIDÆ**

a. New-born individuals with four bristles on basal tarsal joint; head free, not fused with prothorax, adults with vertex margined; labium five-jointed; cornicles broadly conical to pore-like, rarely absent. (**Láchnus** (Pine aphids), **Cínara, Euláchnus, Tràma**) ..... **LACHNÌNÆ**

New-born individuals with two bristles on basal joint of tarsus; labium four-jointed; cornicles pore-like to elongate cylindrical, rarely absent; head of adult with vertex not margined ..... b

b. Head free; newly born with faceted eyes; hind tibiæ of oviparous female thickened. (**Âphis** (Fig. 221), (*A. gossýpii*, Cotton aphis, *A. màidis*, Corn aphis, *A. pòmi*, Green apple aphis), **Rhopalosìphum, Toxóptera** (*T. gráminum*, Green bug of wheat); **Chaitóphorus**; **Saltusàphis**; **Callípterus**; **Pterocómma**; **Anuràphis** (*A. bàkeri*, Clover aphis, *A. màidi-rádicis*, Corn root aphis, *A. pérsicæ-nìger*, Black peach aphis); **Cryptosìphum**; **Brachýcolus** (=*Brevicorýne*) **Hyalópterus**;



Figs. 217–223. **Homoptera**

217. **Phylloxera,** wings (Patch) Phylloxeridæ.
218. **Adelges,** wings (Patch) Adelgidæ.
219. **Aleyrodes,** tarsus (Quaintance) Aleyrodidæ.
220. **Aleyrodes** (Bemis) Aleyrodidæ.
221. **Aphis** (Chittenden) Aphididæ.
222. **Macrosiphum,** wings (Patch) Aphididæ.
223. **Mindarus,** wings (Patch) Aphididæ.

Liosomàphis; **Amphoróphora** (=*Illinoia*); **Macrosìphum** (=*Siphonóphora*) (Fig. 222) (*M. solanifòlii*, Potato aphis); **Mỳzus** (*M. pérsicæ*, Green peach aphis); **Phòrodon** (*P. hùmuli*, Hop aphis)) ..... **APHIDÌNÆ**

Head fused with prothorax, the eyes located midway on the head, eyes of new-born with three facets; hind tibiæ of oviparous females not thickened c

c. Underside of antennæ with oval or rounded secondary sensoria; radial sector of fore wings arising at the base of the elongate stigma, cell R_1 therefore long; sexual forms small, the female laying a number of eggs. (**Míndarus** (Fig. 223), **Anomalàphis, Theláxes**). (*MINDARÌNÆ*) ..... **THELAXÌNÆ**

Antennæ with narrow transverse sensoria; radial sector of fore wings arising from the stigma; wing veins much reduced so that the media is usually simple; cornicles usually absent or much reduced; sexual forms usually apterous and of small size; species usually producing galls; wax glands usually present. (**Hormàphis, Ceratàphis, Hamamelístes**). **HORMAPHIDÌNÆ**

Parthenogenetic females with functional rostrum, sexual forms greatly reduced and with no mouthparts; oviparous females producing only one egg; cornicles much reduced or absent; wax glands abundantly developed; wing venation usually reduced; antennal sensoria prominent ..... **ERIOSOMÁTIDÆ**

a. Anal tergite of new-born with four bristles, new-born agamic individuals with four bristles on other tergites also; sexual individuals produced in the spring. (**Fórda, Aploneùra, Melàphis, Pemphigélla**) ..... **FORDÌNÆ**

Anal tergite of new-born with four bristles, the other tergites with bristles forming six rows; sexual individuals produced after midsummer. (**Eriosòma** (*E. lanígerum*, Woolly aphis of apple), **Asìphum, Pemphìgus, Procíphilus, Schizoneùra** (*S. úlmi*, Elm aphis)) ..... **ERIOSOMATÌNÆ**

46. Wings when at rest held roof-like, vein Cu of fore wing distant from first anal vein; antennæ of wingless agamic females three-jointed, of sexual forms four-jointed, of winged forms five-jointed; sexual as well as parthenogenetic females with beak; wingless agamic females secrete a waxy flocculence. Infesting only conifers; formerly known as *Chermes*..... **ADÉLGIDÆ**

a. Abdomen with five pairs of spiracles, the first not evident; new-born fundatrix with ring-like dorsal wax glands. (**Pinèus, Pineòdes, Dreyfùsia**.) ..... **PINEÌNÆ**

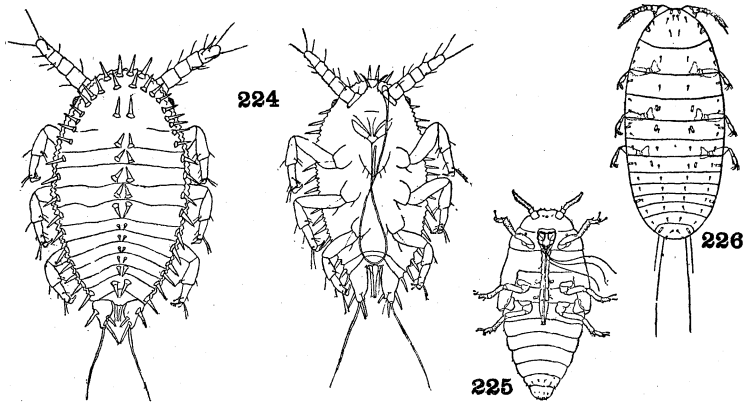
Abdomen with six pairs of spiracles, the first not evident; agamic young of two kinds, either (a) delicate summer forms, the first generation usually winged, with short rostrum, moulting four times, and not overwintering, or (b) chitinized, wingless, winter form, with long rostrum, moulting three times, which rest over summer and are active in fall. (**Adélges** (Fig. 218) (=*Cnaphalòdes*), **Gilletteélla, Sacchiphántes**) ..... **ADELGÌNÆ**

Wings when at rest laid flat upon the abdomen, veins Cu and 1A fused at base forming a Y-vein; antennæ three-jointed; parthenogenetic females with beak, sucking but not defecating; sexual forms without beak; wingless agamic females not secreting a waxy flocculence, but in *Phylloxera* they secrete a waxy powder.

(**Phylloxèra** (*P. vastàtrix*, Grape phylloxera) (Figs. 217, 224, 225), **Acanthochérmes, Moritziélla, Xerophýlla** (*X. caryæcaulis*, Hickory phylloxeran)). . . . . **PHYLLOXÉRIDÆ**

47. Abdominal spiracles present in all stages; adult male usually with compound eyes. 48

Abdominal spiracles wanting in all stages; adult male without definite compound eyes, *i.e.* without clusters of facets in hemispherical or other shape. 49



Figs. 224-226. **Homoptera**

224. **Phylloxera,** dorsal and ventral views. (Doten) Phylloxeridæ.
225. **Phylloxera,** nymph, ventral view (Simanton) Phylloxeridæ.
226. **Phœnicococcus,** larva (Morrison) Cylindrococcidæ.

48. Larva and all female stages with a distinctly developed flat anal ring bearing pores and six setæ; adult male with simple nine-jointed antennæ, with a rather conspicuous seta at extreme tip of apical joint; penis sheath of adult male appearing strongly bivalved. (**Orthèzia,** tropicopolitan). . . . . **ORTHEZIIDÆ**

None of the stages with a flat anal ring bearing pores and setæ; adult male nearly always with simple ten-jointed antennæ, rarely with pectinate antennæ or with more than ten joints; penis sheath of adult male mostly entire, or merely cleft at apex, at most with short bilobate tip, in which case the compound eyes are poorly developed. (*MARGARÓDIDÆ*).

MONOPHLÉBIDÆ

a. Adult female with tarsi two-jointed (Fig. 241), rarely the legs reduced to a small unsegmented protuberance; disk-like simple pores present; intermediate female legless; halteres of male with four to six long curved apical bristles (Fig. 242). Widespread. (**Matsucóccus**, palæarc. (Figs. 242, 245); **Stigmacóccus**, neotrop. (Figs. 241, 248, 249); **Xylocóccus**, nearc.).
XYLOCOCCÌNÆ

Adult female with tarsi one-jointed, legs, if reduced, with some segmentation; disk-like simple pores wanting.....b

b. Adult female with six to twelve large knobbed bristles surrounding and surpassing the tarsal claw (Fig. 246); antennæ contiguous at base; intermediate females legless; male with eyes reduced to a row of facets or even to a single facet. Holarctic. (**Steingèlia**, palæarc.; **Stomacóccus**, nearc.) ....**STEINGELIÌNÆ**

Adult female usually with two bristles on tarsal claw, if more than two the bristles are short and acute; antennæ often close together but not contiguous at base; male with well developed compound eyes.....c

c. Adult female with dorsal anus, anal tube relatively well developed and provided with a simple proximal ring; intermediate female with antennæ and legs fully developed, anal tube with ring and anal opening distinctly dorsal; male tibiæ, tarsi and front femora with bifurcate setæ, middorsal area of thorax with an unchitinized area, and abdomen with one or more pairs of fleshy marginal tassels. (**Drósicha**, widespr.; **Icèrya**, tropicopol. (Figs. 230, 243); **Llavèia**, neotrop., indomal.; **Monóphlebus**, indomal.; **Palæocóccus** (Fig. 231), widespr.; **Steatocóccus**).
MONOPHLEBÌNÆ

Adult female with the anal tube, if well developed and with proximal ring, apical in position, if the anal opening is subapical the tube is poorly developed or wanting.....d

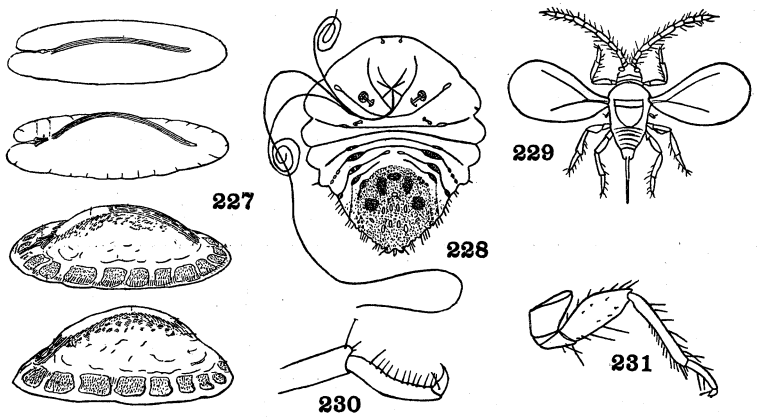
d. Adult female usually with disk pores in a band or plate within the thoracic spiracles, if without these the front legs enlarged and fitted for digging; intermediate female legless; male legs without bifurcate bristles, middorsal area of thorax chitinized. (**Callipáppus**, austr.; **Kuwània**, palæarc.; **Margaròdes**, widespr.).....**MARGARODÌNÆ**

Adult female usually with disk pores or pore plate external to, but never within the thoracic spiracle; intermediate female with antennæ and legs usually reduced but still segmented; male tibiæ, tarsi and front femora with bifurcate bristles; middorsal area of thorax unchitinized. Principally neotropical and Australian. (**Cœlostomídia**, austr.; **Cryptokérmes**, neotrop.; **Marchalìna**).....**CŒLOSTOMIDIÌNÆ**

49. Abdomen of female and of nymphs terminating in a compound pygidium; anal opening simple; body covered by a secreted thin shield-like scale. Scale insects.....50

Abdomen of female and of nymphs not having the posterior segments fused to form a definite pygidium contrasting with the anterior segments; anal orifice often setiferous; body not covered by a thin shield-like scale.....51

50. Scale covering constructed around the first moulted skin; pygidium of the covered insect definitely formed of the fused



Figs. 227–231. **Homoptera**

227. **Lecanium,** growth stages of female scale. Lecaniidæ.
228. **Diaspis,** female (Howard) Diaspididæ.
229. **Aspidiotus,** male (Howard) Diaspididæ.
230. **Icerya,** tarsus of female (Riley) Monophlebidæ.
231. **Palæococcus,** hind leg. Monophlebidæ.

terminal segments contrasting with the anterior segments of the abdomen, pygidium of the first instar larva bearing two long anal setæ; legs and six-jointed antennæ present during the crawling stage but atrophied after the insect becomes sessile; beak one-jointed..... **DIASPÍDIDÆ**

a. Scale of adult female or second nymphal female more or less elongate or sometimes rounded, with exuviæ at one end, if nearly circular the exuviæ near margin or when central not concentrically superposed; exuvia of first nymphal female with the remains of antennæ showing as porrect appendages..... b

Scale of adult and second nymphal female nearly circular, the exuviæ central, if elongate the exuviæ concentrically superposed, not projecting beyond margin of scale or attached at margin; exuvia of first nymphal female never showing remains of antennæ. (**Aspidiòtus,** widespr. (Fig. 229) (*A.* (*Comstockáspis*) *perniciòsus,* San José scale); **Chrysómphalus,** widespr.; **Targiònia,** widespr.) ..... **ASPIDIOTÌNÆ**

b. Scale of female nearly circular, with nipple central or excentric, rarely projecting beyond margin of scale; male scale elongate, with almost parallel sides. (**Aulacáspis,** widespr. (Figs. 233, 234) (*A. ròsæ,* Rose scale); **Diáspis,** widespr. (*D. bromèliæ,* Pineapple scale; *D. pirícola,* Pear scale); **Howárdia,** widespr.). **DIASPIDÌNÆ**

Scale of female not circular, but pyriform to linear, at least twice as long as wide, rarely, in certain gall-making species, the scale is reduced to a lining of the gall c

c. Male scale elongate, very unlike the broader female, usually tricarinate and white or pale-colored ..... d

Male scale essentially similar in form and structure to that of the female ..... e

d. Female scale with exuviæ small, not forming the greater part of the scale. (**Chionáspis,** widespr. (Figs. 235, 236, 237) (*C. fúrfura,* Scurfy scale; *C. pinifòliæ,* Pine leaf scale); **Hemichionáspis,** widespr., mainly indomal.; **Phenacáspis,** widespr.; **Poliáspis,** ethiop., indomal.) ..... **CHIONASPIDÌNÆ**

Female scale elongate (Fig. 232), formed in greater part by the puparium (nymphal exuvia which encloses the adult); secreted part of scale thin. (**Adiscofiorínia,** ethiop., indoaustr.; **Fiorínia,** indoaustr. (Fig. 232); **Trullifiorínia,** indoaustr.). **FIORINIÌNÆ**

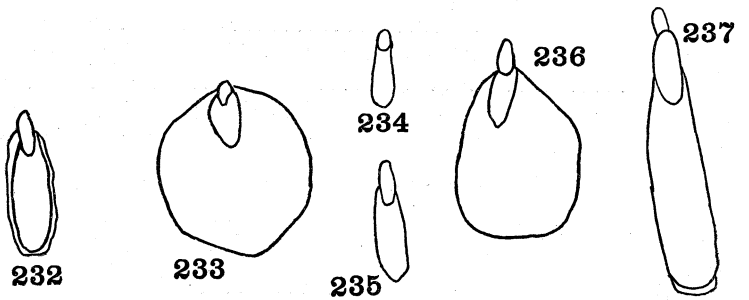
e. Pygidium usually edged with a continuous series of lobes and wide fringed processes (pectinæ), rarely with pointed narrow plates; preanal median group of wax glands often wanting, when present rarely with more than eight glands; scale white or whitish .. f

Pygidium of adult female or of second nymphal stage usually with pointed narrow plates, and pectinæ at most with narrow shafts; scale of adult female with second exuvia small, rarely covering half of scale; usually more than eight preanal wax glands; scale dark colored. Oyster-shell scales. (**Coccomýtilus,** widespr.; **Lepidósaphes** (=*Mytiláspis*), widespr. (Fig. 240) (*L. bécki,* Citrus purple scale; *L. úlmi,* Oyster-shell scale); **Pinnáspis,** Am., indomal.; **Scrupuláspis,** palæarc., indoaustr.). **LEPIDOSAPHÌNÆ**

f. Scale of adult female elongate, often pyriform, sometimes with parallel sides, formed mainly of the large puparium or nymphal

exuvia which encloses the adult; male scale not carinate; basal segments of abdomen without lateral projections. (**Leucáspis,** widespr.; **Suturáspis,** widespr.) ..... **LEUCASPIDÌNÆ**

Scale of adult female round with small marginal exuviæ, or subquadrangular with large exuviæ, or elongate with terminal exuviæ; puparium usually converted into the second exuvia; basal segments of abdomen with lateral projections. (**Cryptoparlatòria,** palæarc., austromal.; **Gymnáspis,** widespr.; **Parlatòria,** widespr. (*P. blánchardi,* Date palm scale); **Syngenáspis,** widespr.) ..... **PARLATORIÌNÆ**



Figs. 232–237. **Homoptera**

232. **Fiorinia,** female, outline of scale. Diaspididæ.
233. **Aulacaspis,** female, outline of scale. Diaspididæ.
234. **Aulacaspis,** male, outline of scale. Diaspididæ.
235. **Chionaspis,** male, outline of scale. Diaspididæ.
236. **Chionaspis,** broad female scale. Diaspididæ.
237. **Chionaspis,** narrow female scale. Diaspididæ.

Scale covering not containing the exuviæ of the early moults; pygidial segments less completely fused; legs present, even in adult female, tibio-tarsal suture obsolete; antennæ of adult female three-jointed; beak two-jointed. (**Conchàspis,** neotrop., Ceylon (Fig. 239); **Fasisùga,** Chile; **Scutàre,** neotrop.). **CONCHASPÍDIDÆ**

51. Female with posterior end cleft; anus closed by a pair of dorsal plates; larvæ also with the anal cleft bounded on each side by a prominent seta-bearing lobe or plate; beak one-jointed; wax glands very rarely paired to resemble the figure 8; body of adult female sometimes greatly convex, bare or encased in waxy or

cottony secretion. (**Ceroplástes,** cosmop. (*C. cerìferus,* Indian wax scale); **Lecànium,** cosmop. (Fig. 227) (*L. córni,* Brown scale; *L. hespéridum,* Soft brown scale; *L. pérsicæ,* Peach scale); **Lecaniópsis**; **Neolecànium,** Am.; **Physokérmes,** nearc.; **Pulvinària,** widespr. (*P. vìtis,* Cottony maple scale); **Saissètia,** widespr. (*S. òleæ,* Black scale); **Toumeyélla**). . . **LECANÌIDÆ**

Anal end of abdomen not medially cleft, if apparently cleft and provided with lobes some of the microscopic wax glands are paired to resemble the figure 8. 52

52. End of abdomen more or less narrowed or prolonged into a tubular anal projection; beak two-jointed. Species inhabiting galls, or enclosed in wax. 53

Abdomen not narrowed at tip or prolonged into an anal protuberance 54

53. Insects enclosed in a mass of resinous cells, each cell with three adjacent openings; adult female legless, body globular or subconical, with mouthparts at one end and three tubular processes at the opposite end, one of the projections bearing the anus and the other two the mesothoracic spiracles. Lac insects. (**Láccifer** (= *Tachárdia*), ind.; **Tachardiélla,** widespr.; **Tachardìna,** ethiop.). (*TACHARDÌIDÆ*). . . . . **LACCIFÉRIDÆ**

Insects forming galls. Usually on Eucalyptus trees; adult female segmented, top-shaped, with at least one pair of legs, or segmentation obsolete, head and thorax globular, abdomen reduced to a tubercle, and legs and antennæ wanting. Australian. Peg-top Coccids. (**Apiomórpha, Áscelis, Cystocóccus, Opisthóscelis**). (*BRACHYSCÉLIDÆ*) . . . . . **APIOMÓRPHIDÆ**

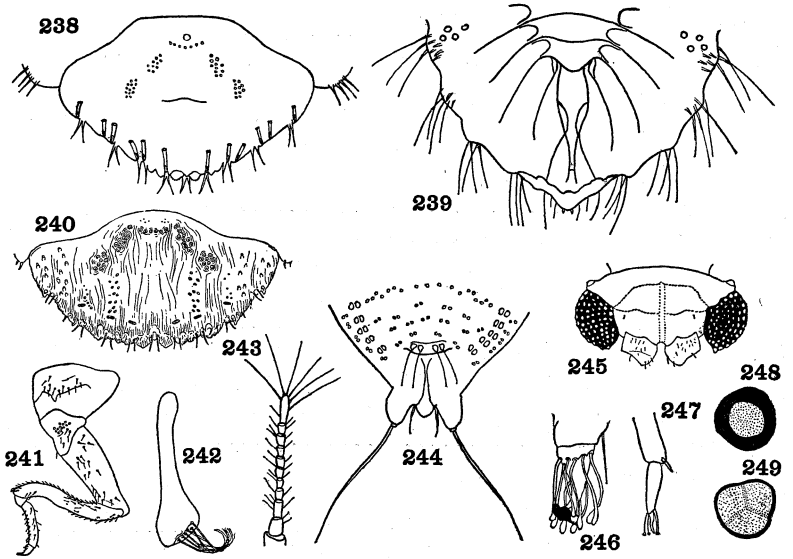
54. Wax glands distributed largely in pairs resembling the figure 8, generally arranged in rows; beak one-jointed; anal ring provided with setæ; legs of adult female vestigial or wanting. (**Asterolecànium,** widespr.; **Cerocóccus,** widespr. (Fig. 244); **Lecaniodiáspis,** widespr.; **Ollíffia,** austr.). **ASTEROLECANÌIDÆ**

Wax glands not seriately arranged in pairs resembling the figure 8. 55

55. Antennæ of adult female eleven-jointed; male eyes consisting of eight units arranged in a circle; anal ring distinct and provided with six prominent anal ring setæ, no anal lobes or anal setæ. (**Phenacoleachia,** Austr.) . . . . . **PHENACOLEACHÌIDÆ**

Antennæ of adult female with at most nine joints, often reduced or wanting; male eyes consisting of fewer parts, not arranged in a circle. 56

56. Adult female and all nymphs with no anal ring and corresponding setæ. 57
Adult female and intermediate nymphs with anal ring developed, with or without setæ, first stage nymphs with anal ring setæ. . 58



Figs. 238–249. **Homoptera**

238. **Lepidosaphes,** pygidium of adult female (Green) Diaspididæ.
239. **Conchaspis,** pygidium of adult female (Green) Conchaspididæ.
240. **Lepidosaphes,** pygidium of adult female (Quayle) Diaspididæ.
241. **Stigmacoccus,** leg of adult female (Morrison) Monophlebidæ.
242. **Matsucoccus,** halter of male (Morrison) Monophlebidæ.
243. **Icerya,** antenna of female (Riley) Monophlebidæ.
244. **Cerococcus,** pygidium of adult female (Green) Asterolecaniidæ.
245. **Matsucoccus,** male, dorsal view of head (Morrison) Monophlebidæ.
246. **Steingelia,** tip of tarsus of female (Morrison) Monophlebidæ.
247. **Rhizococcus,** tip of tibia and tarsus (Packard) Diaspididæ.
248. **Stigmacoccus,** simple disk pore (Morrison) Monophlebidæ.
249. **Stigmacoccus,** trilobate disk pore (Morrison) Monophlebidæ.

57. Adult female with all legs present and subequal in length, their antennæ normally seven-jointed, and body deep carmine red. Cochineal insects. (**Cóccus,** widespr. (orig. Am.); **Epicóccus,** Austr.) . . . . . **CÓCCIDÆ**

Adult female with some or all legs wanting, or when all legs present the hind pair are two or three times as long as the others; antennæ, if present, with less than seven joints, often vestigial or wanting. Southern hemisphere. (**Apiocóccus**, neotrop.; **Cylindrocóccus**, austr.; **Halimocóccus**, ethiop.; **Ourocóccus**, austr.). (*IDIOCÓCCIDÆ*)..... **CYLINDROCÓCCIDÆ**

58. Anal ring and distinct anal ring setæ present in young and adult females, anal lobes present. (**Antònia, Eriocóccus, Phenacóccus**, widespr.; **Gossypària**, holarc., austr. (*G. spùria*, Elm bark louse); **Pseudocóccus** (=*Dactylòpius*), cosmop. Mealy bugs; **Triónymus**, holarc.). (*PSEUDOCÓCCIDÆ, DACTYLOPIÌNÆ*). ..... **ERIOCÓCCIDÆ**

Adult female rarely with anal ring, female nymphs with anal ring and anal ring setæ, anal lobes not formed; adult female berry-like or gall-like, living on oaks. (**Kérmes** (= *Kermocóccus*), holarc., austr.). (*HEMICOCCÌNÆ*)..... **KERMÉSIDÆ**

59. Head freely articulated with the thorax; fore wings membranous, with veins and crossveins that enclose numerous cells. Terrestrial. (**Pelorídium** neotrop.; **Xenophỳes, Hemiodœcus**, austr.) ..... **PELORIDÌIDÆ**

Head more or less completely fused with the thorax, not movable; upper wings very thick, covering the whole abdomen; scutellum short and broad; aquatic. (**Plèa**, widespr.) .... **PLÈIDÆ**

LITERATURE ON BOTH HOMOPTERA AND HEMIPTERA

BANKS, N. Catalogue of Nearctic Hemiptera-Heteroptera. Philadelphia, Am. Ent. Soc., 103 pp. (1910).

BERG, C. Hemiptera Argentina. Anal. Soc. Cient. Argentina, **5-34** (1878–1892) (numerous parts).

BRITTON, W. E. (Editor). Hemiptera and Homoptera of Connecticut. Connecticut Nat. Hist. Surv., Bull. No. 34, 783 pp. (1923). (Various authors).

BUTLER, E. A. A Biology of the British Hemiptera-Heteroptera. London, 695 pp. (1923).

CHAMPION, G. C. Hemiptera-Heteroptera. In Biologia centrali-Americana, **2** (1897–1901).

DISTANT, W. L. Hemiptera-Heteroptera. In Biologia centrali-Americana, **1** (1880–1893).

Rhynchota in Fauna of British India, 5 vols., London (1902–10).

DOHRN, A. Catalogus Hemipterorum. Entom. Verein, Stettin, 112 pp. (1859).

GUÉRIN, J. and PENEAU, J. Faune entomologique armoricaine, Hémiptères. Trav. Sci. Univ. Rennes, **13**, pp. 201–301 (1915).

HORVÁTH, G. Nomenclature des familles des Hémiptères. Ann. Mus. Nat. Hungarici, **9**, pp. 1–34 (1911).

Hemiptera. Fauna Regni Hungariæ, **1**, pp. 5–64 (1918).

KIRKALDY, G. W. Hemiptera. Fauna Hawaiiensis, **3**, Pt. 2 (1902); **2**, Pt. 6 (1902).

LETHIERRY, L. and SEVERIN, G. Catalogue Générale des Hémiptères, 3 vols., Brussels (1893–96).

OSHANIN, B. Verzeichnis der paläarktischen Hemipteren. Ann. Mus. Zool. Acad. Imp. Sci. St. Petersbourg, **11–15** (1906–10).

Katalog der paläarktischen Hemipteren, 187 pp., Berlin (R. Friedländer und Sohn) (1912).

Vade mecum destiné a faciliter la détermination des Hémiptères. Hor. Soc. Entom. Rossicæ, **42**, No. 2, pp. 1–106 (1916). (Very complete and classified list of literature).

PENEAU, M. J. Hémiptères. In Houlebert, Encyclop. Sci., 2 vols. (1922).

STÅL, C. Bidrag till Rio Janeiro-traktens Hemipter-fauna. K. Svensk. Akad. Handl., **2** and **3** (1860–62).

Hemiptera africana, **1–4**, Holmiæ (1864–66).

Hemiptera Fabriciana. Svensk. Vet. Akad. Handl., **7** and **8** (1868–69).

Enumeratio hemipterorum. Svensk. Vet. Akad. Handl., **9–15** (1870–76).

VAN DUZEE, E. P. Catalogue of the Hemiptera of America north of Mexico, except Aphididæ, Coccidæ and Aleurodidæ. Univ. California Pubs. Ent., **2**, 902 pp. (1917).

LITERATURE ON HOMOPTERA (GENERAL)

(See also General List, p. 134)

DISTANT, W. L. Fauna of British India, **6**, 240 pp. (Homoptera appendix).

DISTANT, W. L. and FOWLER, W. W. Homoptera. In Biologia centrali-Americana, **1** (1881–1905).

EDWARDS, J. The Hemiptera Homoptera of the British Isles. 271 pp., London (1894–96).

FOWLER, W. W. Homoptera. In Biologia centrali-Americana, **2**, pt. 1 (1894–1909).

JENSEN-HAARUP, A. C. The Danish Homoptera. Copenhagen (1920).

MELICHAR, L. Die Homopterenfauna von Ceylon. 248 pp., Berlin (1903).

OSHANIN, B. Katalog der paläarktischen Hemipteren. 187 pp., Berlin (R. Friedländer und Sohn) (1912).

Vade mecum destiné a faciliter la determination des Hémiptères. Hor. Soc. Entom. Rossicæ, **42**, No. 2, pp. 1–106 (1916). (Very complete and classified list of literature).

VAN DUZEE, E. P. Catalogue of the Hemiptera of America north of Mexico, except Aphididæ, Coccidæ and Aleyrodidæ. Univ. California Publ. Tech. Bull. Entom., **2** (1917).

WALKER, F. List of specimens of Homopterous Insects in the British Museum, **1–4** (1850–52); Supplement (1858) London, British Museum.

SUBORDER AUCHENORRHYNCHA
CICADOIDEA

ASHTON, H. A Revision of the Australian Cicadidæ, Pt. 1. Proc. Roy. Soc. Victoria, **33**, pp. 87–107 (1921).

BUCKTON, G. B. A Monograph of the British Cicadæ. 2 vols., London (1890–91).

DELETANG, L. F. Monográfia de los Cicádidos Argentinos. An. Mus. Nac. Buenos Aires, **31**, pp. 538–649 (1923).

DISTANT, W. L. Monograph of the Oriental Cicadidæ. London, 158 pp. (1889–92).

A Synonymic Catalogue of the Cicadidæ. 207 pp., London, British Museum (1906).

Cicadidæ, Cicadinæ. Gen. Insectorum, fasc. 142, 64 pp. (1913).

Cicadidæ, Gæaninæ. Gen. Insectorum, fasc. 158, 38 pp. (1914).

HAUPT, H. Neueinteilung der Homoptera-Cicadina. Zool. Jahrb. Abth. f. Syst., **58**, pp. 173–286 (1929).

HORVÁTH, G. Cicadidarum genera palæarctica. Ann. Mus. Nat. Hungarici, **10**, pp. 599–609 (1912).

LAWSON, P. B. The Cicadidæ of Kansas. Kansas Univ. Sci. Bull., **12**, pp. 307–352 (1920).

MELICHAR, L. Die Cicadinen von Mitteleuropa. Berlin, 364 pp. (1896).

MOULTON, J. Cicadas of Malaysia. Journ. Fed. Malay States Mus., **11**, pp. 69–182 (1923).

MYERS, J. G. Insect Singers. A Natural History of the Cicadas. London, Geo. Routledge and Sons (1929). (Very complete bibliography).

MEMBRACOIDEA

BUCKTON, G. B. Monograph of Membracidæ. 296 pp., London (1901–03).

FUNKHOUSER, W. D. Review of the Philippine Membracidæ. Philippine Journ. Sci., **10**D, pp. 365–405 (1915).

Membracidæ. Gen. Cat. Hemip. fasc. 1 (1927) Smith College, Northampton, Mass.

GODING, F. W. Catalogue of Membracidæ of North America. Bull. Illinois State Lab. Nat. Hist., **3**, pp. 391–482 (1892).

A Monograph of the Australian Membracidæ. Proc. Linn. Soc. New South Wales, **38**, pp. 2–41 (1903).

Classification of the Membracidæ of America. Journ. New York Entom. Soc., **34**, pp. 295–317 (1926).

Revision of the Membracidæ of South America and the Antilles. Journ. New York Entom. Soc., **35**, pp. 183–191 (1927).

The Membracidæ of South America and the Antilles. Pt. 4, Trans. American Entom. Soc., **55**, pp. 197–330 (1929).

VAN DUZEE, E. P. Review of North American Membracidæ. Bull. Buffalo Soc. Nat. Sci., **9**, pp. 29–129 (1908).

CERCOPOIDEA

BAKER, C. F. Some Philippine and Malaysian Machærotidæ. Philippine Journ. Sci., **32**, pp. 529–548 (1927).

DOERING, K. Synopsis of North American Cercopidæ. Journ. Kansas Entom. Soc., **3**, pp. 53–64; 81–108 (1930).

GODING, F. W. Synopsis of Genera of North American Cercopidæ. Bull. Illinois State Lab. Nat. Hist., **3**, pp. 483–501 (1895).

LALLEMAND, V. Cercopidæ. Gen. Insectorum, fasc. 143, 167 pp. (1913).

MATSUMURA, S. Monographie der Cercopiden Japans. Journ. Sapporo Agric. Coll., **2**, p. 15 (1903) and Annot. Zool. Japonenses, **5**, pp. 31–55 (1904).

SCHMIDT, E. Monographie der Macherotiden. Stettiner Entom. Zeitg., **68**, pp. 165–200 (1907).

JASSOIDEA

BUYS, J. L. Cicadellidæ of Ithaca, New York. Mem. Cornell Univ. Agric. Expt. Sta., No. 80, 115 pp. (1924).

CRUMB, S. E. Partial Key to Genera of North American Jassidæ. Trans. Kansas Acad. Sci., **25**, pp. 129–137 (1914).

LATHROP, F. H. The Cicadellidæ of South Carolina. Bull. 199, South Carolina Agric. Expt. Sta. (1919).

LAWSON, P. B. The Cicadellidæ of Kansas. Kansas Univ. Sci. Bull., **12**, No. 1, Ent., 4, pp. 1–306 (1920).

MATSUMURA, S. Monographie der Jassinen Japans. Termes. Füzetek, **25**, pp. 353–404 (1902).

MCATEE, W. L. The Genera of the Eupterygidæ. Proc. Biol. Soc. Washington, **31**, pp. 109–124 (1918).

NAUDÉ, T. J. Cicadellidæ of South Africa. Entom. Mem. Dept. Agric. Pretoria, No. 4, 106 pp. (1926).

OSBORN, H. The Leafhoppers of Ohio. Ohio State Univ. Bull., **32**, pp. 199–374 (1928).

Neotropical Homoptera, Part 6. (Typhlocybinæ). Ann. Carnegie Mus., **18**, pp. 253–298 (1928).

FULGOROIDEA

BAKER, C. F. Spolia Mentawiensia: Homoptera Fulgoroidea. Philippine Journ. Sci., **32**, pp. 391–412 (1927).

CRAWFORD, D. L. Monograph of American Delphacidæ. Proc. U. S. Nat. Mus., **46**, pp. 557–640 (1914).

DOZIER, H. L. The Fulgoridæ of Mississippi. Tech. Bull. Mississippi Agric. Expt. Sta., No. 14, 152 pp. (1928).

GIFFARD, W. M. A Review of the Hawaiian Cixiidæ, with Descriptions of Species (Homoptera). Proc. Hawaiian Entom. Soc., **6**, pp. 51–156 (1925).

MATSUMURA, S. Uebersicht der Fulgoriden Japans. Entom. Nachricht., **26**, pp. 205–213; 257–270 (1900).

Beitrag zur Kenntnis der Fulgoriden Japans. Ann. Mus. Nat. Hungarici, **12**, pp. 261–305 (1914).

Die Cixiinen Japans. Annot. Zool. Jap. Tokyo, **8**, pp. 393–434 (1914).

MELICHAR, L. Monographie der Ricaniiden. Ann. Hofmus. Wien, **13**, pp. 197–359 (1898).

Monographie der Acanaloniden und Flatiden. Ann. Hofmus. Wien, **16**, pp. 178–258 (1901); **17**, pp. 1–253 (1902).

Monographie der Issiden. Abh. zool.-bot. Ges. Wien, **3**, pp. 1–327 (1906).

Monographie der Dictyopharinen. Abh. zool.-bot. Ges. Wien, **7**, pp. 1–221 (1912).

Monographie der Tropiduchinen. Verh. naturh. Ver. Brünn, **53**, pp. 82–225 (1914).

Monographie der Lophopinen. Ann. Mus. Hist. Hungarici, **13**, pp. 337–385 (1915).

METCALF, Z. P. Fulgoridæ of Eastern North America. Journ. Elisha Mitchell Sci. Soc., **38**, pp. 139–230 (1923).

MUIR, F. Derbidæ of the Philippine Islands. Philippine Journ. Sci., **12**D, pp. 49–104 (1917).

Classification of the Fulgoroidea. Proc. Hawaiian Entom. Soc., **5**, pp. 205–247 (1922).

South American Fulgoroidea, Pt. 1, Delphacidæ. Bull. Hawaiian Sugar Planters' Exp. Sta., No. 18 (1926).

Classification of the Fulgoroidea. Ann. Mag. Nat. Hist. (10), **6**, pp. 461–478 (1930).

MUIR, F. and GIFFARD, W. M. Studies in North American Delphacidæ. Entom. Bull. Hawaiian Sugar Planters' Expt. Sta., No. 15, 53 pp. (1924).

VAN DUZEE, E. P. Review of North American Delphacidæ. Bull. Buffalo Soc. Nat. Sci., **5**, pp. 225–261 (1897).

SUBORDER STERNORRHYNCHA

CHERMOIDEA

AULMANN, G. Psyllidarum catalogus. 92 pp. W. Junk, Berlin (1913).

BLÖTE, A. C. Overzicht der Nederlandsche Psyllidensoorten. Tijdschr. Entom., **69**, pp. 57–84 (1926).

CRAWFORD, D. L. Monograph of Psyllidæ of the New World. Bull. U. S. Nat. Mus., No. 85 (1914).

The Psyllidæ of the Hawaiian Islands. Proc. Hawaiian Entom. Soc., **3**, pp. 430–457 (1918).

ALEYRODOIDEA

BAKER, A. C. and MOLES, M. L. Aleyrodidæ of South America. Rev. Chilena Hist. Nat., **25**, pp. 609–648 (1923).

BEMIS, F. E. Aleurodidæ of California. Proc. U. S. Nat. Mus., **27**, pp. 471–537 (1904).

MASKELL, W. M. Contributions toward a Monograph of the Aleurodidæ. Trans. New Zealand Inst., **28**, pp. 411–449 (1896).

QUAINTANCE, A. L. Aleyrodidæ. Gen. Insectorum, fasc. 87, 11 pp. (1908).

QUAINTANCE, A. L. and BAKER, A. C. Classification of the Aleyrodidæ. Bull. Bur. Entom., U. S. Dept. Agric. Tech. Ser., No. 27, 109 pp. (1913).

A Contribution to our Knowledge of the Aleyrodinæ. Proc. U. S. Nat. Mus., **51**, pp. 335–445 (1917).

APHIDOIDEA

ANNAND, P. N. A Contribution toward a Monograph of the Adelginæ (Phylloxeridæ) of North America. Stanford Univ. Publ. Biol. Sci., **6**, pp. 1–146 (1928).

BAKER, A. C. A Generic Classification of the Hemipterous Family Aphididæ. Bull. U. S. Dept. Agric. 826, pp. 1–109 (1920).

BÖRNER, C. Das System der Phylloxerinen. Zool. Anz., **33**, pp. 600–612 (1908).

Beiträge zu einem neuen System der Blattläuse. Arch. Klass. Phylog. Ent., **1**, pp. 115–194 (1930).

Monographische Studie über die Chermiden. Arb. Kais. biol. Anst. Land. Forstwirtsch., **6**, Pt. 2 (1908).

BUCKTON, G. B. A Monograph of the British Aphides. 4 vols. London, Ray Soc. (1875–82).

CHOLODKOWSKY, N. Die Koniferen-Läuse Chermes. 44 pp. Berlin, Friedländer (1907).

DAVIDSON, J. A List of British Aphides. 176 pp. London, Longmans, Green & Co. (1925).

ESSIG, E. O. The Aphididæ of California. Univ. California Publ. Entom., **1**, pp. 301–346 (1917).

GOOT, P. van der. Zur Systematik der Aphididen. Tijdschr. Entom., **55**, pp. 69–154 (1903).

KIRKALDY, G. W. Catalogue of the Genera of Aphidæ. Canadian Entom., **37**, **38**, **40** (1905–08) (various parts).

LOMBARDI, D. Contribuzione alla conoscenza della tribu Fordina. Bull. Lab. Zool. Gen. Agrar. Portici, **7**, pp. 149–188 (1913).

MORDVILKO, A. K. Aphidoidea. Faune Russie, Hemiptera, **1**, pp. 237–508 (1919).

OESTLUND, O. W. Key to Aphididæ of Minnesota. 19th Rept. Minnesota State Entomologist, pp. 114–151, St. Paul (1923).

SCHOUTEDEN, H. Catalogue des Aphides de Belgique. Mém. Soc. Entom. Belgique, **12**, pp. 189–246 (1906).

TAKAHASHI, R. Aphididæ of Formosa. Pt. 1, from Agric. Expt. Sta. Govt. Formosa (1921); Pts. 2–5, Repts. 4, 10, 16, and 22 from Govt. Res. Sta. Formosa (1923, 24, 25, and 27).

THEOBALD, F. V. Aphididæ of Great Britain. I. 372 pp. London, Headley Bros. (1926).

WILSON, H. F. A Synopsis of the Aphid tribe Pterocommini. Ann. Entom. Soc. America, **8**, pp. 347–358 (1915).

WILSON, H. F. and VICKERY, R. A. Species List of Aphididæ of World and Food Plants. Trans. Wisconsin Acad. Sci., Arts, Letters, **19**, Pt. 1 (1918).

COCCOIDEA

CHAMBERLIN, J. C. Systematic Monograph of the Tachardiinæ. Bull. Entom. Research, **14**, pp. 147–212 (1923).

COCKERELL, T. D. A. Coccoidea. In Biologia centrali-Americana, Homoptera. **2**, Pt. 2 (1899).

FERNALD, M. E. Catalogue of the Coccidæ of the World. Bull. Massachusetts Agric. Expt. Sta., No. 88, 360 pp. (1903).

FROGGATT, W. W. A Descriptive Catalogue of the Scale Insects of Australia. Agric. Gazette New South Wales, **25** (1914) (six parts).

GREEN, E. E. The Coccidæ of Ceylon. 5 vols. London (1896–1922).

HALL, W. J. Observations on the Coccidæ of Southern Rhodesia. Bull. Entom. Res., **20**, pp. 345–376 (1929).

HEMPEL, A. As Coccidas do Brazil. Cat. Fauna Brasiliera. Rev. Mus. São Paulo, **3**, pp. 1–77 (1912).

KUWANA, I. The Diaspine Coccidæ of Japan. Imp. Plant Serv. Tech. Bulls., Nos. 1–3, 80 pp. (1925).

LEONARDI, G. Monografia delle Cocciniglie Italiane. 555 pp. Portici (1920).

LINDINGER, L. Die Schildläuse (Coccidæ) Europas, Nordafrikas und Vorderasiens. Stuttgart (1912).

MACGILLIVRAY, A. D. The Coccidæ. Scarab Co., Urbana, Ill. (1921).

MORRISON, H. The Non-diaspine Coccidæ of the Philippines. Philippine Journ. Sci., **17**, pp. 147–202 (1920).

Classification of Ortheziinæ. Journ. Agric. Res., **30**, pp. 97–154 (1925).

NEWSTEAD, R. A Monograph of the Coccidæ of the British Isles. 2 vols. London, Ray Soc. (1901–03).

STEINWEDEN, J. B. Bases for the Generic Classification of the Coccidæ. Ann. Entom. Soc. America, **22**, pp. 197–243 (1929).

ORDER **HEMÍPTERA**

(*HETERÓPTERA*; *RHYNCHÒTA*, part)

Terrestrial or aquatic species ranging from minute to large size; usually more or less flattened or cylindrical; feeding on the juices of plants or animals. Head free, bearing a sucking, inflexed, jointed beak which is usually inserted toward the front end of the head; antennæ with few joints, those of the terrestrial species usually long; in the

aquatic forms very short. Prothorax large, free; mesothorax and metathorax firmly united; scutellum very large. Wings overlapping on the abdomen, the fore pair (hemelytra) tough at the base and membranous apically, the hind pair with large anal field, the venation much reduced and irregular, wings sometimes reduced or absent; legs of variable form, tarsi usually three-jointed, rarely reduced to two, or one joint. Abdomen with ten visible segments, frequently the sternites are larger than the tergites; no cerci. Metamorphosis incomplete. True Bugs.

250

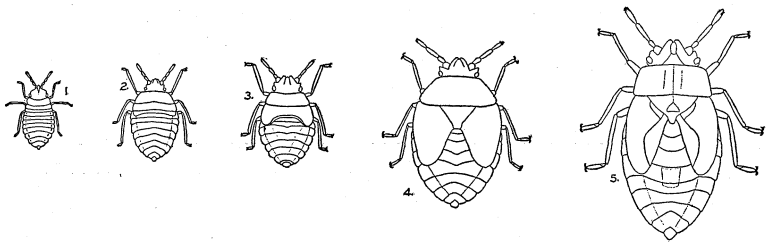


Fig. 250. **Hemiptera**

Piesma, developmental stages. Five larval instars, 1–5 (Barber) Piesmidæ.

1. Antennæ as long as or longer than the head, usually free, rarely (Phymatidæ) fitting in a groove under the sides of the prothorax, if the antennæ are slightly shorter than the head the eyes and ocelli are absent; tarsal claws with or without arolia. (*GEOCÓRISÆ*). Suborder GYMNOCÉRATA 2

   Antennæ shorter than the head, usually (except Ochteridæ) hidden in cavities beneath the eyes; meso- and metasternum composite, metasternal gland openings absent; tarsal claws without arolia; aquatic or hygrophilous species. (*HYDROCÓRISÆ*). Suborder CRYPTOCÉRATA 46

2. Eyes and generally also the ocelli present (eyes small in *Aepophilus,* Couplet 13) 3

   Both eyes and ocelli wanting; scutellum not formed 55

3. Claws apical, the last tarsal joint with entire tip 4

   Claws of at least front tarsi distinctly anteapical, the apex of the last tarsal joint more or less cleft; hind coxæ distant; upper

wings of uniform texture, the clavus, corium and membrane confluent; underside of body with silvery, velvety pubescence; aquatic, surface-living. Water striders, Jesus-bugs. (Superfamily GERRÓIDEA) 45

4. Head shorter than thorax including the scutellum; body rarely very narrow 5

Body linear; head horizontal, as long as the entire thorax and widened toward the apex; legs slender; upper wings with corium and membrane not separate; wings often absent; antennæ four-jointed. Marsh-treaders. (**Hydrómetra** (=*Limnóbates*), cosmop.) (Figs. 251, 252). (*LIMNOBÁTIDÆ*).... **HYDROMÉTRIDÆ**

5. Antennæ four-jointed, disregarding minute intermediate ring-joints or antenniferous tubercles on the head which are sometimes present; head not shield-like, the antennæ visible from above. (If the antennæ are five-jointed with the basal two joints thickened and visible from above, see Hebridæ, couplet 40) 6

Antennæ with five principal joints 39

6. Upper wings more or less lace-like in appearance, the small reticulate cells usually with membranous center; body with reticulate sculpturing; tarsi two-jointed; small, more or less flattened bugs, less than five mm. in length. Lace-bugs. (Superfamily TINGIDÒIDEA) 7

Upper wings and body not so reticulate; ocelli usually present... 8

7. Middle lobe of head (tylus) not extending forward as much as the side lobes (juga), the head appearing bifid in front; ocelli present; upper wings with the membrane not reticulate but the remainder reticulately punctate; pronotum not covering the scutellum. (**Piésma** (Fig. 250)) ..... **PIÉSMIDÆ**

Side lobes of head not prominent; ocelli absent; upper wings entirely reticulate; pronotum with an angular process extending over the scutellum and often with an anterior hood more or less covering the head. (**Phatnòma, Cantácader**, widespr.; **Acalýpta, Corýthucha** (Fig. 254), **Galeàtus**, palæarc., indomal.; **Gargáphia, Gelchóssa**). (*TÍNGIDÆ, TINGÍTIDÆ*). **TINGÍDIDÆ**

8. Tarsal claws devoid of basal pads (arolia), if very rarely the arolia are present (Miridæ, Reduvioidea) the meso- and metasternum are composite or the front legs are raptorial 9

Tarsal claws always provided with arolia; proboscis generally four-jointed; meso- and metasternum simple 31

9. Antennæ whip-like, the basal two joints very short, last two joints long and very slender, pilose, the third joint thickened at the base; ocelli present; proboscis three-jointed; tarsi three-jointed; veins of upper wings forming cells; small or minute species. (Superfamily DIPSOCORÒIDEA) 10

Third antennal joint not thickened at base, the second joint often longer than the third or equal to it, rarely shorter..... 11

10. Head more or less extended horizontally, or slightly bent down; proboscis long; eyes small; front coxal cavities not prominent. (**Ceratocómbus, Crescéntius**, ind.). (*CERATOCÓMBIDÆ, CRYPTOSTEMMÂTIDÆ*) ..... **DIPSOCÓRIDÆ**

Head transverse, inflexed between the prominent front coxæ; costa of fore wings not fractured. (**Hypselosòma** (=*Glyptocómbus*))..... **SCHIZOPTÉRIDÆ**

11. Meso- and metasternum composite, formed of more than one piece, very rarely the sutures obsolete, in which case the clypeus is triangulate (Cimicidæ); cuneus of the fully winged forms more or less distinct; hind coxæ hinged (except in a few Miridæ). (Superfamily CIMICÒIDEA) 12

Meso- and metasternum simple, formed of a single piece; hind coxæ rotating with a ball and socket joint (except in Saldidæ)..... 19

12. Proboscis three-jointed; upper wings, when developed, with an embolium; when the wings are vestigial no ocelli are present. (Compare also Microphysidæ, couplet 18, some of which have three-jointed proboscis, but no embolium) 13

Proboscis four-jointed 16

13. Metapleuræ without glands; body not broadly oval and thorax not flattened; occurring under stones along Atlantic coast of Europe. (**Aepóphilus**) ..... **AEPOPHÍLIDÆ**

Metapleuræ with glands 14

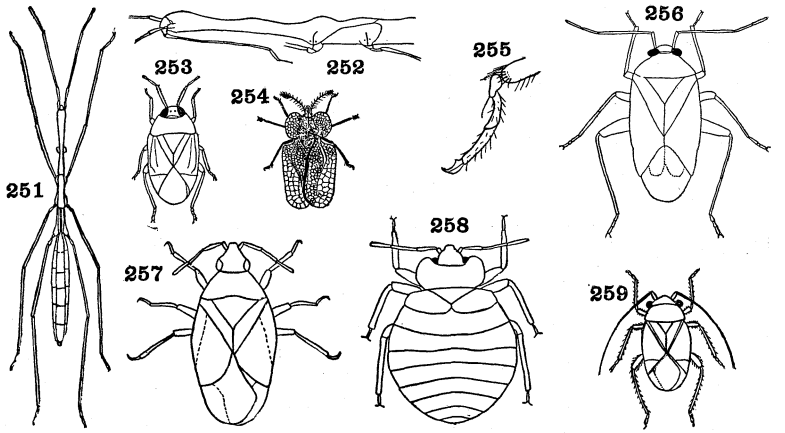
14. Wings vestigial; clypeus triangular, broader apically; ocelli absent; parasitic on man, bats and birds. Bedbug family. (**Cìmex** (*C. lectulàrius*, Bedbug) (Figs. 255, 258), **Hæmatosìphon**). (*ACANTHÌIDÆ* of authors, *CLINOCÓRIDÆ*). **CIMÍCIDÆ**

Wings usually well developed; sides of clypeus parallel or subparallel; ocelli present; proboscis three-jointed..... 15

15. Membrane of fore wings with many distinct veins; antennæ long and thin; proboscis long; gland opening of metathorax small; legs long and thin, similar; eyes large and bulging; moderately large species. (**Velocípeda**, indomal.)..... **VELOCIPÉDIDÆ**

Membrane with few veins, legs not lengthened; small species. Minute pirate-bugs. (**Anthócoris, Tríphleps,** cosmop. (*T. insidiòsus,* Predatory flower-bug)). (Fig. 257). **ANTHOCÓRIDÆ**

16. Ocelli of both sexes absent; tarsi three-jointed (exceptionally two-jointed in a few Miridæ) 17



Figs. 251–259. **Hemiptera**

251. **Hydrometra** (Miall) Hydrometridæ.
252. **Hydrometra,** profile of anterior portion of body (Hungerford) Hydrometridæ.
253. **Isometopus** (Heidemann) Isometopidæ.
254. **Corythuca** Tingididæ.
255. **Cimex,** tip of tibia and tarsus (Eysell) Cimicidæ.
256. **Lygus** (MacGregor) Miridæ.
257. **Triphleps** (MacGregor) Anthocoridæ.
258. **Cimex** (Patton and Cragg) Cimicidæ.
259. **Halticus** (Distant) Miridæ.

Ocelli present; membrane of upper wings with one or two small basal cells 18

17. Proboscis with basal joint scarcely longer than wide, not extending backward beyond middle of eyes; membrane of upper wings with a single large quadrangular cell. (**Hesperophỳlum, Termatophỳlum**) ..... **TERMATOPHÝLIDÆ**

Proboscis with basal joint longer than broad, usually reaching beyond hind margin of head; membrane with two, sometimes

one, small cells near base, rarely with irregular free veins. Leaf-bugs, Plant-bugs. (**Hálticus** (Fig. 259), **Psállus, Calócoris, Pœcilocápsus, Irbísia,** widespr.; **Lygus** (Fig. 256), (*L. praténsis,* Tarnished plant-bug), **Mìris,** cosmop.; **Cápsus, Camptóbrochis,** palæarc., indomal.). (*CÁPSIDÆ*).

MÍRIDÆ

18. Tarsi two-jointed; proboscis normally four-jointed, the third joint very small, or three-jointed. (**Mallochìola, Cyrtostérnum,** indomal.; **Pachytársus,** indomal.). **MICROPHÝSIDÆ**

Tarsi three-jointed. (**Cortícoris, Díphleps, Isometòpus,** palæarc., indomal. (Fig. 253), **Myiómma**) . . . **ISOMETÓPIDÆ**

19. Front legs not raptorial; prosternum without medial stridulation groove; head rarely cylindrical. 20

Front legs more or less raptorial; prosternum usually with a median transversely striated or granulated stridulation groove in front of the front coxæ; pronotum with a transverse groove; head cylindrical; proboscis three-jointed, fitted for piercing, rarely with an extra very short basal joint, the first joint stout and usually curved. (Superfamily REDUVIÒIDEA) 26

20. Ocelli absent; proboscis three-jointed or apparently so when the basal joint is minute; body flat, adapted for living under bark. (Superfamily ARADÒIDEA) 21

Ocelli present, when rarely absent the proboscis is four-jointed and the head is not apically widened. 23

21. Proboscis arising before the end of the head and lying in a groove between the cheeks. 22

Proboscis terminal, not lying in a ventral groove. (**Isodérmus,** austr., neotrop.; **Procympiùtus,** austr.) . . . . **ISODÉRMIDÆ**

22. Head not wide behind the eyes, which are prominent; proboscis longer than the head; trochanters very short, fusing with the femora; abdominal spiracles placed near the base of the segments. (**Áradus, Brachyrhýnchus,** cosmop.; **Eumenòtes,** indomal. (Fig. 260), **Carvéntus,** neotrop., indoaustr.).

ARÁDIDÆ

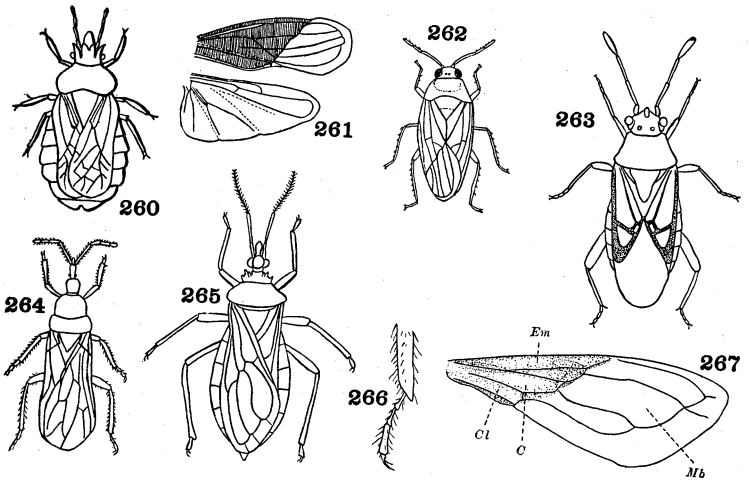
Posterior part of head wide, enclosing the eyes, often spinose; proboscis rarely longer than the head; trochanters distinct; abdominal spiracles remote from the base of the segments. (**Aneùrus, Mezìra, Neuróctenus**). (*MEZÍRIDÆ*).

DYSODÌIDÆ

23. Membrane of upper wings destitute of veins, more or less confluent with the membranous clavus. 24

Membrane furnished with four or five long closed cells, the clavus more or less distinct. Shore-bugs. (**Sálda,** cosmop.; **Sáldula, Pentácora** (Fig. 262)). (*ACANTHÌIDÆ* of some authors). **SÁLDIDÆ**

24. Ocelli approximated; semiaquatic bugs.....25
Ocelli widely separated; flattened, oblong-oval bugs with large porrect head. (Fig. 273). (**Xylastodòris** (Royal-palm bug). (*THAUMASTOCÓRIDÆ*)..... **THAUMASTOTHERÌIDÆ**



Figs. 260–267. **Hemiptera**

260. **Aradus** (Howard) Aradidæ.
261. Pentatomid bug, wings (Handlirsch) Pentatomidæ.
262. **Pentacora** (Torre Bueno) Saldidæ.
263. **Corizus** (Hambleton) Corizidæ.
264. **Henicocephalus** (Maxwell-Lefroy) Henicocephalidæ.
265. **Triatoma** (Chagas) Reduviidæ.
266. **Reduvius,** tip of tibia and tarsus (Eysell) Reduviidæ.
267. **Triatoma,** wings (Patton and Cragg). Em., embolium; Cl., clavus; C., corium; Mb., membranaceous area. Reduviidæ.

25. Antennæ long and slender; body narrow; tarsi three-jointed, the basal joint minute; corium submembranaceous with elevated veins. (**Mesovèlia,** widespr.) ..... **MESOVELÌIDÆ**
Basal two joints of antennæ thicker than the others; body robust, not over 2.5 mm. in length; tarsi two-jointed; head and thorax grooved beneath; body densely clothed with velvety pile.

(**Merragàta**; **Hèbrus**, widespr.). (*NÆOGÆIDÆ*). (See couplet 39) ..... **HÉBRIDÆ**, part

26. Pronotum divided into three lobes; head constricted at the base and behind the eyes, swollen between; upper wings wholly membranous, with longitudinal veins and a few crossveins; front tibiæ swollen; front tarsi one-jointed, hind tarsi two-jointed; minute, delicate species. (**Henicocéphalus**, cosmop. (Fig. 264), **Systellóderes**). (*ENICOCEPHÁLIDÆ*).
HENICOCEPHÁLIDÆ

Pronotum simple, often large and broad, or long and narrow; head not constricted at the base behind the eyes 27

27. Antennæ elbowed, slender, filiform or often very thin apically . . 28

Antennæ short, with the last joint swollen or enlarged; membrane with the veins joined, frequently forked and uniting; tarsi two-jointed; front legs very stout, raptorial, the front femora greatly thickened. (**Phýmata** (Ambush-bug); **Macrocéphalus**; **Amblythỳreus**, indomal.; **Carcinócoris**, indoaustr.). (*MACROCEPHÁLIDÆ*) ..... **PHYMÁTIDÆ**

28. Prosternum with a cross-striated median stridulation groove; proboscis three-jointed 29

Prosternum without a stridulation groove; proboscis usually four-jointed, rarely three-jointed 30

29. Front coxæ short; rather robust species, the body not linear; ocelli usually present; front legs raptorial, but not greatly modified. Assassin bugs. (**Acantháspis**, ethiop., indomal.; **Apiomèrus** (*A. crássipes*, Bee assassin); **Arìlus** (*A. cristàtus*, Wheel-bug); **Melanoléstes** (*M. pìcipes*, Kissing-bug); **Redùvius**, palæarc., ethiop., indoaustr. (Fig. 266); **Sìnea**, holarc.; **Triátoma** (=*Conorhìnus*) widespr. (*T. sanguisùga*, Big bedbug) (Figs. 265–267); **Oncocéphalus**, **Harpáctor**, **Piràtes**, widespr.)
REDUVÌIDÆ

Front coxæ greatly elongated; body greatly elongated, the middle and hind legs long and thin, the front legs highly raptorial; ocelli absent. Thread-legged bugs. (**Bárce**, **Ploiària** (=*Émesa*), widespr.; **Myióphanes**, palæarc., indoaustr.; **Stenolæmus**, **Gárdena**, widespr.). (*EMÉSIDÆ*) ..... **PLOIARÌIDÆ**

30. Legs slender, the front pair strongly raptorial; tarsi three-jointed; membrane of upper wings with more or less distinctly branched veins, or with two or three longitudinal cells emitting radiating veins. Damsel-bugs. (**Nàbis** (=*Coríscus*, = *Reduvìolus*), cosmop., **Págasa**) ..... **NÁBIDÆ**

Legs short, tarsi two-jointed; membrane with four free veins. (**Joppèicus**, palæarc.) ..... **JOPPEÍCIDÆ**

31. Membrane of upper wings with many longitudinal veins which often unite; antennæ inserted well up on the sides of the head; ocelli present. (Superfamily COREÒIDEA) 32

Membrane usually with a few veins, if many branching veins are present the ocelli are absent. (Superfamily LYGÆÒIDEA, *et al.*) 34

32. Fourth dorsal segment of the abdomen constricted medially; gland openings of the metathorax usually obsolete, if rarely visible, placed behind the hind coxal cavities and emitting two divergent grooves. (**Córizus**, cosmop. (Fig. 263); **Harmóstes**; **Serinètha**, ethiop., indomal.) ..... **CORÍZIDÆ**

Basal margin of fourth and fifth dorsal segments of the abdomen usually sinuate in parallel manner; gland openings of metathorax almost always distinct 33

33. Head much narrower and shorter than the prothorax, cheeks usually reaching behind the insertion of the antennæ; exterior margin of hind coxal cavities nearly parallel with axis of the body. (**Ánasa** (Figs. 269, 270, 274, 275) (*A. trístis*, Squash-bug); **Leptoglóssus**, widespr. (Fig. 268) (*L. phýllopus*, Leaf-footed bug); **Acanthócoris**, **Stenocéphalus**, widespr.; **Homœócerus**, ethiop., palæarc., indomal.; **Míctis**, widespr.; **Anoplocnèmis**, ethiop., indomal.) ..... **CORÈIDÆ**

Head nearly as broad and long as the prothorax, the cheeks scarcely extending behind the base of the antennæ; exterior margin of the hind coxal cavities more or less transverse. (**Álydus**, **Leptocórisa** (*L. trivittàta*, Box-elder bug), widespr.; **Cùru**, neotrop. indomal.; **Pròtenor**, **Stachyocnèmus**). (*CORÍSCIDÆ*) ..... **ALÝDIDÆ**

34. Ocelli present 35

Ocelli absent 38

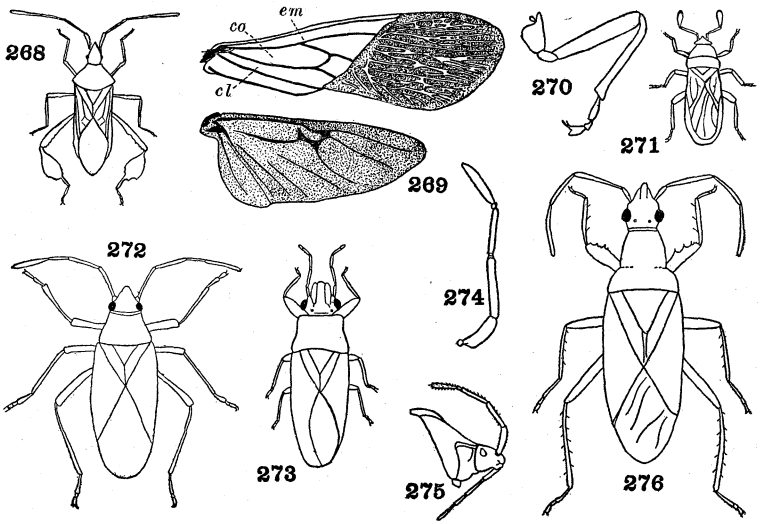
35. Wings when present long and narrow, without distinct veins; slender bugs with long thin antennæ and abdomen narrowed at base. Indoaustral. and neotropic. (**Colobathrístes**, **Perùda**, **Phænacántha**, **Málcus**) ..... **COLOBATHRÍSTIDÆ**

Membrane with veins 36

36. Antennæ not elbowed; head not constricted in front of the eyes. 37

Antennæ elbowed, the first joint long and clubbed, the last joint spindle-shaped; head constricted in front of the eyes; scutellum small; femora clubbed. Stilt bugs. (**Jálysus**, widespr.; **Nèides**, **Metacánthus**, palæarc., indomal.). (*BERÝTIDÆ*). **NEÍDIDÆ**

37. Veins of membrane usually four or five in number and not forming anteapical cells. (**Geócoris, Nýsius,** cosmop. (False chinch-bug); **Graptostèthus,** palæarc., ethiop., indomal.; **Oncopéltus,** widespr.; **Lygæus, Ligyrócoris** (Fig. 276), **Lygæosòma,** widespr.; **Blíssus** (*B. leucópterus,* Chinch-bug (Fig. 271))). (*GEOCÓRIDÆ, MYODÓCHIDÆ*). ..... **LYGÆIDÆ**



Figs. 268–276. **Hemiptera**

268. **Leptoglossus** (Chittenden) Coreidæ.
269. **Anasa,** wings (Tower) Coreidæ.
270. **Anasa,** leg (Tower) Coreidæ.
271. **Blissus** (Webster) Lygæidæ.
272. **Dysdercus** (Barber) Pyrrhocoridæ.
273. **Xylastodoris** (Barber) Thaumastocoridæ.
274. **Anasa,** antenna (Tower) Coreidæ.
275. **Anasa,** lateral view of prothorax and head (Hyatt and Arms) Coreidæ.
276. **Ligyrocoris** (Barber) Lygæidæ.

Veins of membrane four in number, arising distinctly from the corium, forming three large preapical cells and thence branching. (**Hyocéphalus,** austr.) ..... **HYOCEPHÁLIDÆ**

38. Membrane of upper wings with two large basal cells which emit seven or eight branching veins; stout bugs of moderate size. (**Dysdércus,** widespr. (Fig. 272) (Cotton stainers); **Physo-**

pélta, widespr.; **Euryophthálmus**; **Pyrrhócoris**, palæarc., ind.; **Ectatops**, **Antílochus**, ethiop., indoaustr.).

PYRRHOCÓRIDÆ

Membrane with few veins forming one or two basal cells. (See couplet 17) ..... **MÍRIDÆ**, part

39. Upper wings with the clavus membranous and confluent with the membrane which is devoid of veins; head and thorax grooved beneath; antennæ with the two basal joints stouter than the others; tarsi two-jointed; small, semiaquatic bugs. (See couplet 25). (**Hèbrus** (= *Neogœus*), widespr.) ..... **HÉBRIDÆ**

Upper wings with the clavus noticeably heavier than the membrane; antennæ with the first joint thickened, the second joint slender; head more or less expanded, the side margins acute in front of the eyes and thickened above the base of the antennæ; ocelli present; scutellum large or very large; terrestrial. (Superfamily SCUTELLERÒIDEA). (*PENTATOMÒIDEA*) 40

40. Scutellum excessively large, U-shaped and convex, covering the greater part of the abdomen; opaque part of the corium much narrowed toward the apex 41

Scutellum nearly always narrowed behind, more or less triangular; opaque part of the corium subtriangular, broad apically 44

41. Tibiæ not armed with strong spines 42

Tibiæ with two or more rows of distinct spines. Negro-bugs. (**Corimelæna** (= *Thyreócoris*)). (*THYREOCÓRIDÆ*).

CORIMELÆNIDÆ

42. Fore wings about twice as long as the abdomen, folded at the middle and at rest tucked under the scutellum; tarsi two-jointed. (**Brachýplatys**, ethiop., indoaustr.; **Coptosòma**, old world; **Platáspis**, palæarc.). (*COPTOSÒMIDÆ, PLATÁSPIDÆ*).

PLATASPÍDIDÆ

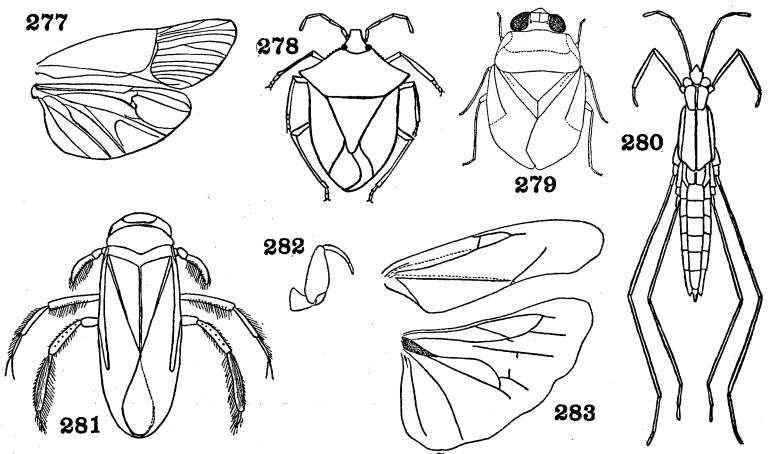
Fore wings of normal length, not folded; tarsi nearly always three-jointed 43

43. Sides of the prothorax without a strong tooth or lobe in front of the humeral angles and another on the front angles; hind wings with a heavy, abrupt, spur-like vein (hamus). Shield-back bugs. (**Eurygáster**, holarc.; **Homæmus**, widespr.; **Scutéllera**, **Chrysócoris**, **Pœcilócoris**, indomal.) ..... **SCUTELLÉRIDÆ**

Sides of the thorax with a prominent tooth or lobe in front of both the humeral and the front angles; eyes protuberant; hind wings with no hamus. (**Arctócoris**, palæarc.; **Oncozýgia**, **Pòdops**, widespr.). (*GRAPHOSOMÁTIDÆ*) ..... **PODÓPIDÆ**

44. Tibiæ strongly spinose, front legs fossorial; veins of the membrane radiating from the base. (**Aèthus,** widespr.; **Geótomus, Cýdnus,** cosmop.; **Brachypélta,** palæarc., ethiop., indoaustr.; **Cyrtómenus, Pangæus**) ..... **CÝDNIDÆ**

Tibiæ unarmed, or at most with weak spines, front legs not fossorial; veins of membrane extending from a vein which arises near the inner basal angle and lies nearly parallel with the edges of the corium. Stink-bugs. (**Brochýmena, Cosmopépla, Euschístus** (Fig. 278), **Murgántia** (*M. histriónica,* Harlequin cabbage-bug); **Pentátoma, Perîbalus, Podìsus, Catacántha** (Fig. 277)) ..... **PENTATÓMIDÆ**



Figs. 277–284. **Hemiptera**

277. **Catacantha,** wings (Kirkaldy) Pentatomidæ.
278. **Euschistus.** Pentatomidæ.
279. **Ochterus** (Garman) Ochteridæ.
280. **Gerris** (Miall) Gerridæ.
281. **Corixa** (Miall) Corixidæ.
282. **Corixa,** font leg (Kolbe) Corixidæ.
283. **Corixa,** wings (Handlirsch) Corixidæ.

45. Hind femora extending much beyond the apex of the abdomen, the posterior pairs of legs arising close together and very distant from the front pair; proboscis four-jointed, but the first joint short. (**Gérris,** cosmop. (Fig. 280); **Halóbates,** tropicopol.;

Rheumatóbates; **Onychótrechus**, **Chimarrhómetra**, indomal.). (*HYDROBÂTIDÆ*) ..... **GĔRRIDÆ**

Hind femora not extending much beyond the apex of the abdomen; middle legs about midway between the front and hind pairs (except *Rhagovelia*); proboscis three-jointed. Broad-shouldered water-striders. (**Microvèlia**, cosmop.; **Rhagovèlia**, cosmop.; **Vèlia**, Am., palæarc.) ..... **VELĬIDÆ**

46. Head articulated with the thorax as usual or at most partly fused with it; tarsi with more than a single joint 47

Head completely fused with the thorax, the boundary more or less indicated by a shallow impression; antennæ one- or two-jointed; eyes located rather dorsally; proboscis four-jointed; no distinct venation; anterior tarsi one-jointed, hind tarsi two-jointed, all tarsi with two claws; male genitalia strongly asymmetrical. **HELOTRÉPHIDÆ**

Two subfamilies, probably deserving family rank, may be distinguished as follows:

a. Antennæ two-jointed; body globose, shining; suture between head and pronotum visible as a fine impressed line; scutellum rounded on the sides, but little wider than long. (**Helótrephes**, indomal.) ..... **HELOTREPHĬNÆ**

Antennæ composed of a single flat, disk-like joint; suture between head and pronotum completely obliterated, except in the nymph; scutellum elongate, acutely triangular toward apex. (**Idiócoris**, **Páskia**, ethiop.) ..... **IDIOCORĬNÆ**

47. Front tarsi of the usual form 48

Front tarsi consisting of a single spatulate joint bearing a leaf-like claw; body flattened above; head overlapping the pronotum; proboscis very short, hidden, one- or two-jointed; middle legs long, hind legs formed for swimming; hind tarsi with indistinct bristle-like claws. Water boatmen. (**Coríxa**, cosmop.; **Micronécta**, palæarc., indomal.). (Figs. 281, 282, 283) .. **CORĬXIDÆ**

48. Upper wings of leathery consistency, with the clavus, corium and membrane developed; legs often modified for swimming or grasping 49

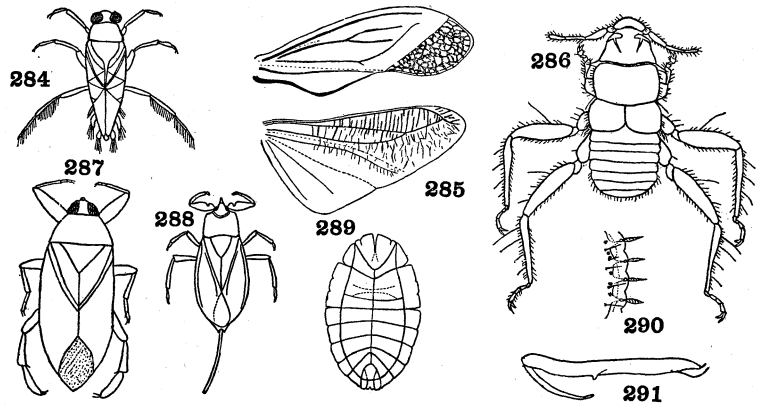
Upper wings transparent, the corium and membrane not separated, with longitudinal veins and crossveins that enclose numerous cells. Austr. and neotrop. (**Pelorídium**). (See page 134) ..... **PELORIDĬIDÆ**

49. Ocelli present; proboscis four-jointed; shore-living species 50

Ocelli absent; proboscis usually three-jointed; aquatic species .. 51

50. Antennæ exposed; front legs as long as the middle pair, formed for running; small active bugs. (**Óchterus** (= *Pelógonus*), widespr.) (Fig. 279). (*PELOGÓNIDÆ*) ..... **OCHTÉRIDÆ**

Antennæ hidden; front legs raptorial; short, broad species with prominent eyes. Toad-bugs. (**Mónonyx, Nérthra, Gelastócoris** (= *Gálgulus*)). (*GALGÙLIDÆ, GELASTOCÓRIDÆ, MONONÝCHIDÆ*) ..... **NÉRTHRIDÆ**



Figs. 284–291. **Hemiptera**

284. **Notonecta** (Miall) Notonectidæ.
285. **Nepa,** wings (Handlirsch) Nepidæ.
286. **Polyctenes** (Westwood) Polyctenidæ.
287. **Lethocerus** (Smith) Belostomatidæ.
288. **Nepa** (Miall) Nepidæ.
289. **Termitaradus** (Myers) Termitaphididæ.
290. **Termitaradus,** marginal lobe (Myers) Termitaphididæ.
291. **Ranatra,** apical portion of front leg (Hungerford) Nepidæ.

51. Front coxæ inserted at or near the front margin of the prosternum; front legs formed for grasping; hind tarsi with distinct claws. . 53

Front coxæ inserted at the hind margin of the short prosternum; legs fitted for swimming, the hind tarsi without claws; upper wings strongly convex, the membrane without veins; body convex above. Back-swimmers 52

52. Posterior tibiæ and tarsi ciliate; abdomen with a median carinate ridge below; beak four-jointed; eyes large. (**Notonécta,** cosmop.; **Ánisops,** widespr.; **Buénoa,** Am. (Fig. 284)).

NOTONÉCTIDÆ

Posterior tibiæ and tarsi simple, not ciliate; abdomen not carinate beneath; beak three-jointed; eyes small. (**Plèa,** widespr.). (See page 134). . . . . **PLEIDÆ**

53. Upper wings with the membrane reticulately veined; beak with very small labial palpi 54

Membrane without veins; beak without labial palpi; hind coxæ hinged; hind tibiæ slender, with small spines. Water creepers. (**Heleócoris,** widespr.; **Cheirochèla,** indomal.; **Ambrỳsus, Naucoris, Pelócoris**).

NAUCÓRIDÆ and **APHELOCHÍRIDÆ**

54. Hind coxæ hinged, hind legs fitted for swimming, posterior tibiæ flattened and fringed, hind femora usually sulcate; tip of abdomen with two short, flat, retractile appendages. Giant water-bugs, Electric light bugs, Toe-biters. (**Belóstoma, Benàcus, Ábedus, Lethócerus,** widespr. (Fig. 287); **Zàitha, Sphæródema**) . . . . . **BELOSTOMÁTIDÆ**

Hind coxæ globular, rotating; hind legs formed for walking, not flattened; apical appendages of abdomen long and slender, not retractile, forming a respiratory siphon. Water-scorpions. (**Laccótrephes,** palæarc., indoaustr.; **Cercomètus,** indomal. (Figs. 285–288); **Nèpa, Ránatra,** cosmop. (Fig. 291)).

NÉPIDÆ

55. Broadly oval, flat, completely wingless species; clypeus without movable appendage; living in termite nests. (**Termitàphis** (=*Termitócoris*), **Termitáradus** (Figs. 289, 290)). (*TERMITOCÓRIDÆ*) . . . . . **TERMITAPHÍDIDÆ**

Body oblong, head broadly triangular; upper wings vestigial; parasites of batr. (**Eóctenes, Hesperóctenes, Polýctenes,** widespr. (Fig. 286)), ... **POLYCTÉNIDÆ**

LITERATURE ON HEMIPTERA (GENERAL)

(See also general list on Homoptera and Hemiptera, p. 134)

BLATCHLEY, W. S. Heteroptera of Eastern North America. Indianapolis, Nature Pub. Co., 1116 pp. (1926).

GULDE, J. Die Wanzen (Hemiptera-Heteroptera) der Umgebung von Frankfurt a. M. Abh. Senckenberg. naturf. Ges., **37**, pp. 329–503 (1921).

MYERS, J. G. The order Hemiptera in New Zealand with special reference to its biological and economic aspects. New Zealand Journ. Sci. Tech., **5**, pp. 1–12 (1922).

MYERS, J. G. and CHINA, W. E. A List of New Zealand Heteroptera. Ann. Mag. Nat. Hist. (10) **1**, pp. 378–388 (1928).

PARSHLEY, H. M. List of Hemiptera of New England. Occ. Pap. Boston Soc. Nat. Hist., **7**, pp. 1–125 (1920).

Bibliography of North American Hemiptera-Heteroptera. 252 pp. Smith College, Northampton, Mass. (1925).

PUTON, A. Synopsis des Hémiptères-Hétéroptères de France, 4 vols. (1878–81).

SAUNDERS, E. The Hemiptera-Heteroptera of the British Isles. 350 pp. London (1892).

SEABRA, A. F. Sinopse dos Hemípteros Heteróperos de Portugal. Mem. Estud. Mus. Zool. Univ. Coimbra (1), No. 1, pp. 1–67 (1924–25).

STICHEL, W. Illustrierte Bestimmungstabellen der deutschen Wanzen. Berlin (1927).

TAEUBER, H. W. Beiträge zur Kenntnis der Heteropteren-Fauna der Philippinen. Konowia, **6**, pp. 165–201 (1927); **8**, pp. 194–233 (1929).

SUBORDER GYMNOCERATA

ATKINSON, E. T. Catalogue of the Capsidæ. Suppl. Journ. Roy. Asiatic Soc., **58**, pt. 2, pp. 25–200 (1889).

BARBER, H. G. Synoptic Keys to the Lygæidæ of the United States. Psyche, **24**, pp. 128–135 (1917); **25**, pp. 71–88 (1918).

Tingitoidea of New Jersey. Circ. New Jersey Dept. Agric. Bur. Statistics, No. 54, 24 pp. (1922).

BERGROTH, E. Gerridæ, Subfamily Halobatinæ. Ohio Naturalist, **8**, pp. 371–382 (1908).

Isometopidæ of New Zealand. Notulæ Entom., **4**, pp. 3–9 (1924).

BRUNER, S. C. Sinopsis de los Redúvidos de Cuba. Mem. Soc. Cubana Hist. Nat., **7**, pp. 65–82 (1926).

CHINA, W. E. and MYERS, J. G. Classification of the Cimicoid Families. Ann. Mag. Nat. Hist. (10), **3**, pp. 97–125 (1929).

COSTA LIMA, A. Insectos da Familia Polyctenidæ. Arch. Esp. Agric. Med. Vet. Nictheroy, **4**, pp. 61–71 (1920).

DEAY, H. O. The Coreidæ of Kansas. Kansas Univ. Sci. Bull., **18**, pp. 371–415 (1928).

DISTANT, W. L. Revision of Pentatomidæ in the Hope collection. Proc. Zoöl. Soc. London, 1900, pp. 807–825 (1900).

ESAKI, T. The Halobatinæ in the Hungarian National Museum. Ann. Mus. Nat. Hungarici, **23**, pp. 117–164 (1926).

ESAKI, T. and CHINA, W. E. A New Family (Helotrephidæ) of Hemiptera. Trans. London Entom. Soc., **75**, pp. 279–295 (1927).

Monograph of the Helotrephinæ. Eos, **4**, pp. 129–172 (1928).

FRACKER, S. B. Reduviidæ of North America. Proc. Iowa Acad. Sci., **19**, pp. 217–247 (1912).

Alydinæ of the United States. Ann. Entom. Soc. America, **11**, pp. 255–280 (1918).

Review of North American Coreini. Ann. Entom. Soc. America, **16**, pp. 165–173 (1923).

GIBSON, E. H. Isometopidæ of North America. Bull. Brooklyn Entom. Soc., **12**, pp. 73–77 (1917).

HANDLIRSCH, A. Monographie der Phymatiden. Ann. Hofmus. Wien, **12**, pp. 127–230 (1897).

HARRIS, H. M. A Monographic Study of the Hemipterous Family Nabidæ in North America. Entom. Americana, **9**, pp. 1–90 (1928).

HART, C. A. Pentatomoidea of Illinois with keys to nearctic genera. Ill. Nat. Hist. Surv. Bull., **13**, pp. 157–223 (1919).

HORVÁTH, G. Monographia Colobathristidarum. Ann. Mus. Hist. Nat. Hungarici, **2**, pp. 117–172 (1904).

Synopsis Tingitidarum regionis Palæarcticæ. Ann. Mus. Nat. Hungarici, **4**, pp. 1–118 (1906).

Revision des Leptopodides. Ann. Mus. Nat. Hungarici, **9**, pp. 358–370 (1911).

Revision of the American Cimicidæ. Ann. Mus. Nat. Hungarici, **10**, pp. 257–262 (1912).

Monographie des Mésoveliides. Ann. Mus. Nat. Hungarici, **13**, pp. 535–556 (1915).

Analecta ad cognitionem Cydnidarum. Ann. Mus. Nat. Hungarici, **17**, pp. 205–273 (1919).

Description of a New Bat-Bug from India. Rec. Indian Mus., **27**, pp. 191–192 (1925).

Mesoveliidæ. Gen. Cat. Hemiptera, pt. 2, 24 pp., Northampton, Mass., Smith College (1929).

HUSSEY, R. F. Pyrrochoridæ. Gen. Cat. Hemiptera, 144 pp. Northampton, Mass., Smith College (1929).

JOHANNSEN, O. A. North American Henicocephalidæ. Psyche, **16**, pp. 1–4 (1909).

JORDAN, K. Morphology and Systematics of the Polyctenidæ. Novit. Zool., **18**, pp. 555-579 (1912).

The American Polyctenidæ. Ectoparasites, **1**, pp. 204–215 (1922).

KIRITSCHENKO, A. Coreidæ, Coreinæ. Fauna Russie Hemiptera, **6**, pt. 2, pp. 1–395 (1916) (In Russian).

KIRKALDY, G. W. Catalogue of Hemiptera. Pentatomidæ (*Cimicidæ*). 392 pp. Berlin (1909).

Generic Key to Phyllocephalinæ, Phlocinæ and Dinidorinæ (Pentatomidæ). Canadian Entom., **45**, pp. 81–84 (1913).

KNIGHT, H. H. A Revision of the Genus Lygus in America North of Mexico. Bull. Cornell Agr. Exp. Sta., No. 391, pp. 555–645 (1917).

Key to Subfamilies of Miridæ. Journ. New York Entom. Soc., **26**, pp. 40–44 (1918).

Monograph of the North American species of Deræocoris (Miridæ). 18th Rept. St. Entom. Minnesota for 1920, pp. 76–210. Reprinted as Tech. Bull. I, Univ. of Minnesota Agr. Exp. Sta. (1921).

McAtee, W. L. Key to Nearctic Geocorinæ (Lygæidæ). Proc. Biol. Soc. Washington, **14**, p. 102 (1914).

Key to the Nearctic species of Paracalocoris (Miridæ). Ann. Entom. Soc. America, **9**, pp. 366–390 (1916).

Key to Piesmidæ. Bull. Brooklyn Entom. Soc., **14**, pp. 80–93 (1919).

Key to Nearctic Berytidæ. Journ. New York Entom. Soc., **27**, pp. 79–92 (1919).

McAtee, W. L. and Malloch, J. R. Revision of Cryptostemmatidæ in the United States National Museum. Proc. U. S. Nat. Mus., **67**, Art. 13, 42 pp. (1925).

Revision of the Ploiariinæ (Reduviidæ). Proc. U. S. Nat. Mus., **67**, Art. 1, 135 pp. (1925).

Morrison, H. On three apparently new species of Termitaphis. Zoologica, New York, **3**, pp. 403–408 (1923).

Myers, J. G. On the Systematic Position of the Family Termitaphididæ. Psyche, **31**, pp. 259–278 (1924).

Myers, J. G. and China, W. E. The systematic position of the Peloridiidæ. Ann. Mag. Nat. Hist. (10), **3**, pp. 282–294 (1930).

Osborn, H. and Drake, C. J. The Tingitoidea of Ohio. Ohio State Univ. Bull., **20**, pp. 217–251 (1916).

Parshley, H. M. Synopsis of the Pentatomidæ of New England. Psyche, **22**, pp. 170–177 (1915).

American species of Aradus. Trans. American Entom. Soc., **47**, pp. 1–106 (1921).

Pennington, M. S. Notas sobre Coréidos Argentinos. Physis, Buenos Aires, **5**, pp. 125–170 (1922).

Pinto, C. Ensaio Monográphico dos Reduvideos hæmatóphagos o "Barbieros." 118 pp. Rio de Janeiro (1925).

Classification des genres de la famille Triatomidæ. Bol. Biol. São Paulo, fasc. 8, pp. 103–114 (1927).

Poppius, B. R. Beiträge zur Kenntnis der Anthocoriden. Acta Soc. Sci. Fennica, **37**, No. 9, pp. 1–43 (1909).

Zur Kenntnis der Cylapinæ. Acta Soc. Sci. Fennica, **37**, No. 4, pp. 1–45 (1909).

Beiträge zur Miridenfauna Australiens. Öfv. vet. Soc. Förh., **53**, No. 3, pp. 1–16 (1911).

Beiträge zur Kenntnis der Miriden von Ceylon. Öfvers Vet. Soc. Helsingfors, **53**, No. 2, pp. 1–36 (1911).

Miriden der æthiopischen Region. Part I., Acta Soc. Sci. Fennica, **41**, pp. 1–203 (1912); Part II., ibid., **44**, pp. 1–138 (1914).

Readio, P. A. Biology of the Reduviidæ of America North of Mexico. Sci. Bull. Univ. of Kansas, **17**, pp. 1–248 (1927).

Reuter, O. M. Monographia anthocoridarum orbis terrestris. Acta Soc. Sci. Fennica, **14**, pp. 555–758. Also published separately (1885).

Monographia Ceratocombidarum orbis terrestris. Acta Soc. Sci. Fennica, **19**, pp. 1–28 (1891).

Die Familie der Bettwanzen. Zeits. wiss. Insektenbiol., **9**, p. 251 etc. (several parts) (1913).

Monographia Nabidarum orbis terrestris. Acta Soc. Sci. Fennica, **37**, pp. 1–62 (1909).

Neue Beiträge zur Phylogenie und System der Miriden. Acta Soc. Sci. Flor. Faun. Fennica, **37**, No. 3, pp. 1–167 (1910).

REUTER, O. M. and POPPIUS, B. R. Zur Kenntnis der Termatophyliden. Öfv. Finska Vet. Soc. Förh., **54**A, pp. 1–17 (1912).

SCHOUTEDEN, H. Pentatomidæ, Scutellarinæ. Gen. Insectorum, fasc. 24, 100 pp. (1904).

Pentatomidæ, Graphosomatinæ. Gen. Insectorum, fasc. 30, 46 pp. (1905).

Pentatomidæ, Aphylinæ. Gen. Insectorum, fasc. 47, 4 pp. (1906).

Pentatomidæ, Asopinæ = Amyoteinæ. Gen. Insectorum, fasc. 52, 82 pp. (1907).

Pentatomidæ, Dinidorinæ. Gen. Insectorum, fasc. 153, 19 pp. (1913).

SIGNORET, V. Revision du Groupe des Cydnides. Ann. Soc. Entom. France, **1–3** (various parts) (1881–83).

STONER, D. The Scutelleroidea of Iowa. Univ. Iowa Studies Nat. Hist., **8**, No. 4, pp. 1–140 (1920).

VAN DUZEE, E. P. Keys to Genera of North America Miridæ. Univ. California Pubs., Ent., **1**, pp. 199–216 (1916).

List of Pentatomidæ of America North of Mexico. Trans. American Entom. Soc., **30**, pp. 1–80 (1904).

WATSON, S. A. The Miridæ of Ohio. Ohio State Univ. Bull., **33**, 44 pp. (1928).

WHITE, F. B. Report on the Pelagic Hemiptera. Challenger Exped., Zoöl., **7**, pt. 19, p. 82 (1883).

ZIMMER, J. F. The Pentatomidæ of Nebraska. Univ. Nebraska, Contr. Dept. Entom., No. 4, pp. 1–33 (1912).

SUBORDER CRYPTOCERATA

FERRARI, E. Die Hemipterengattung Nepa. Ann. Hofmus. Wien, **3**, pp. 161–194 (1888).

HALE, H. M. Two New Hemiptera from New South Wales. Proc. Linn. Soc. New South Wales, **49**, p. 462 (1924).

Studies in Australian Aquatic Hemiptera. Rec. South Australian Mus., **3**, pp. 195–217 (1926).

HUEBER, T. Deutsche Wasserwanzen. Jahrb. Ver. Vaterl. Naturk. Würtemburg, **61**, pp. 91–176 (1905).

HUNGERFORD, H. B. The Biology and Ecology of Aquatic and Semiaquatic Hemiptera. Univ. Kansas Sci. Bull., **11**, pp. 3–265 (1919).

The Nepidæ of North America north of Mexico. Kansas Univ. Sci. Bull., **14**, pp. 425–469 (1922).

Revision of the Notonectidæ and Corixidæ of South Africa. Ann. South African Mus., **25**, pp. 375–474 (1929).

KIRKALDY, G. W. A guide to the study of British waterbugs (aquatic Rhynchota). Entom., **31**, pp. 177–180 (1898); continued in vols. 32, 33, 38, 39, 41 (1899–1908).

Revision of Notonectidæ. Trans. Entom. Soc. London, 1897, pp. 393–426 (1897) and Wiener Entom. Zeitg., **23**, pp. 111–135 (1904).

Notes on Corixidæ. No. I. Canadian Entom., **50**, pp. 117–120 (1908).

MAYR, G. L. Die Belostomiden. Verh. zool.-bot. Ges. Wien, **21**, pp. 399–440 (1871).

MELIN, D. Neotropical Gelastocoridæ (partial revision). Zool. Bidrag., **12**, pp. 151–198 (1930).

REUTER, O. M. Hemiptera Gymnocerata Europæ. 5 vols. (1878–96).

TORRE-BUENO, J. R. The Genus Notonecta in North America. Journ. New York Entom. Soc., **13**, pp. 143–167 (1905).

ORDER **ODONÀTA**

(*LIBELLULÒIDEA, PARANEURÓPTERA*)

Slender predatory insects, usually of large or very large size and usually strong fliers; head mobile, eyes large, three ocelli; antennæ minute, four- to seven-jointed; mouth inferior, mandibles strong, maxillary palpi one-jointed, labial palpi two-jointed; prothorax small but free, meso- and metathorax fused, oblique; cerci one-jointed; legs not large, similar, usually armed with spines, placed far forward, tarsi three-jointed; wings four, nearly alike, elongate, membranous, net-veined, not folded, with characteristic nodus, arculus and triangle (see Figs. 298, 299). Abdomen long and narrow, cylindrical or flattened, sometimes clubbed at apex; ovipositor sometimes complete; male sexual apparatus attached to the second sternite. Metamorphosis considerable, the nymphs aquatic, no resting pupal stage. Damsel flies, Dragon flies.

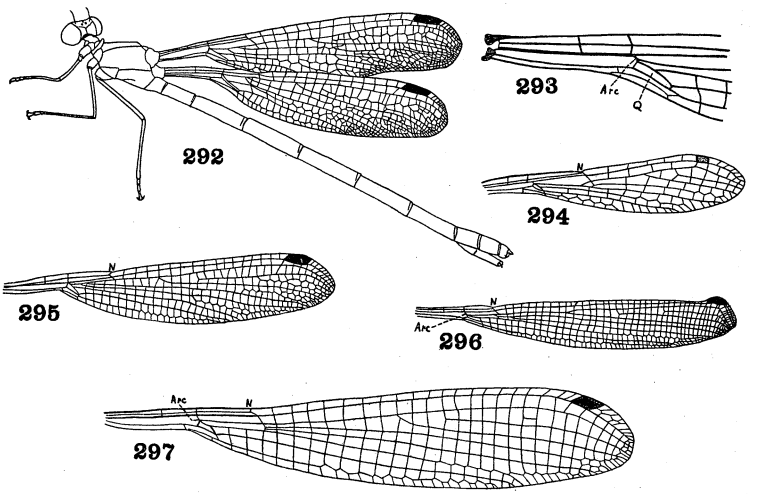
Adults

1. Discoidal cell in both fore and hind wings a simple quadrangle; wings more or less distinctly stalked at the base (Fig. 292), the fore and hind ones essentially alike in shape and venation; nodus almost always before the middle of the wing. Slender species, nearly always resting with the wings closed above the body 2

   Discoidal cell divided into two cells, a triangle and supratriangle; wings without a distinct narrowed stalk-like portion at the base; hind wings noticeably different from the fore ones in shape and venation; nodus at or beyond the middle of the wings, at least

in the fore pair; stouter bodied forms holding the wings extended horizontally from the sides of the body when at rest. (Suborder ANISÓPTERA) 14

2. Eyes strongly projecting from the sides of the head, often almost stalked and always separated by a distance greater than their width in dorsal view; mesothorax longer than wide; abdomen long and slender, cylindrical. (Fig. 292). (Suborder ZYGÓPTERA) 3



Figs. 292–297. **Odonata**

292. **Lestes** (Garman) Lestidæ.
293. **Chromagrion,** base of fore wing (Garman) Cœnagriidæ.
294. **Hemiphlebia,** wing (Needham) Hemiphlebiidæ.
295. **Megalestes,** wing (Needham) Synlestidæ.
296. **Mecistogaster,** wing (Needham) Pseudostigmatidæ.
297. **Nesobasis,** wing (Tillyard) Cœnagriidæ.

Eyes less noticeably projecting laterally; separated by less than their width (female) or almost contiguous above (male); mesothorax wider than long; abdomen distinctly swollen apically. (**Epiophlèbia,** Ind., Japan). (Suborder ANISOZYGÓPTERA). **EPIOPHLEBÌIDÆ**

3. Only two antenodal crossveins (except *Thaumatolestes* and *Neurolestes*) (Fig. 295); arculus at least as near to the nodus as to the

base of the wing; wings strongly petiolate; mesopleura not divided by an oblique suture. (Superfamily CŒNAGRIÒIDEA (=*CŒNAGRIONÒIDEA*)) 4

Five or more antenodal crossveins; arculus farther from the nodus than from the base of the wing (equidistant in some Libellaginidæ); wings less strongly petiolate; frequently with metallic coloration; mesopleura with a distinct oblique suture extending from the root of the wing toward the middle coxa. (Superfamily AGRIÒIDEA (=*AGRIONÒIDEA*)) 10

4. Second branch of cubitus strongly arched upwards at its base, just beyond the apex of the discoidal cell; discoidal cell very narrow, pointed apically; two, rarely three antenodal crossveins; nodus at the basal third of the wing. (Fig. 295). (**Synléstes,** Austr.; **Chloroléstes,** ethiop.; **Periléstes,** neotrop.; **Megaléstes**) ..... **SYNLÉSTIDÆ**

Second branch of cubitus straight, or very weakly curved upwards at the base. (Fig. 294) 5

5. Postnodal crossveins more or less completely in line with the crossveins beneath them (*i.e.* extending as straight lines from the costa to the first branch of the radius) 6

Postnodal crossveins not at all in line with the crossveins beneath them; discoidal cell open basally. Small, slender, metallic green species, with short wings. (Fig. 294). (**Hemiphlèbia,** Austr.). **HEMIPHLEBÌIDÆ**

6. Wing without any supplemental sectors extending inwards from the apical part of the hind margin 7

Wing with one or more supplemental sectors 8

7. Second branch of cubitus long, extending to beyond the middle of the wing (except *Chlorocnemis*); first anal vein usually present. (Fig. 297). (**Cœnágrion** (=*Ágrion,* auctt.), widespr.; **Ischnùra, Enallágma,** cosmop.; **Pseudágrion,** indoaustr.; **Árgia,** Am.; **Nehallènia,** holarc., neotrop.; **Chlorocnèmis,** ethiop.; **Platycnèmis,** palæarc.). (Including *PLATYCNÉMIDÆ*). (*CŒNAGRIÓNIDÆ*) ..... **CŒNAGRÌIDÆ**

Second branch of cubitus short, entering the wing margin before the middle of the wing; first anal vein usually absent. (**Nosostícta, Neostícta,** Austr.; **Protoneùra,** neotrop.). **PROTONEÙRIDÆ**

8. Last two branches of radial sector arising nearer to the nodus than to the arculus; apical angle of discoidal cell obtuse, rarely more or less acute 9

Last two branches of radial sector (R_{4+5} and IR_3) arising near the base of the wing, closer to the arculus than to the nodus (Fig. 292); discoidal cell drawn out to a very acute angle at apex. (**Léstes,** cosmop.; **Sympýcna,** palæarc.; **Archiléstes,** Am.; **Austroléstes,** austr.) ..... **LÉSTIDÆ**

9. Nodus at the basal third or fourth of the wing; pterostigma regular in shape, short or long. (**Megapodágrion,** neotrop.; **Argioléstes, Lestòidea,** austr.; **Podoléstes,** austromal.). **MEGAPODAGRÌIDÆ**

Nodus at the basal sixth or seventh of the wing; pterostigma weak, absent or of abnormal shape. (Fig. 296). (**Pseudostígma, Mecistogáster, Megalóprepus, Microstígma, Thaumatoneùra,** neotrop.) ..... **PSEUDOSTIGMÂTIDÆ**

10. Wings without a distinct petiole at the base, the posterior margin without any angulation basally near the arculus; antenodal crossveins numerous between the costa, subcosta and radius. 11

Wings with a distinct petiole at the base, marked off by an angulation of the posterior margin basally near the arculus; antenodal crossveins few in number (seven or less) and sometimes absent between the subcosta and radius. (**Amphípteryx,** neotrop.; **Diphlèbia,** neotrop., austr.; **Devadátta,** indomal.). **AMPHIPTERÝGIDÆ**

11. Sectors of arculus arising at or near the middle or below the middle of the arculus; discoidal cell with the basal side not longer than the apical one. 12

Sectors of arculus arising at the extreme upper end of the arculus and thus attached to the radius; discoidal cell irregular, the basal side longer than the apical one. (**Thóre, Eùthore, Chalcópteryx,** neotrop.) ..... **POLYTHÓRIDÆ**

12. Sectors of the arculus arising near the middle of the arculus; pterostigma long and regular. 13

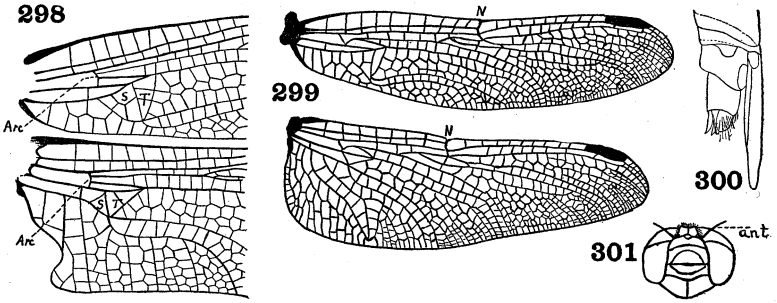
Sectors of the arculus arising from the lower third of the arculus; pterostigma frequently imperfect or obsolete in the male; whole wing, including the anal field, closely reticulate. (**Ágrion** (=*Calópteryx*) holarc.; **Hæterìna,** Am.; **Pentaphlèbia, Sàpho,** ethiop.; **Vestàlis,** indomal.; **Neuróbasis,** indoaustr.). (*CALOPTERÝGIDÆ*) ..... **AGRÌIDÆ**

13. Antenodal crossveins of the first and second series nearly all corresponding; arculus much closer to the base of the wing than to the nodus. (**Pseudophæa,** indomal.; **Dysphæa,** mal.; **Anisopleùra,** ind.) ..... **EPALLÁGIDÆ**

Antenodal crossveins of the first and second series not corresponding beyond the arculus; arculus often nearly as close to the base of the wing as to the nodus. (**Libellàgo,** ethiop.; **Rhinocỳpha,** indomal.; **Dictèrias, Heliócharis,** neotrop.).

LIBELLAGÍNIDÆ

14. Antenodal crossveins of the first and second series (*i.e.* above and below the subcostal vein) not corresponding or continuous, except for two greatly thickened ones that extend straight across from the costa to the radius; triangles in fore and hind wings alike or closely similar in shape and occupying the same position with reference to the arculus in both wings; labial palpi two-jointed. (Fig. 298). (Superfamily ÆSCHNÒIDEA)... 15



Figs. 298–301. **Odonata**

298. **Petalura,** base of wings (Needham) Petaluridæ.
299. **Libellula,** wings. Libellulidæ.
300. **Cordulegaster,** tip of abdomen of female (Tillyard) Cordulegastridæ.
301. **Libellula,** head; *ant.*, antenna (Hyatt and Arms) Libellulidæ.

Antenodal crossveins of the first and second series corresponding, extending as straight continuous veins from the costa to the radius, except sometimes the last one or two; none of these crossveins greatly thickened; triangles of fore and hind wings markedly different in form and position, placed much nearer to the arculus in the hind wing than in the fore wing. (Superfamily LIBELLULÒIDEA)..... 18

15. Eyes clearly separated above, usually by a broad space; anal loop absent in hind wing or very imperfectly developed. (Fig. 198). 16

Eyes meeting above, or separated by a very narrow space; anal loop in hind wing clearly formed.....17

16. Female with a well developed ovipositor; two of the crossveins between the third and fourth branches of the radius (R_3 and IR_3) strongly oblique; anal angle of hind wing of male angularly produced. (Fig. 298). Very large species. (**Petalùra,** Austr.; **Tachópteryx,** holarc.; **Phènes,** neotrop.; **Uropétala,** N. Zeal.) ..... **PETALÙRIDÆ**

Ovipositor reduced to a pair of valves attached to the eighth segment; only one oblique crossvein between the third and fourth branches of the radius; smaller species. (**Gómphus, Ophiogómphus,** holarc.; **Lindènia,** palæarc.; **Erpetogómphus,** Am.; **Ictìnus,** indoaustr.; **Austrogómphus,** austr.). **GÓMPHIDÆ**

17. Third branch of radial vein (nodal sector) strongly arched below the pterostigma; a thickened crossvein (brace vein) present just below the base of the pterostigma; eyes almost always contiguous for a long distance above. (**Ànax,** cosmop.; **Æschna,** widespr.; **Gynacántha,** neotrop., ethiop., indoaustr.; **Basiæschna,** nearc.; **Austrophlèbia,** austr.) ..... **ÆSCHNIDÆ**

Third branch of radial vein gently curved; no brace vein; eyes just touching or very slightly separated above; ovipositor long. (Fig. 300). (**Cordulegáster,** holarc.; **Anotogáster,** palæarc., indomal.; **Allogáster,** indomal.) .... **CORDULEGÁSTRIDÆ**

18. Triangle in fore wing not shortened, its upper side much more than half as long as its basal side; anal angle of wing almost always angulated in the male; posterior margin of eye slightly lobed at middle. (**Cordùlia,** holarc.; **Somatochlòra,** holarc., austr.; **Macromìa,** widespr.; **Tetragoneùria,** nearc.). **CORDULÌIDÆ**

Triangle in fore wing greatly shortened, its upper side usually less than half as long as its basal side; anal angle of wing rounded in both sexes; hind margin of eye evenly rounded. (Figs. 299, 301). (**Libéllula, Leucorrhínia, Sympètrum,** holarc.; **Pántala,** cosmop.; **Crocóthemis,** ethiop., indoaustr.; **Tràmea,** Am.; **Celíthemis,** nearc.) ..... **LIBELLÙLIDÆ**

Nymphs[1]

1. Body slender, bearing three long tracheal gills attached to the tip of the abdomen; these are usually leaf-like in shape and traversed by conspicuous tracheal tubes (rarely much reduced

[1] The following key will serve as an aid in determining the families, but must not be relied on as infallible.

in some Cœnagriidæ); lateral abdominal gills usually absent. (Suborder ZYGÓPTERA) 3

Body stout, the abdomen not narrow; without tracheal gills attached to the tip of the abdomen; the caudal gills concealed in an enlargement of the rectum; tip of abdomen bearing three spine-like or triangular processes 2

2. Gizzard with four to eight dental folds. (Suborder ANISÓPTERA) 12

Gizzard with sixteen dental folds; very rare Indian and Japanese species. (Suborder ANISOZYGÓPTERA).

EPIOPHLEBÌIDÆ

3. Mask bearing at least two pairs, and usually with numerous stiff bristles or setæ 4

Mask destitute of setæ both on the mentum and the lateral lobes. 6

4. Median lobe of mask incised; lateral lobes deeply cleft; caudal gills with the secondary tracheæ lying at right angles to the gill axis; legs long ..... **LÉSTIDÆ**

Median lobe of mask projecting, not incised; legs short or moderate in length 5

5. Caudal gills stalked, with pointed, leaf-like apical portion.

PSEUDOSTIGMÁTIDÆ

Caudal gills usually slender, lamellate, held in a vertical plane, not clearly stalked, often distinctly constricted.

CŒNAGRÌIDÆ

6. Second joint of antennæ greatly lengthened, as long as or longer than the following together. (Fig. 302) 7

Second joint of antennæ not noticeably lengthened 8

7. Median caudal gill flat, much shorter than the lateral ones which are triangular in section ..... **AGRÌIDÆ**

All three caudal gills of approximately the same size and shape.

SYNLÉSTIDÆ

8. Caudal gills strongly constricted at the middle. (Fig. 303).

PROTONEÙRIDÆ

Caudal gills not constricted at the middle 9

9. Abdomen with six or seven pairs of lateral gills; caudal gills swollen, sac-like 10

Abdomen without lateral gills 11

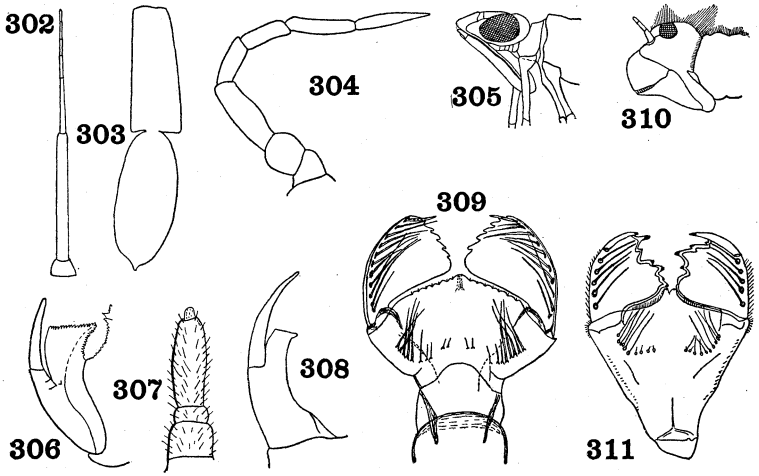
10. Caudal gills swollen, oblong, with sharply pointed tips.

EPALLÁGIDÆ

Caudal gills with the apex broad, not pointed.

POLYTHÓRIDÆ

11. Caudal gills broad and flat, leaf-like..... **MEGAPODAGRÌIDÆ**
Caudal gills not flat; rounded in cross-section and tapering to a point ..... **AMPHYPTERÝGIDÆ**



Figs. 302–311. **Odonata,** *Nymphs*

302. **Synlestes,** antenna of nymph (Tillyard) Synlestidæ.
303. **Isosticta,** caudal gill of nymph (Tillyard) Protoneuridæ.
304. Æschnid, antenna of nymph (Howe) Æschnidæ.
305. Æschnid, lateral view of head, with labium closed (Howe) Æschnidæ.
306. **Tachopteryx,** lateral lobe of labium (Howe) Petaluridæ.
307. Gomphid, antenna (Howe) Gomphidæ.
308. **Æschna,** lateral lobe of labium (Tillyard) Æschnidæ.
309. **Plathemis,** labium, open (Garman) Libellulidæ.
310. Libellulid, lateral view of head, with labium closed (Howe) Libellulidæ.
311. **Cordulegaster,** labium, open (Garman) Cordulegastridæ.

12. Antennæ seven-jointed; tarsi of all legs three-jointed 13
Antennæ four-jointed (Fig. 307); tarsi of front and middle legs two-jointed; mask with flat median lobe; distal margin of mentum not cleft ..... **GÓMPHIDÆ**
13. Labium forming a more or less spoon-shaped mask which covers the ventral and sometimes also the front surface of the head as far as the antennæ (Fig. 310); setæ usually numerous....14
Labium flat, not forming a spoon-shaped mask for the lower surface of the head (Fig. 305), almost always without setæ.....16

14. Lateral lobes of labium provided with a few large and irregular teeth on the inner margin that interlock from the two sides when closed; the median lobe divided at the tip by a median emargination (Fig. 311); mask extending to the base of the antennæ ..... **CORDULEGÁSTRIDÆ**

    Lateral lobes of labium variable in form, smooth, serrate, regularly dentate or sometimes with a few long teeth, but in the last case these do not interlock with those of the other side; median lobe triangular, projecting, not bifid or emarginate. (Fig. 309). 15

15. Teeth along inner margin of lateral lobes of labium deep or moderate, the dentition always clearly marked; legs usually long, with the hind femora longer than the width of the head; generally large species ..... **CORDULÌIDÆ**

    Teeth on inner margin of lateral lobes of labium usually reduced to crenulations or obsolete (in a few forms with long teeth the mask is either greatly enlarged (*Pantala*) or the species are very small (Tetratheminæ)) ..... **LIBELLÙLIDÆ**

16. Antennæ long and slender, the segments longer than wide (Fig. 304); lateral lobes of labium with a long movable hook (Fig. 308) ..... **ÆSCHNIDÆ**

    Antennæ short and stout, the segments wider than long; lateral lobes of labium with a short movable hook (Fig. 306). **PETALÙRIDÆ**

LITERATURE ON ODONATA

ANDRES, A. The Dragonflies of Egypt. Mem. Soc. Entom. Egypte, **3**, pp. 1–43 (1928).

BARTENEV, A. N. Libellulidæ II. Faune Russ. Pseudoneuroptera, **1**, pp. 353–576 (1919).

CALVERT, P. P. Odonata. In Biologia centrali-Americana, Neuroptera, **1**, pp. 17–420 (1901–08).

Odonata of Cuba. Trans. American Entom. Soc., **45**, pp. 335–396 (1919).

FRASER, F. C. Indian Dragonflies. Journ. Bombay Nat. Hist. Soc., **25–29** (numerous parts) (1918–25).

FRÖHLICH, C. Die Odonaten und Orthopteren Deutschlands. Jena (1903).

GARMAN, P. The Zygoptera of Illinois. Bull. Illinois State Lab. Nat. Hist., **12**, pp. 411–587 (1917).

Odonata of Connecticut. Bull. State Geol. Nat. Hist. Surv., Connecticut, No. 39, 331 pp. (1927).

HOWE, R. H. Manual of Odonata of New England. Mem. Thoreau Mus. Concord, Mass., **2**, 7 parts, 138 pp. and supplement (1917–23).

KELLICOTT, D. S. Odonata of Ohio. Ohio Acad. Sci., Special Paper, No. 2, 114 pp. (1899).

KENNEDY, C. H. Classification of Zygoptera. Ohio Journ. Sci., **21**, pp. 83–88 (1920).

KIRBY, W. F. Catalogue of Odonata. 202 pp., London (1890).

KRÜGER, L. Einführung in das Studium der Libellen. Abh. Ber. pommers. naturf. Ges., **6**, pp. 53–106 (1925).

LUCAS, W. J. British Dragonflies. London (1900).

MARTIN, R. Corduliidæ. Collection Zoologiques, Selys-Longchamps, fasc. 17 (1909).

Æschnidæ. Coll. Zool. Selys-Longchamps, fasc. 18–19 (1909).

Æschnidæ, Æschninæ. Gen. Insectorum, fasc. 115, 33 pp. (1911).

Cordulidæ. Gen. Insectorum, fasc. 155, 32 pp. (1914).

MUNZ, P. A. Keys for identification of genera of Zygoptera. Mem. American Entom. Soc., No. 3, 78 pp. (1919).

MUTTKOWSKI, R. A. Odonata of Wisconsin. Bull. Wisconsin Nat. Hist. Soc., **6**, pp. 57–123 (1908).

Catalogue of Odonata of North America. Bull. Pub. Mus. Milwaukee, **1**, Art. 1 (1910).

NEEDHAM, J. G. Manual of Dragonflies of China. Zoologica Sinica, Series A, 344 pp. Peiping, China (1930).

NEEDHAM, J. G. and HEYWOOD, H. B. Handbook of Dragonflies of North America. 378 pp., Springfield, Illinois (1929).

OGUMA, K. The Japanese Æschnidæ. Insecta Matsumurana, **1**, pp. 78–100 (1926).

RIS, F. Odonata. Süsswasserfauna Deutschlands, Heft 9, 67 pp. (1909).

Libellulidæ. Coll. Zool. Selys-Longchamps, fasc. 9–16 (1909–14).

Neuer Beitrag zur Kenntnis der Odonatenfauna der Neu-Guinea Region. Nova Guinea, Livr. 13, pt. 2, pp. 81–131 (1913).

Die Odonatenfauna von Argentina. Mem. Soc. Entom. Belgique, **22**, pp. 55–102 (1913).

Odonata of South Africa. Ann. South African Mus., **18**, pp. 247–452 (1921).

SCHMIDT, E. Odonata. In Tierwelt Mitteleuropas, **4**, Lief. **1**b, pp. IV 1–66 (1929).

SEEMAN, T. M. Dragonflies, Mayflies and Stoneflies of Southern California. Pomona Journ. Entom. Zool., **19**, pp. 1–69 (1927).

TILLYARD, R. J. The Biology of Dragonflies. University Press, Cambridge, England (1917).

WALKER, E. M. North American Species of Æschna. Univ. Toronto Biolog. Stud., No. 11, pp. 1–213 (1912).

North American Somatochlora. Univ. Toronto Stud. Biol. Ser., No. 26, 202 pp. (1925).

WILLIAMSON, E. B. Dragonflies of Indiana. Rept. Dept. Geol. Ind., No. 24, pp. 229–333 (1901).

North American Species of Macromia. Proc. U. S. Nat. Mus., **37**, pp. 369–398 (1909).

ORDER **PLECTÓPTERA**

(*EPHEMERÓPTERA, EPHEMÉRIDA, AGNÂTHA*)

Delicate insects with short, filiform antennæ and vestigial mouthparts; abdomen slender, bearing two or three long, many-jointed caudal filaments; four wings, usually with very complex venation. Head not very freely movable, with the compound eyes and three ocelli present; antennæ with two large basal joints and a bristle-like, indistinctly jointed terminal portion. Prothorax more or less free, small or very small; mesothorax large. Fore wings much larger than the hind ones, usually with many longitudinal veins and a great number of cross-veins; commonly with numerous short longitudinal veins near the margin that are not attached at the base; media more complex than in other living orders, its anterior, convex branch preserved; hind wings often very small or even absent. Abdomen slender, usually cylindrical or tapering, with ten segments. Legs weak; tarsi usually with five or four joints. Metamorphosis incomplete, the nymph aquatic and provided with abdominal gills and three caudal filaments. Aerial form emerging from the nymph as a subimago which is similar to the imago, but which molts when it transforms to the imago. Imaginal life very short. Mayflies.

Adults

1. Base of media (M_{1+2}) in fore wing strongly divergent from Cu_1 at base; hind tarsi with four movable joints, or less; if a fifth joint is indicated it is immovably united to the tibia. (Superfamily EPHEMERÒIDEA) 2

   Base of media and Cu_1 parallel at base or very weakly divergent; tarsi with four or five freely movable joints 5

2. Subcosta in fore wing concealed in a fold of the wing membrane, visible only at the base; branches of the radius and media approximated in pairs; wings dull, translucent; legs of female short and weak; tibiæ and tarsi of male transversely striated; only two caudal filaments. (**Palingènia**, **Anagenèsia**, palæarc.; **Plethogenèsia**, indoaustr.) ..... **PALINGENÌIDÆ**

   Subcosta completely developed, visible for its entire length 3

3. Wings translucent, subopaque in the male, entirely opaque in the female; hind margin of wings without unattached veinlets; legs weak, the front pair sometimes long in the male; hind legs almost always short and weak. (**Euthyplòcia**, neotrop., ethiop.;

Exeuthyplòcia, Povílla, ethiop.; **Campsùrus,** neotrop.; **Polymitárcys,** widespr.) ..... **POLYMITÁRCIDÆ**

Wings transparent, shining; margin of wings, especially the hind pair, with numerous short unattached veinlets; legs strong, functional 4

4. First branch of cubitus in fore wing simple, not branched, but connected with the wing margin by numerous crossveins; fork of R_2 and R_4 in hind wing much longer than its stalk. (**Ephémera,** holarc., indoaustr.; **Hexagènia,** Am., ethiop.; **Eatónica,** ethiop.; **Pentagènia,** nearc.) ..... **EPHEMÉRIDÆ**

First branch of cubitus in fore wing forked; not connected to the wing margin by crossveins; fork of R_2 and R_4 in hind wing shorter or no longer than its stalk. (**Potamánthus,** holarc.; **Rhœnánthus,** palæarc., indoaustr.; **Potamanthòdes,** indomal.) ..... **POTAMÁNTHIDÆ**

5. Hind tarsi with four freely movable joints; if with the indication of a fifth joint, this is immovably attached to the tibia. (Superfamily BAETÒIDEA) 6

Hind tarsus with five freely movable joints 10

6. Subcosta in fore wing fused with the radius or wanting, at most visible at the base; wings milky or grayish, with very simple venation, the fore wing with only four to seven longitudinal veins, with crossveins in only from two to five of the anterior spaces; hind wing without or with very few crossveins which are restricted to the anterior part; large or medium sized species. (Fig. 314). (**Oligoneùria,** palæarc., neotrop., ethiop.; **Homoneùria, Lachlania,** nearc.; **Spaniophlèbia, Nòya,** neotrop.; **Elassoneùria,** ethiop.) ..... **OLIGONEURÌIDÆ**

Subcosta in fore wing free, well developed and visible for its entire length 7

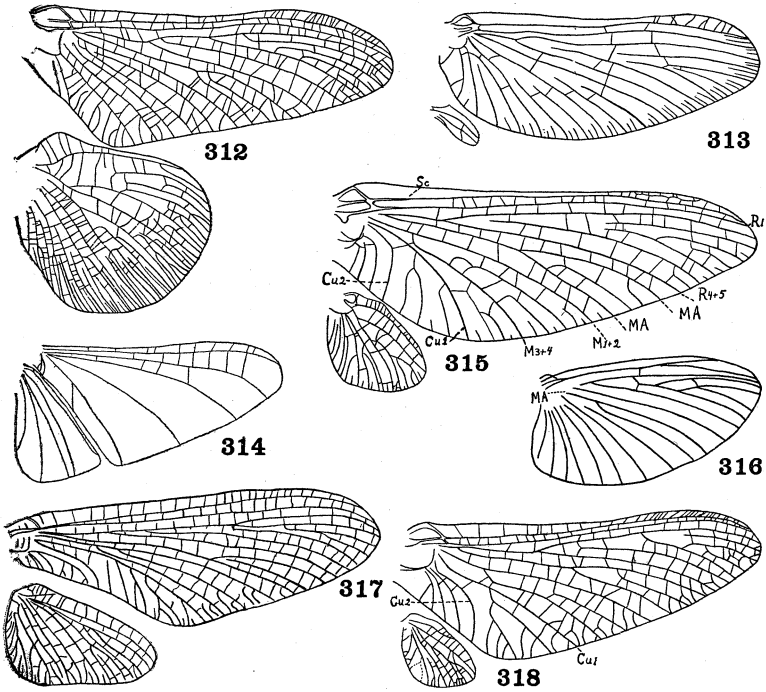
7. Anterior median vein in fore wing (MA) clearly forked 8

Anterior median vein in fore wing, simple, not forked, although behind it are two free veins which are not attached at the base (Fig. 313); fore wing usually with few crossveins; hind wings very small and narrow, sometimes absent, with at most two or three longitudinal veins. (**Clòeon,** cosmop.; **Baètis,** widespr.; **Centróptilum,** holarc., ethiop.; **Callibaètis,** Am.) .. **BAÉTIDÆ**

8. Wings milky or infuscated, ciliate on the hind margin; hind wings absent, although sometimes present in the subimago; no unattached intercalated veins; frequently with only a few crossveins; small species. (Fig. 316). (**Caènis,** widespr.; **Tricory-**

phòdes, Leptòhyphes, Am.; **Leptohyphòdes,** neotrop.; **Tricórythus,** ethiop.). (Including *PROSOPISTOMÁTIDÆ*?). (*BRACHYCÉRCIDÆ*) ..... **CAËNIDÆ**

Wings hyaline; hind wings almost always present; wings with numerous crossveins 9



Figs. 312–318. **Plectoptera**

312. **Baetisca,** wings (Eaton) Baetiscidæ.
313. **Baetis,** wings (Eaton) Baetidæ.
314. **Oligoneuria,** wings (Eaton) Oligoneuriidæ.
315. **Ephemerella,** wings (Eaton) Ephemerellidæ.
316. **Caenis,** wing (Eaton) Caenidæ.
317. **Chirotenetes,** wings (Needham) Siphluridæ.
318. **Atalophlebia,** wings (Eaton) Leptophlebiidæ.

9. Second branch of cubitus in the fore wing usually widely separated at base from the first branch, but lying close to the first anal vein; no unattached intercalated veins between the media and cubitus and none in front of the posterior branch of the media.

(Fig. 318). (**Thraùlus,** palæarc., neotrop., indoaustr.; **Atalophlèbia,** neotrop., indoaustr.; **Habrophlèbia, Leptophlèbia,** holarc.; **Adenophlèbia,** ethiop.) ..... **LEPTOPHLEBÌIDÆ**

Second branch of cubitus in fore wing approximate at base to the first branch, but widely separated from the first anal vein; several (usually two) unattached intercalated veins between the media and cubitus and also in front of the posterior branch of the media. (Fig. 315). (**Ephemerélla, Chitonóphora,** holarc.; **Drunélla,** nearc.; **Melanomerélla,** neotrop.; **Teloganòdes,** indoaustr.) ..... **EPHEMERÉLLIDÆ**

10. First and second branches of the cubitus running more or less parallel to the first anal vein; Cu_1 and Cu_2 connected by crossveins, but the cubital area without paired crossveins or sinuous veins extending to the wing margin; hind wings rounded, with numerous long intercalated veins extending to the posterior part of the wing margin; prothorax very small. (Fig. 312). (**Baetísca,** nearc.) ..... **BAETÍSCIDÆ**

First and second branches of the cubitus very close together at base and strongly divergent apically, the second branch much shorter than the first and strongly curved backwards towards apex, hind wings oval; pronotum well developed 11

11. Cubital area of fore wing with a number of more or less sinuous veins extending from the first branch of the cubitus to the wing margin. (Fig. 317). (**Amelètus,** holarc., austr.; **Chirotónetes, Siphlùrus** (=*Siphlonùrus*), holarc.; **Siphlonísca,** nearc.; **Oniscigáster,** indoaustr.). (*SIPHLONÙRIDÆ*).. **SIPHLÙRIDÆ**

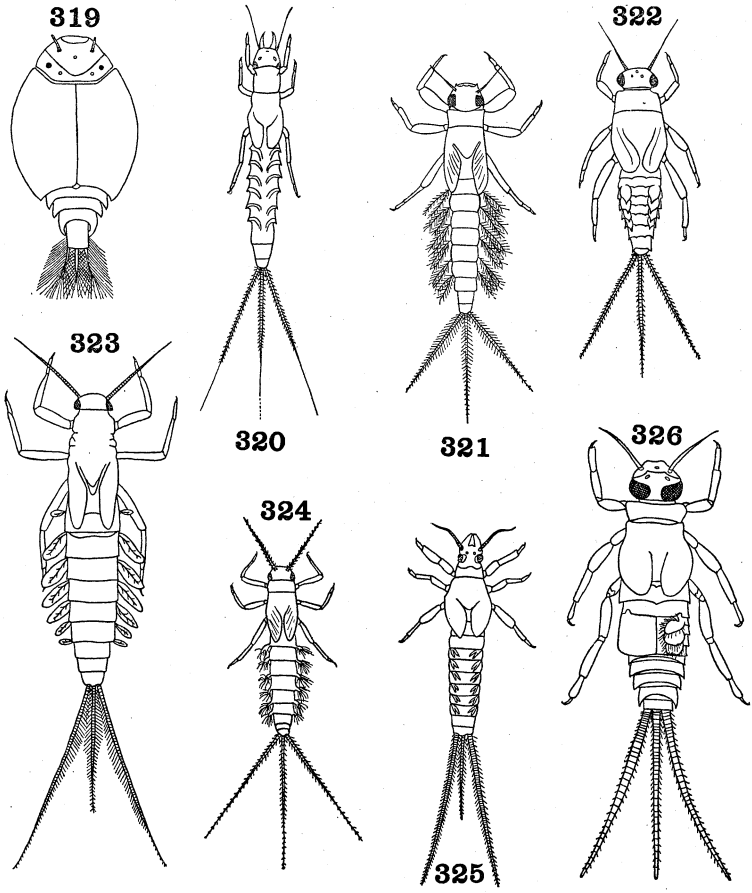
Cubital area of fore wing without oblique sinuous veins extending from the first branch of the cubitus to the wing margin, but with from two to four straight unattached veins more or less parallel to the branches of the cubitus 12

12. Only two unattached intercalated veins in the cubital area of the fore wing; if sometimes with a second pair indicated, these are short and lie close to the second branch of the cubitus; two or three caudal filaments. (**Amétropus, Métropus,** palæarc.). **AMETROPÓDIDÆ**

Four unattached intercalated veins in the cubital area of the fore wing, the longer pair lying close to the second branch of the cubitus; two caudal filaments. (**Heptagènia, Epeòrus,** holarc.; **Ìron,** nearc., **Ecdyonùrus,** palæarc., Am.; **Rhithrógena,** palæarc.; **Atópopus,** indoaustr.). (*ECDYONÙRIDÆ*). **HEPTAGENÌIDÆ**

Nymphs

1. Abdominal gills visible at their insertion above or on the sides of the abdomen 2
   Gills entirely concealed by a large shield-like prolongation of the thorax behind which covers most of the abdomen. (Fig. 319). Imago unknown. (**Prosopístoma**, palæarc., ethiop.).
   PROSOPISTOMÁTIDÆ
2. Mandibles usually very long and extended anteriorly; six or seven pairs of plumose gills, the first sometimes much reduced; legs stout 3
   Mandibles very short, not extended anteriorly; gills not plumose; legs slender 6
3. Mandibles extremely large and projecting far beyond the head in front; gills extended dorsally over the abdomen 4
   Mandibles much shorter, but slightly projecting in front of the head; gills extended laterally, away from the abdomen. (Fig. 321) ..... **POTAMÁNTHIDÆ**
4. Front with two tubercles anteriorly; mandibles curved outwards at tips; antennæ with long cilia ..... **EPHEMÉRIDÆ**
   Front without tubercles; mandibles curved downwards at tips; antennæ without or with short cilia 5
5. Body short and stout; six pairs of similar gills; caudal filaments short, the median one shorter than the lateral ones. (Fig. 325).
   PALINGENÏIDÆ
   Body long and slender; seven pairs of gills, the first pair much reduced in size; anal filaments long, of equal length. (Fig. 320).
   POLYMITÁRCIDÆ
6. Body strongly flattened, the head orbicular, or more or less transverse, the eyes placed on its dorsal surface 7
   Body more or less cylindrical, not or very slightly flattened, the eyes placed at the sides of the head 8
7. Gills uniform, extending from the sides of the abdomen; anal filaments at least as long as the body ..... **HEPTAGENÏIDÆ**
   First pair of gills inserted on the under side of the first abdominal segment, the six following pairs extended from the sides of the abdomen ..... **OLIGONEURÏIDÆ**
8. Lateral caudal filaments (cerci) fringed on both edges 9
   Lateral caudal filaments ciliated on the inner border only 11
9. Seven pairs of gills, inserted laterally at the sides of the abdomen; sometimes all are filamentous or the first is much reduced and the others leaf-like. (Fig. 324) ..... **LEPTOPHLEBÏIDÆ**



Figs. 319–326. **Plectoptera,** *Nymphs*

319. **Prosopistoma,** nymph (Rousseau) Prosopistomatidæ.
320. **Polymitarcys,** nymph (Rousseau) Polymitarcidæ.
321. **Potamanthus,** nymph (Rousseau) Potamanthidæ.
322. **Ephemerella,** nymph (Rousseau) Ephemerellidæ.
323. **Baetis,** nymph (Rousseau) Baetidæ.
324. **Habrophlebia,** nymph (Rousseau) Leptophlebiidæ.
325. **Palingenia,** nymph (Rousseau) Palingeniidæ.
326. **Tricorythus,** nymph (Rousseau) Caenidæ.

Five or six pairs of gills, inserted dorsally at the sides of the abdomen 10

10. Six pairs of gills, the first very small, the second greatly enlarged and covering the following pairs which bear a long fringe. (Fig. 326) ..... **CAÉNIDÆ**

Five pairs of gills, the last or the last two pairs not visible. (Fig. 322) ..... **EPHEMERÉLLIDÆ**

11. Body cylindrical; head bent downwards; hind corners of abdominal segments not produced. (Fig. 323) ..... **BAÉTIDÆ**

Body more or less flattened; head horizontal or nearly so; hind corners of abdominal segments produced backwards to form a tooth-like projection 12

12. Claws not longer than the tibiæ ..... **SIPHLÛRIDÆ**

Claws of four posterior legs stout, as long as their tibiæ, those of the front legs bifid at tips ..... **AMETROPÓDIDÆ**

LITERATURE ON PLECTOPTERA

CHOPRA, B. Indian Ephemeroptera: Ephemeroidea. Rec. Indian Mus., **29**, pp. 91–138 (1927).

EATON, A. E. Revisional monograph of recent Ephemeridæ. Trans. Linn. Soc. London, (2), **3**, (1883–85).

Ephemeridæ. In Biologia centrali-Americana, pp. 1–16 (1892).

GROS, A. J. and LESTAGE, J. A. Contribution a l'étude des larves des Éphéméroptères. Ann. Biol. Lacust., **15**, pp. 123, 133, 136, 161 (1927).

KLAPÁLEK, F. Ephemerida: Süswasserfauna Deutschlands, Lief. 8 (1909).

LESTAGE, J. A. Notes sur les Éphémères de la "Monographical Revision" de Eaton. Ann. Soc. Entom. Belgique, **64**, pp. 33–60 (1924).

Les Éphéméroptères de la Belgique. Bull. Ann. Soc. Entom. Belgique, **68–69** (several parts).

Contribution a l'étude des larves des Éphémères paléarctiques. Ann. Biol. Lacust., **8**, pp. 213–457 (1918).

NEEDHAM, J. G. Ephemeridæ of New York. Bull. New York State Mus., No. 86, pp. 17–62 (1905).

ROUSSEAU, E. Les larves et nymphes aquatiques des insectes d'Europe, Vol. 1, pp. 162–273 (1921).

SEEMAN, T. M. Dragonflies, Mayflies and Stoneflies of southern California. Pomona Journ. Entom. and Zool., **19**, pp. 1–69 (1927).

TÜMPEL, R. Die Geradeflügler Mitteleuropas. (Plectoptera, pp. 73–108) (1901).

ULMER, G. Übersicht über die Gattungen der Ephemeropteren. Stettiner Entom. Zeit., **81**, pp. 97–144 (1920).

Verzeichnis der deutschen Ephemeropteren. Konowia, **6**, pp. 234–262 (1927).

Ephemeroptera. In Tierwelt Mitteleuropas, **4**, Lief. 1b, pp. III 1–43 (1929).

ORDER **PLECÓPTERA**

(*PERLÀRIA*)

Body soft, of moderate or large size; four membranous wings, usually with many veins and numerous crossveins, rarely reduced in size; anal area of hind wing large and pleated, usually separated by a notch from the rest of the wing. Head broad and flattened; mandibles either well developed or much reduced; antennæ long, thread-like; three ocelli; cerci usually long and many-jointed. Prothorax large, free; legs strong, tarsi three-jointed. Nymphs aquatic, commonly with tracheal gills; antennæ long, much like those of the adults; eyes well developed; ocelli present; cerci usually long, many-jointed. Metamorphosis slight. Stoneflies, Salmon-flies.

Adults

1. Hind wing with an anal lobe (Figs. 327, 330) which is separated by a notch or indentation on the outer margin just behind the cubital vein (Cu_2); no meshwork of delicate crossveins on anal lobe 2

   Hind wing with the outer margin entire, not notched; anal lobe without meshwork of fine veins. (Fig. 331). (**Stenopérla, Eusthènia,** austr., neotrop.). (Including *GRIPOPTERÝGIDÆ,* part) ..... **EUSTHENÌIDÆ**

2. Anterior coxæ closely approximated; mandibles very weakly developed; wings with crossveins except in the anal lobe of the hind pair, the anal area of the fore pair with two or more full rows of crossveins (**Pteronárcys**) ..... **PTERONÁRCIDÆ**

   Anterior coxæ widely separated 3

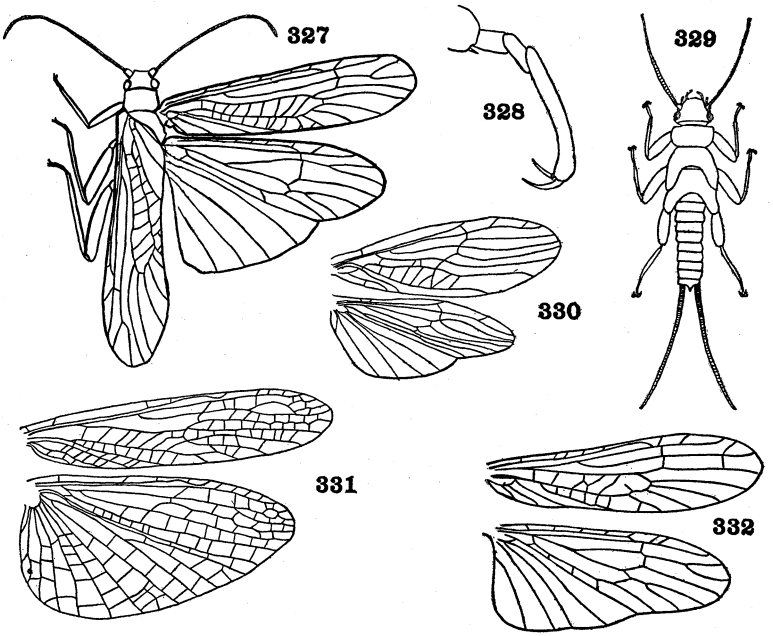
3. Mandibles reduced to a weak blade; clypeus and labrum concealed under a frontal shelf; third joint of tarsi much longer than the other two together. (Figs. 327, 328, 332). (**Pérla, Isópteryx** (=*Chloropérla*)). (Including *PERLÓDIDÆ*). **PÉRLIDÆ**

   Mandibles well developed, clypeus and labrum not covered by a frontal shelf; third joint of tarsi shorter than the other two together 4

4. Fore wing with three anal veins, the first one lying very close to the second branch of the cubitus. Australian. (**Tasmanopérla**). (Including *GRIPOPTERÝGIDÆ,* part... **AUSTROPÉRLIDÆ**

   Fore wing with only two anal veins, the posterior one sometimes forked 5

5. Both wings with the radius, media and cubitus connected near the middle of the wing by a transverse cord or continuous series of transverse veins; usually no crossveins present distal to this. (Fig. 330) 6



Figs. 327–332. **Plecoptera**

327. **Isopteryx** Perlidæ.
328. **Perla,** tarsus. Perlidæ.
329. **Perla,** nymph (Pictet) Perlidæ.
330. **Notonemoura,** wings. Nemouridæ.
331. **Stenoperla,** wings (Tillyard) Eustheniidæ.
332. **Perla,** wings. Perlidæ.

No such transverse cord near the middle of the wing; distal portion of wing with crossveins. Australian, neotropical. (**Leptopérla, Dinotopérla**). (Including *GRIPOPTERÝGIDÆ*, part) ..... **LEPTOPÉRLIDÆ**

6. Cerci very short, sometimes reduced to a single joint, never with more than ten joints; last anal vein in fore wing forked beyond

the anal cell. (**Nemoùra, Leùctra**). (Fig. 330). (Including *TÆNIOPTERÝGIDÆ* and *LEÙCTRIDÆ*). . **NEMOÙRIDÆ**

Cerci long, many-jointed; both anal veins simple. (**Cápnia,** holarc.; **Capnélla, Capnùra,** nearc.) ..... **CAPNÌIDÆ**

Nymphs

1. Visible gills present 2
   No visible gills 7
2. Gills present on the thorax 3
   Gills on the abdomen, but none on the thorax 6
3. Gills on the thorax and also on the underside of abdominal segments 1 and 2, or 1 to 3 ..... **PTERONÁRCIDÆ**
   Gills present on thorax only 4
4. Gills on the underside of the prothorax only ..... **NEMOÙRIDÆ**
   Gills on all three thoracic segments 5
5. Three pairs of gills in the form of filamentous tufts on the pleuræ; legs densely fringed with long hairs ..... Some **PÉRLIDÆ**
   A pair of tubular gills at the base of each coxa. A few **NEMOÙRIDÆ**
6. Gills a series of paired latero-ventral abdominal appendages on segments 1 to 5 or 1 to 6; large species ..... **EUSTHENÌIDÆ**
   Gills a rosette of small filaments surrounding the anus. **LEPTOPÉRLIDÆ**
7. Palpi with the apical joints more slender than the basal ones (Fig. 329) ..... **PÉRLIDÆ**
   Palpi with the apical joints as stout as the basal ones 8
8. Second joint of tarsi very much shorter than either the first or third ..... **NEMOÙRIDÆ**
   Second joint not very short 9
9. Third joint of tarsi not longer than the first and second together; cerci glabrous, as long as the body ..... Some **NEMOÙRIDÆ**
   Third joint of tarsi twice as long as the first and second together. **CAPNÌIDÆ**

LITERATURE ON PLECOPTERA

ENDERLEIN, G. Klassifikation der Plecopteren. Zool. Anz., **34**, pp. 385–419 (1911).

FRISON, T. H. Fall and Winter Stoneflies or Plecoptera of Illinois. Bull. Illinois Nat. Hist. Surv., **18**, pp. 345–409 (1929).

KLAPÁLEK, F. Die Plecoptera. Coll. Zool. Selys-Longchamps, fasc. 4 and 4A, 266 pp., Brussels (1912–23).

LeRoi, O. Zur Plecopteren von Rheinland-Westfalen. Ver. bot. zool. Ver. Rheinl-Westf. 1912, pp. 25-51 (1912) (Extensive bibliography).

MacLachlan, R. Monograph of the British Neuroptera Planipennia. Trans. London Entom. Soc., 1868, pp. 145–224 (1868).

Needham, J. G. and Broughton, E. Central American Stoneflies. Journ. New York Entom. Soc., **35**, pp. 109–120 (1927).

Needham, J. G. and Claassen, P. W. A Monograph of the Plecoptera or Stoneflies of America North of Mexico. 397 pp., Lafayette, Indiana (1925).

Schoenemund, E. Plecoptera. In Tierwelt Mitteleuropas, **4**, Lief. 2, pp. V 1–18 (1928).

Die Larven der deutschen Perla-Arten. Entom. Mitt., **14**, pp. 113–121 (1925).

Seeman, T. M. Dragonflies, Mayflies and Stoneflies of Southern California. Pomona Journ. Entom. and Zool., **19**, pp. 1–69 (1927).

Smith, L. W. Studies in North American Plecoptera. (Pteronarcinæ and Perlodini). Trans. American Entom. Soc., **43**, pp. 433–489 (1917).

Tillyard, R. J. A new classification of the Order Perlaria. Canadian Entom., **53**, pp. 35–43 (1921).

Revision of the Family Eustheniidæ. Proc. Linn. Soc. New South Wales, **46**, pp. 221–226 (1921).

The Stone-flies of New Zealand. Trans. New Zealand Inst., **54**, pp. 197–217 (1923).

ORDER **MEGALÓPTERA**

(*SIALÒIDEA*)

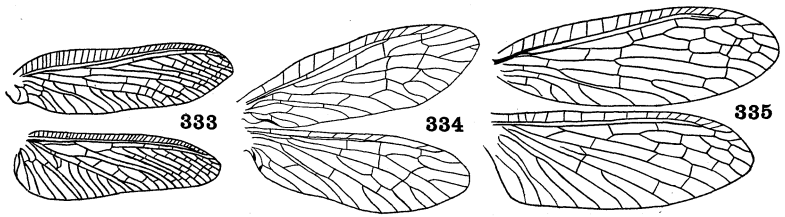
Soft-bodied species with large wings, long and sometimes pectinate antennæ and simple, similar legs. Costal cell with many transverse veins, subcosta and first radius simple, apically fused, the radial sector arising near the base; hind wings with the anal space normally large, folded fan-like when at rest. Prothorax quadrate. Metamorphosis complete; larvæ aquatic, living in freshwater streams; predatory, mandibulate, possessing lateral abdominal gill-filaments; wings appearing in the pupal stage; no cocoon.

Adults

1. Three ocelli present; fourth joint of the tarsi simple, not bilobed; venation regular, with the crossveins weakly formed, branches of the radial sector directed backward; large or medium sized species, 45 to 100 mm. in wing expanse. (Figs. 333, 335). (**Archichauliòdes**, Austr.; **Chauliòdes, Neohérmes, Corýdalis** (Dobson, Hellgrammite), Am.; **Neochauliòdes**, indomal.; **Hérmes, Neùromus, Protohérmes, Neoneùromus**, Asia).

CORYDÁLIDÆ

Ocelli absent; fourth joint of the tarsi prominently bilobed; some of the branches of the radial sector directed forward; medium sized species, 20 to 40 mm. in wing expanse. (Fig. 334). (**Protosìalis,** Am.; **Austrosìalis, Stenosìalis,** Austr.; **Sìalis,** holarc.). **SIÁLIDÆ**



Figs. 333–335. **Megaloptera**

333. **Corydalis,** wings. Corydalidæ.
334. **Austrosialis,** wings (Tillyard) Sialidæ.
335. **Chauliodes,** wings. Corydalidæ.

Larvae

1. Eight pairs of lateral gills; a pair of hooked anal prolegs, but no terminal filament ..... **CORYDÁLIDÆ**
   Seven pairs of lateral gills; no anal prolegs; terminal filament present ..... **SIÁLIDÆ**

LITERATURE ON MEGALOPTERA

(See also general papers on Neuroptera)

BARNARD, K. H. Cape Megaloptera. Trans. Roy. Soc. South Africa, **19**, pp. 169–184 (1931).

DAVIS, K. C. Sialididæ of North and South America. Bull. New York State Mus., No. 68, pp. 442–487 (1903).

ESBEN-PETERSEN, E. Megaloptera. Gen. Insectorum, fasc. 154 (1913).

STITZ, H. Megaloptera. In Tierwelt Mitteleuropas, **6**, Lief. 1, pp. XIV 1–2 (1928).

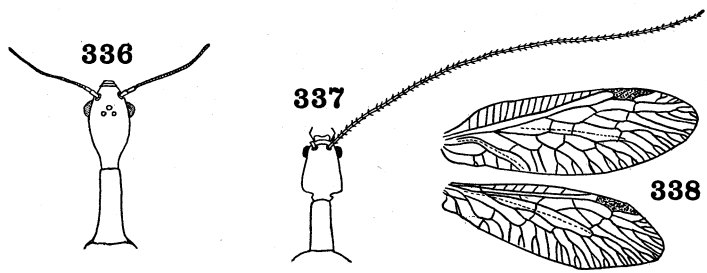
WEELE, H. W. Megaloptera. Coll. Zool. Selys-Longchamps, fasc. 5, Brussels (1910).

ORDER **RAPHIDIÒDEA**

(*RAPHIDIÒIDEA, EMMENÓGNATHA,* part.)

Moderate-sized, slender, predatory species with elongate cylindrical prothorax; head large, nearly horizontal, mandibles strong, antennæ

long and thread-like; ovipositor long; cerci not developed; wings membranous, both pairs similar, with numerous forkings, the costal cell with crossveins, subcosta not fused with the first radial; legs similar, the first pair attached at the base of the prothorax, tarsi five-jointed. Metamorphosis complete; larvæ terrestrial. Snake-flies, Serpent-flies. A single family. (**Inocéllia**, holarc. (Fig. 337); **Raphídia**, palæarc., Am. (Figs. 336, 338) ..... **RAPHIDÌIDÆ**



Figs. 336–338. **Raphidiodea**

336. **Raphidia,** head and prothorax of female (Albarda) Raphidiidæ.
337. **Inocellia,** head and prothorax of female (Albarda) Raphidiidæ.
338. **Raphidia,** wings (Handlirsch) Raphidiidæ.

LITERATURE ON RAPHIDIODEA

ALBARDA, H. Revision des Raphidides. Tijd. Entom., **34**, pp. 65–184 (1891).
ESBEN-PETERSEN, E. Raphididæ. Gen. Insectorum, fasc. 154, 13 pp. (1913).
NAVÁS, L. Monografia de l'orde dels Rafidiopters. Arch. Inst. Catalans, Barcelona, 93 pp. (1918).
STITZ, H. Raphidiodea. In Tierwelt Mitteleuropas, **6**, Lief. 1, pp. XIV 2–4 (1928).

ORDER **NEURÓPTERA**

(*SYNISTÀTA*, part., *DICTYÓPTERA*, part.)

Small to rather large, slender, predaceous insects with large wings, but of slow flight. Head free, vertical, eyes prominent, mouth inferior, mandibles strong; prothorax more or less freely movable and prominent, meso- and metathorax not closely grown together; abdomen long and narrow, the first sternite reduced, no cerci; wings similar, membranous, no large anal field; when at rest the wings usually lie roof-like over the abdomen, longitudinal veins almost always very

numerous through repeated branching, costal cell almost always with crossveins. Metamorphosis complete, larvæ terrestrial, aquatic only in Sisyridæ, strongly mandibulate, the mandibles and maxillæ specialized for sucking the body juices of the insect prey; pupæ in cocoons.

1. Veins and usually crossveins abundant, radial sector with several branches or forkings; wings not covered with a whitish powder. 2

   Veins and crossveins few in number, the radial sector at most only forked; wings covered with a whitish powder; very small, slender, pale-colored rare species, of 3 to 10 mm. wing expanse. (Superfamily CONIOPTERYGÒIDEA). **CONIOPTERÝGIDÆ**

   The following subfamilies are distinguished:

a. Outer lobe of maxilla three-jointed; abdomen with four to six pairs of everted ventral pouches; stem of media of fore wings usually with two thickenings which bear bristles. (**Aleuróptéryx,** palæarc.; **Coniocómpsa, Helicocònis,** holarc., austr., neotrop.; **Heterocònis,** austr.) .... **ALEUROPTERYGÌNÆ**

   Outer lobe of maxilla with only one joint; abdomen without ventral pouches; stem of media of fore wings without thickenings bearing bristles. (**Coniópteryx, Parasemídalis,** widespr.; **Conwéntzia,** holarc.; **Nìphas,** neotrop.; **Semídalis,** palæarc., Am. ethiop.) ..... **CONIOPTERYGÌNÆ**

2. Large, stout, showy, moth-like, cursorial species, of 30 to 70 mm. wing-expanse; costal area not broad, Sc, R and R_s not forming a distinct triple vein; head small and closely set on the prothorax; antennæ long and filiform, and tapering in both sexes, 40- to 50-jointed; abdomen of the male terminating in large forcipate appendages; ovipositor not exserted (Fig. 339). (Superfamily ITHONÒIDEA). (**Ithòne, Várnia,** austr.; **Oliárces,** Calif.; **Rapísma,** Asia) ..... **ITHÒNIDÆ**

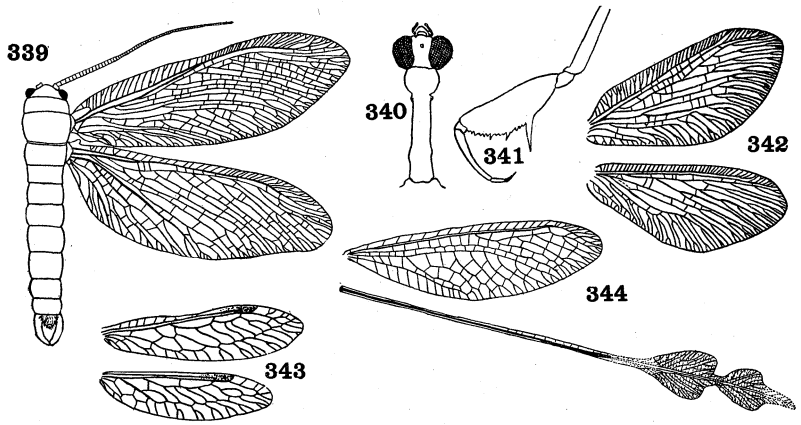
   Small to large, but not moth-like insects, except the showy Psychopsidæ which have a very broad costal area and distinctive triple vein; otherwise differing..... 3

3. Antennæ never enlarged toward the end, moniliform or filiform, rarely pectinate; Cu usually ending near or before the middle of the wing and without a straight longitudinal branch behind Cu_1 4

   Antennæ at least thickly cylindrical, variable in length, usually gradually enlarged toward the end, or filiform with clavate end; at least the discal portion of the wings densely reticulate, Sc

and R_1 apically fused, Cu ending in the apical part of the wing and commonly with a long straight branch behind Cu_1. (Superfamily MYRMELEONTÒIDEA) 16

4. Hind wings not longer than the fore wings, the two pairs similar in form and venation. (Superfamily HEMEROBIÒIDEA)..5



Figs. 339–344. **Neuroptera**

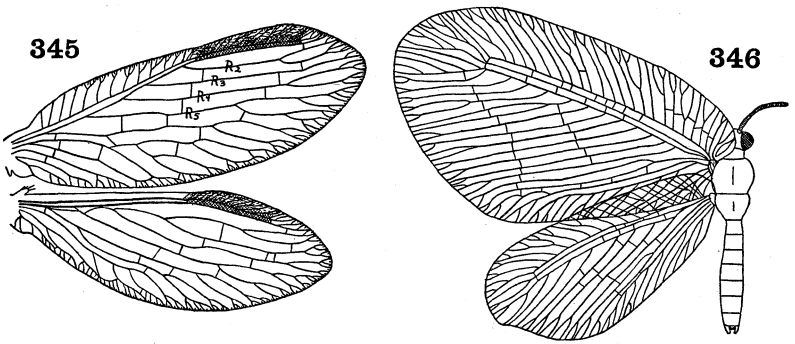
339. **Ithone,** Outline of body and wings (Tillyard) Ithonidæ.
340. **Mantispa,** head and thorax from above. Mantispidæ.
341. **Mantispa,** raptorial front leg. Mantispidæ.
342. **Dilar,** wings (Handlirsch) Dilaridæ.
343. **Mantispa,** wings (Handlirsch) Mantispidæ.
344. **Chasmoptera,** wings (Tillyard) Nemopteridæ.

Hind wings greatly elongate and ribbon-like, often with widened, spoon-like ends; head usually rostrate. (Fig. 344). (Superfamily NEMOPTERÒIDEA). (**Chasmóptera,** Austr.; **Cròce,** palæarc., ethiop., Austr.; **Nemóptera, Nìna,** palæarc.; **Nemopístha, Nemopterélla,** ethiop.)..... **NEMOPTÉRIDÆ**

5. Front legs normal, not raptorial.....6

Front legs strong, formed for seizing prey, their coxæ elongate, femora robust and spined, and tibiæ curved to meet femora; prothorax usually greatly lengthened; antennæ short; wings rather narrow. (Figs. 340, 341, 343). Mainly tropicopol. (**Climaciélla, Drepánicus, Sýmphrasis,** neotrop.; **Ditáxis,** Austr.; **Mantíspa,** cosmop.; **Euclimàcia,** ethiop., austro-mal.). **MANTÍSPIDÆ**

6. Fore wings with two or more branches or R_s arising from the apparently fused stems of R_1 and R_s 7
   Fore wings with all the branches of R_s arising from a single sector 9
7. Antennæ moniliform in both sexes; ovipositor not projecting; crossveins few; ocelli absent 8
   Antennæ of male coarsely pectinate; ovipositor exserted; vertex with three prominent ocellus-like tubercles; crossveins numerous; rather small species. Cosmopol. (**Dìlar** (Fig. 342), **Lìdar,** Eur.; **Nallàchius,** Am.; **Nèpal,** Asia) ..... **DILÁRIDÆ**



Figs. 345–346. **Neuroptera**

345. **Micromus,** wings (Tillyard) Hemerobiidæ.
346. **Psychopsella,** outline of body and wings (Tillyard) Psychopsidæ.

8. Fore wings with three or more branches of the radial sector present, veins R_4 and R_5 arising separately. (Fig. 345). Cosmopol. (**Boriomỳia, Drepanépteryx, Gayomỳia, Hemeròbius, Magalòmus, Micròmus**) ..... **HEMEROBÌIDÆ**
   Fore wings with apparently two radial sectors, one of which is R_{2+3} and the other R_{4+5}. Widespread. (**Euròbius, Pséctra, Spadòbius, Sympheròbius**) ..... **SYMPHEROBÌIDÆ**
9. Rather large, moth-like species, with broad wings, the costal area of the fore wings very wide, Sc, R_1 and R_s closely parallel, forming a chitinized triple midrib and fusing at the apical fourth of the wing; antennæ short; rare, nocturnal species. (Fig. 346). (**Psychópsis, Megallànes,** Austr.; **Psychopsélla, Arteriópteryx, Psychóphasis,** ethiop.; **Megapsỳchops**).
   PSYCHÓPSIDÆ

Not moth-like, wings not broadly rounded, with normal costal area and without the above-described prominent triple vein ... 10

10. Ocelli present; discal area of the wings with many crossveins, marginal area with no crossveins but with many forked veinlets; moderate to large, slender species. Widespr., but not North American. (**Euporísmus, Œdósmylus, Ósmylus, Porísmus, Spilósmylus**) ..... **OSMÝLIDÆ**

Ocelli absent 11

11. Humeral crossvein forming a recurrent vein; discal area of the wings with a simple graduate series of crossveins, and distinct from the costal and marginal areas which have very many forked veinlets; Sc and R_1 fused near wing-tip; vertex convex; antennæ moderate in length; rather large, nocturnal species, wing-expanse 40 to 75 mm. (**Polystœchotes**, N. Am.). **POLYSTŒCHÓTIDÆ**

No recurrent vein at the humeral angle of the wings; discal area of the wings not differentiated from the marginal area; antennæ longer than the head and thorax; smaller species 12

12. Vertex convex; wing venation relatively simple, radial sector of fore wings without definitive accessory veins, Sc and R_1 coalesced near tip of wing, costal crossveins not forked, r-m crossvein of hind wings in the axis of the wing; size small, 6 to 8 mm. in length; larvæ aquatic, feeding on freshwater sponges. (Fig. 348). Spongilla-flies. (**Climàcia**, nearct.; **Neurórthrus, Sisyrélla**, palæarct.; **Sísyra**, holarct.) ..... **SISÝRIDÆ**

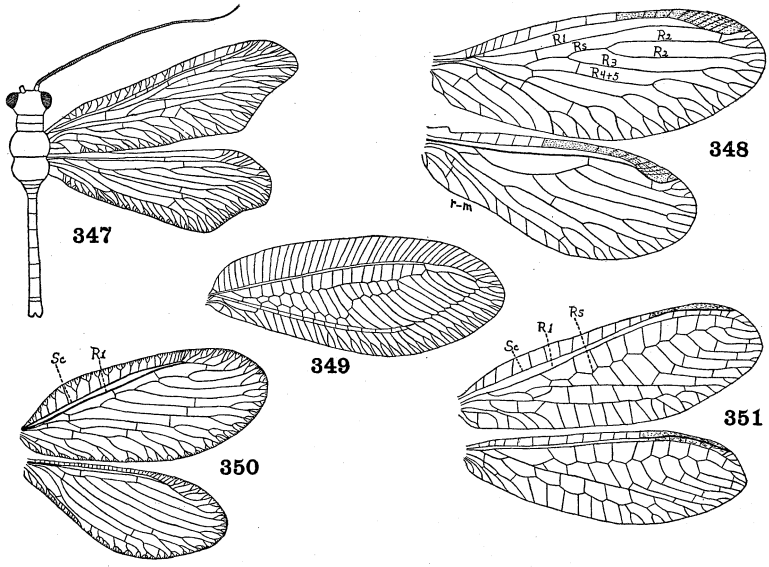
Vertex flattened; the single radial sector in the fore wings with definitive accessory veins; hind wings with the r-m crossvein oblique or transverse; size larger 13

13. Costal crossveins not forked, Sc and R_1 free at the tip, R_s swinging away from R_1, the cell R_1 broad and containing many crossveins; wings rounded, not falcate 14

Costal crossveins forked, cell R_1 narrow and almost devoid of crossveins, apical portion of the hind margin of the fore wings sometimes widely notched, leaving the apex more or less acute (the falcate condition); wings and body hairy, especially the hind margin of the wings 15

14. Wings of nearly equal width, a crossvein placed near base of the subcostal cell, less than thirty crossveins in the costal cell before the stigma. (Fig. 351). Green lacewings, Stink-flies; the larvæ are Aphis-lions. Cosmopolitan. (**Allochrỳsa, Chrysòpa, Meleòma, Nothochrỳsa**) ..... **CHRYSÓPIDÆ**

Fore wings distinctly wider than the hind pair, no crossveins near the base of the subcostal cell, more than forty costal crossveins before the stigma. (Fig. 349). Austr., Malay. (**Apochrỳsa, Oligochrỳsa**) ..... **APOCHRÝSIDÆ**



Figs. 347–351. **Neuroptera**

347. **Trichoma,** outline of body and wings (Tillyard) Trichomatidæ.
348. **Sisyra,** wings (Tillyard) Sisyridæ.
349. **Oligochrysa,** fore wing (Tillyard) Apochrysidæ.
350. **Protobiella,** wings (Tillyard) Berothidæ.
351. **Chrysopa,** wings (Tillyard) Chrysopidæ.

15. Fore wings with Sc and R fused before the wing-tip; peculiar seed-like scales often present on some part of the wings. (Fig. 350). (**Acroberòtha,** ethiop., Ind.; **Beròtha,** indomal.; **Isoscelípteron,** palæarc.; **Lomamỳia,** Am.; **Cycloberòtha,** austr.). **BERÓTHIDÆ**

Fore wings with Sc and R not fused apically; hairs of body and wings conspicuously long. (Fig. 347). (**Stenobiélla, Trichòma,** austr.). ..... **TRICHOMÁTIDÆ**

16. Wings about one-third as wide as long, costal area wide, marginal veinlets forked, subcostal cell with many crossveins; antennæ long, cylindrical. (**Myiodáctylus, Ósmylops,** austr.).
MYIODACTÝLIDÆ

Wings much narrower, the marginal area at least in large part closely reticulate 17

17. Antennæ elongate cylindrical; subcostal area with many crossveins. (**Austronýmphes, Nýmphes, Nymphídion,** austr.).
NÝMPHIDÆ

Antennæ more or less distinctly clavate, or apically swollen or flattened; subcostal cell without crossveins 18

18. Antennæ about as long as the head and thorax; wings usually with an elongate narrow cell immediately behind the point of fusion of Sc and R_1 19

Antennæ long, slender, strongly clavate apically; eyes usually divided into two parts by a groove; no elongate hypostigmatic cell differentiated. Widespread, mainly tropical. (**Acmonòtus,** austr.; **Ascálaphus,** palæarc.; **Colobópterus,** Am.; **Hỳbris,** indomal.; **Neuróptynx,** nearc.; **Suhpalácsa,** ethiop., indoaustr.; **Ululòdes,** Am.; **Nephoneùra,** ethiop.).
ASCALÁPHIDÆ

19. Antennæ weakly clubbed, or flattened at tip; hypostigmatic cell elongate; body and wings pubescent; weak fliers. Larvæ are called ant-lions or doodle-bugs. Widespread, mainly tropical. (**Brachynemùrus, Creàgris, Dendròleon, Formicàleo, Hesperòleon, Myrmèleon, Palpàres, Protopléctron**). (*MYRMELEÓNIDÆ*) ..... **MYRMELEÓNTIDÆ**

Antennæ strongly clubbed; hypostigmatic cell variable; abdomen and wings shining; crepuscular, strong fliers, superficially resembling dragonflies. (**Stilbópteryx,** austr.).
STILBOPTERÝGIDÆ

LITERATURE ON NEUROPTERA

BAGNALL, R. S. Review of British Coniopterygidæ. Entom. Rec., **27**, pp. 241–247 (1915).

BANKS, N. Revision of Nearctic Chrysopidæ. Trans. American Entom. Soc., **29**, pp. 137–162 (1903).

A Revision of the Nearctic Hemerobiidæ. Trans. American Entom. Soc., **32**, pp. 21–51 (1905).

Catalogue of the Neuropteroid Insects of the United States. American Entom. Soc., Philadelphia, 53 pp. (1907).

A Revision of the Nearctic Coniopterygidæ. Proc. Ent. Soc. Washington, **8**, pp. 77–86 (1907).

Revision of the Nearctic Myrmeleonidæ. Bull. Mus. Comp. Zoöl. Harvard, **68**, pp. 1–84 (1927).

ENDERLEIN, G. Monographie der Coniopterygiden. Zool. Jahrb. Abth. f. Syst., **23**, pp. 173–242 (1906).

Coniopterygidæ. Gen. Insectorum, fasc. 67, 18 pp. (1908).

Klassifikation der Mantispiden. Stettiner Entom. Zeit., **71**, pp. 341–379 (1910).

Die Klassifikation der Coniopterygiden. Arch. Klass. Phylog. Entom., **1**, pp. 98–114 (1930).

HAGEN, H. A. Neuroptera of North America. Smithsonian Misc. Coll. IV., (1862).

KRÜGER, L. Revision of Osmylidæ. Stettiner Entom. Zeitg., **75**, pp. 9–130 (1914); **76**, pp. 60–87 (1915).

Systematische Uebersicht der Neuropteren. Settiner Entom. Zeitg., **78**, pp. 116–137 (1917).

Revision of Psychopsidæ. Stettiner Entom. Zeitg., **83**, pp. 17–48 (1922).

Revision of Berothidæ. Stettiner Entom. Zeitg., **83**, pp. 49–88 (1922).

Revision of Hemerobiidæ. Stettiner Entom. Zeitg., **83**, pp. 138–173 (1922).

KUWAYAMA, S. Studies on the Dilaridæ of Japan. Trans. Sapporo Nat. Hist. Soc., **8**, pp. 51–83 (1921).

LACROIX, J. L. Faune des Plannipennes de France. Ascalaphidæ. Bull. Soc. Étude Sci. Nat. Elbeuf., **41**, pp. 65–100 (1923).

MOCSARY, A. Neuroptera. Fauna Regni Hungariæ, pp. 33–44 (1918).

NAKAHARA, W. Osmylinæ of Japan. Annot. Zool. Japonenses, Tokyo, **8**, pp. 489–518 (1914).

NAVÁS, P. L. Neurópteros (*s. lat.*) de España y Portugal. Brotéria, **5**, **6**, **7** (three parts) (1906–08).

Monográfia de la familia de los Diláridos. Mem. Roy. Acad. Barcelona, **7**, No. 17, pp. 619–671 (1909).

Monográfia de los Menoptéridos. Mem. Roy. Acad. Barcelona, **8**, No. 18, pp. 1–70 (1910).

Nemopteridæ. Gen. Insectorum, fasc. 136, 23 pp. (1913).

Ascaláfidos sudamericanos. Revist. Chil. Santiago, **17**, pp. 41–74 (1914).

Dilaridæ. Gen. Insectorum, fasc. 156, 14 pp. (1914).

Les Myrméléonides d'Europe. Insecta, Rennes, **5**, pp. 57–62 (1915).

Crisopids d'Europe. Arixius Inst. Cien. Barcelona, **3**, No. 2, pp. 1–98 (1915).

STITZ, H. Neuroptera. In Tierwelt Mitteleuropas, **6**, Lief. 1, pp. XIV 5–19 (1928).

TILLYARD, R. J. Studies in Australian Neuroptera. Proc. Linn. Soc. New South Wales, **41**, pp. 269–332 (1916).

The Family Psychopsidæ (Australian). Proc. Linn. Soc. New South Wales, **43**, pp. 750–786 (1918).

Revision of the Family Ithonidæ. Proc. Linn. Soc. New South Wales, **44**, pp. 414–437 (1919).

WEELE, H. W. Ascalaphiden. Coll. Zool. Selys-Longchamps, fasc. 8, Brussels (1908).

WITHYCOMBE, C. L. A Contribution towards a Monograph of the Indian Coniopterygidæ. Mem. Dept. Agric. India, **9**, pp. 1–19 (1925).

ORDER **MECÓPTERA**

(*PANORPÀTÆ, PANORPÌNA, MECÁPTERA*)

Small or moderate-sized, rather slender, insects with the head nearly always prolonged downwards to form a sort of beak. Eyes large; ocelli present or absent; mandibles small. Wings usually present, almost always long and narrow, similar; radius extensively branched; media and cubitus with few branches; crossveins only rarely numerous; anal area almost always very small, not separated; wing surface without scales. Antennæ long, many-jointed, slender. Prothorax small, free; meso- and metathorax similar. Legs long, slender, similar, fitted for running; coxæ large, pendant and approximate; tarsi five-jointed. Abdomen usually slender; cerci small; genitalia of male usually greatly swollen, forming a reflexed bulb. Metamorphosis complete, the larvæ caterpillar-like. Scorpion flies.

1. Tarsi slender, filiform; the apical joint bearing two claws and not capable of folding back on the fourth. 2

   Tarsi each with a single claw; the apical joint modified for grasping, the fifth joint folding back on the fourth; legs extremely long and slender, wings usually present. (**Bíttacus,** cosmop.; **Neobíttacus, Kalobíttacus, Pàzius,** neotrop.; **Harpobíttacus,** Austr.) (*BITTACÙSIDÆ*) . . . . . **BITTÁCIDÆ**

2. Wings well developed; female without a distinct ovipositor; labial palpi long 3

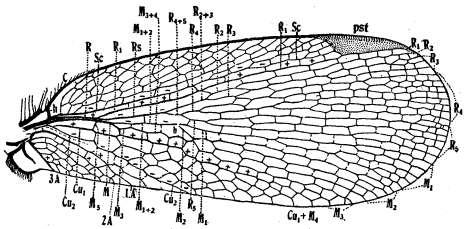
   Wings vestigial, bristle-like (male) or scale-like (female); small, black or very dark colored species. (**Bòreus,** holarc.). **BORÈIDÆ**

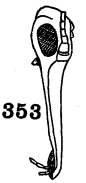
3. Radial sector and media both with more than four branches; radial sector arising close to the base of the wing; media branching much before the middle of the wing; wings short and broad, with rather dense venation; body depressed; male genitalia simple, not forming a bulb 4

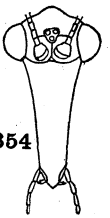
   Radial sector or media, or both with four branches or less; radial sector arising at or beyond the basal third of the wing; media

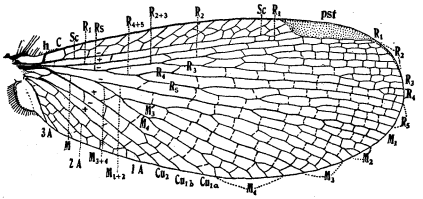
branching at about the middle of the wing; wings long and slender, with rather open venation; body more or less cylindrical; male genitalia enlarged, forming a swollen bulb. (Figs. 353, 354, 355) ..... **PANÓRPIDÆ**

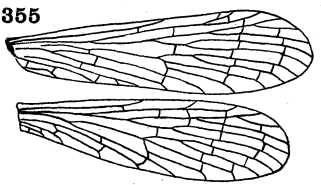
This family is divisable into three well-defined subfamilies which are accorded family rank by some workers.











Figs. 352–355. **Mecoptera**

352. **Notiothauma,** wings (Crampton) Notiothaumidæ.
353. **Panorpa,** head, lateral view (Packard) Panorpidæ.
354. **Panorpa,** head, frontal view (Packard) Panorpidæ.
355. **Panorpa,** wings. Panorpidæ.

a. First branch of cubitus in fore wing fused with the main stem of media for a greater or less distance ..... b
First branch of cubitus in fore wing entirely free from the main stem of the media; media four branched in both wings; radial sector usually with more than four branches. (**Panórpa,** palæarc., Am.; **Panorpòdes,** holarc.; **Neopanórpa. Leptopanórpa,** indomal.) ..... **PANORPÌNÆ**

b. Radial sector three branched; cubitus and main stem of media of fore wing coalescent for a considerable distance; small active species. (**Nannochorísta,** neotrop., austr.; **Choristélla,** austr.) ..... **NANNOCHORISTÌNÆ**

Radial sector four-branched; cubitus and main stem of media of fore wing touching only at a point or for a very short distance; larger species. (**Chorísta, Tæniochorísta,** austr.). **CHORISTÌNÆ**

4. Ocelli present; wings with very dense and irregular venation, the anal area well developed; radius and media coalescent on the basal fifth of the wing. (Fig. 352). (**Notiothauma,** neotrop.) ..... **NOTIOTHAUMIDÆ**

Ocelli absent; venation of wings more open and regular, the anal area slightly developed; radius and media not coalescent at the base of the wing. (**Mérope,** nearc.) ..... **MERÓPIDÆ**

LITERATURE ON MECOPTERA

CARPENTER, F. M. Revision of Nearctic Mecoptera. Bull. Mus. Comp. Zoöl. Harvard Univ., **72,** pp. 205–277 (1931).

ENDERLEIN, G. Ueber die Phylogenie und Klassification der Mecopteren. Zool. Anz., **35**, pp. 385–399 (1910).

ESBEN-PETERSEN, P. Tables for determination of Danish Mecoptera and Megaloptera (in Danish). Kopenhagen Fauna and Flore, pp. 129–144 (1914); pp. 1–16, 41–47 (1915).

A Synonymic List of the Mecoptera. Entom. Meddel., **10**, pp. 216–242 (1915).

Mecoptera. Coll. Zool. Selys-Longchamps, fasc. 5 (1921).

MIYAKE, T. Studies on the Mecoptera of Japan. Journ. Coll. Agric. Imp. Univ. Tokyo, **4**, pp. 265–400 (1913).

STITZ, H. Mecoptera. In Tierwelt Mitteleuropas, **6**, Lief. 1, pp. XIV 19–22 (1928).

TILLYARD, R. J. Nannochoristidæ. Proc. Linn. Soc. New South Wales, **17**, pp. 284–301 (1917).

ORDER **TRICHÓPTERA**

(*PHRYGANÒIDEA*)

Small to medium-sized, slender, flying insects; head freely movable, vertical, eyes prominent, ocelli three or none, mandibles vestigial or absent, palpi prominent, antennæ thread-like, often very long; prothorax small, free; meso- and metathorax similar; wings more or less clothed with hairs, with many veins and a few crossveins; the hind wings often with a folded anal area; wings rarely reduced in size; legs similar, coxæ pendant and approximate, tibiæ always with spurs, tarsi five-jointed. Metamorphosis complete. Larvæ aquatic; usually with tufted tracheal gills; more or less caterpillar-like and usually living in cases constructed of small objects spun together with silk. Caddis (or Caddice) flies; larvæ called Caddis worms.

Adults

1. Minute, often brightly colored, moth-like, pubescent species; the front wings closely covered with projecting, clubbed hairs; marginal fringe of wings very long, that of hind wings longer; discal cell of hind wings open or wanting; wings usually very long and narrow, more or less pointed; antennæ at most as long as the fore wings, usually much shorter and thickened; maxillary palpi five-jointed, strongly hairy, their last joint neither bowed nor ringed; ocelli usually present. (Fig. 359). (**Hydróptila, Allotrichia,** holarc.; **Oxyethira,** widespr.; **Mortoniélla,** neotrop.) ..... **HYDROPTÍLIDÆ**

   Rarely minute species; fore wings without or with solitary, thickened, projecting hairs; marginal fringe shorter than width of wing; antennæ almost always longer than the fore wings.....2

2. Ocelli present 3

   Ocelli absent 9

3. Maxillary palpi strongly hairy or scaly; tibial spurs 1–3–4 or 2–4–4 ..... a few **SERICOSTOMÁTIDÆ**

   Maxillary palpi with only weak hairs, not scaly 4

4. Last joint of maxillary palpi divided into false ring-joints, curved and as long as the third and fourth joints together; front tibiæ without or with two, three, or four spurs.....5

   Last joint of maxillary palpi not ringed, rarely curved, subequal to the other joints (palpi absent in some Hydropsychidæ)...6

5. Hind wings not dilated, in shape similar to the fore wings. (**Chimárrha,** cosmop.; **Philopótamus,** holarc.). **PHILOPOTÁMIDÆ**

   Hing wings with expanded anal angle, much wider than the fore wings. (**Stenopsỳche,** indomal.; **Parastenopsỳche,** palæarc.; **Pseudostenopsỳche,** neotrop.) ..**STENOPSÝCHIDÆ,** part

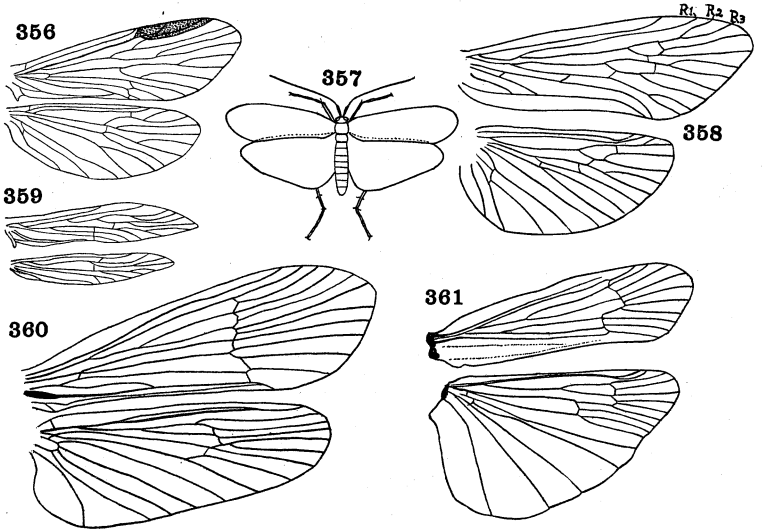
6. Front tibiæ with one or no spur; middle tibiæ with three or two spurs 7

   Front tibiæ with two or three spurs, middle tibiæ with four spurs; maxillary palpi four- or five-jointed.....8

7. Middle tibiæ widened, their tarsi broadened and armed with stiff hairs (see Couplet 8). (**Agrypnètes,** holarc.). **PHRYGANÉIDÆ,** part

   Middle tibiæ simple, normal; maxillary palpi of male three-jointed, of female five-jointed, but of similar structure in the two sexes. (**Anabòlia, Stenóphylax, Limnéphilus, Hálesus, Apatània,** holarc.) (Figs. 357, 361) .....**LIMNEPHÍLIDÆ**

8. Maxillary palpi five-jointed, the basal two joints very short and thick (Fig. 356). (**Rhyacóphila, Glossosòma, Agapètus,** holarc.; **Hydrobiòsis, Psilochorèma,** Austr.).
RHYACOPHÍLIDÆ



Figs. 356–361. **Trichoptera**

356. **Hydrobiosis,** wings (Tillyard) Rhyacophilidæ.
357. **Limnephilus,** outline. Limnephilidæ.
358. **Hydropsyche,** wings. Hydropsychidæ.
359. **Allotrichia,** wings. Hydroptilidæ.
360. **Phyllorheithrus,** wings (Tillyard) Calamoceratidæ.
361. **Limnephilus,** wings. Limnephilidæ.

Maxillary palpi of male four-jointed, of female five-jointed, the joints cylindrical, the second joint not short, the palpi of the two sexes similar. (**Neurònia, Phrygànea, Agrýpnia,** holarc.)
PHRYGANÈIDÆ

9. Tibial spurs 3–4–4; maxillary palpi weakly hairy, five-jointed, the first and second joints very small, the last joint ringed and curved; antennæ thickened.....10
Usually two, never three, spurs on front tibiæ.....11

10. Mandibles robust; maxillary palpi with the second joint short. (**Stenopsychòdes**, austr.) (see couplet 5).
STENOPSÝCHIDÆ, part

Mandibles slender and sinuous; maxillary palpi with the second joint bulbously enlarged internally. (**Polycéntropus, Plectrocnèmia, Neureclípsis**, holarc.; **Polypléctropus**, neotrop., austr.) ..... **POLYCENTROPÓDIDÆ**

11. Last joint of the five-jointed, scarcely hairy, maxillary palpi annulate and arcuate 12

Last joint of the usually strongly hairy maxillary palpi neither ringed nor curved 13

12. First vein from the discal cell of the fore wing (anterior branch of the radial sector) forked; maxillary palpi long and thin. (Fig. 358). (**Hydropsỳche, Macronèma**, cosmop.; **Hydropsychòdes**, widespr.; **Dipléctrona**, holarc.; **Smícrides**, Am.).
HYDROPSÝCHIDÆ

First fork (R_2) wanting in both fore and hind wings; first joint of the maxillary palpi small. (**Psychomỳia, Tinòdes**, holarc.; **Lỳpe, Metalỳpe**, palæarc.) ..... **PSYCHOMYÌIDÆ**

13. Both median and discal cells of fore wings present and closed; maxillary palpi five-jointed (Fig. 360). (**Heteropléctron**, Am.; **Ganonèma**, Am., Ind.; **Anisocéntropus**, holarc., indoaustr.; **Calamóceras**, palæarc.; **Phyllòicus**, neotrop.; **Phyllorheìthrus**, austr.) ..... **CALAMOCERÁTIDÆ**

Median cell of fore wings absent 14

14. Maxillary palpi of the male three-jointed, of the female five-jointed, of different structure in the two sexes; antennæ usually thick, hairy and with large basal joint; wings thickly hairy, discal cell present. (**Brachycéntrus**).. **SERICOSTOMÁTIDÆ**

Maxillary palpi of both sexes five-jointed 15

15. Discal cell of both wings absent, neuration of the two sexes usually different, apical veins few. (**Molánna**, holarc., indomal.; **Berèa**, holarc.; **Molannòdes, Beræòdes**, palæarc.).
MOLÁNNIDÆ

Discal cell of fore wings present 16

16. Middle tibiæ with two spurs; discal cell of hind wings almost always open or absent, only the upper branch of the radial sector forked, only the first apical fork present; joints of maxillary palpi uniform; antennæ long and slender. (**Leptócerus, Œcetis, Setòdes**, widespr.; **Mystácides**, holarc.; **Leptocélla**, Am.; **Notanatólica**, indoaustr.)..... **LEPTOCÉRIDÆ**

Middle tibiæ usually with four spurs; discal cell of hind wings closed, both branches of radial sector of fore wings forked, at least the first and second apical forks present; basal joint of antennæ large. (**Neróphilus**, nearc.; **Psilotrèta**, holarc.; **Odontócerum**, palæarc.; **Marília**, Am.; **Barypénthus**, neotrop.) ..... **ODONTOCÉRIDÆ**

Larvæ

1. Body campodeiform; head held straight forward, forming a continuation of the long axis of the body; abdomen depressed, the sutures between the segments deeply impressed; tracheal gills usually absent; larvæ generally not constructing a movable case (Fig. 367) 2

   Body eruciform or suberuciform; the head bent downward at an angle with the rest of the body; abdomen cylindrical, the sutures between the segments feebly impressed; tracheal gills usually present; larvæ always living in a movable, tubular case 8

2. Abdomen greatly wider than the thorax; very minute species with all three thoracic segments heavily chitinized above, living in portable silken cases which are much larger than the larvæ. **HYDROPTÍLIDÆ**

   Abdomen not much wider than the thorax, much larger species usually with only the prothorax heavily chitinized..... 3

3. Last abdominal segment with a chitinized shield above. **RHYACOPHÍLIDÆ**

   Last abdominal segment without a chitinized shield..... 4

4. Mandible with numerous bristles on the outer edge; tracheal gills present along the sides of the abdomen; legs very unequal. **HYDROPSÝCHIDÆ**

   Mandible with only two bristles on the outer edge; tracheal gills absent 5

5. Labrum soft, whitish, retractile under the edge of the clypeus. (Fig. 367) ..... **PHILOPOTÁMIDÆ**

   Labrum chitinized, yellowish or brownish..... 6

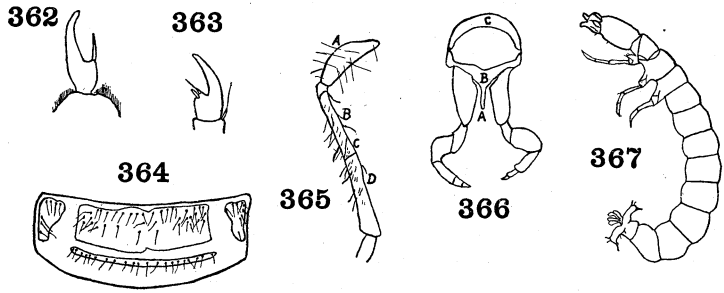
6. Claws of legs long and slender (Fig. 362), nearly straight, with only one basal spur ..... **POLYCENTROPÓDIDÆ**

   Claws of legs short, stout, curved..... 7

7. Claws with a single basal spur ..... **STENOPSÝCHIDÆ**

   Claws of middle and hind legs each with two basal spurs (Fig. 363) ..... **PSYCHOMYÌIDÆ**

8. Labrum with a transverse row of many stout bristles before the middle; tracheal gills filamentous .... **CALAMOCERÁTIDÆ**
Labrum not thus armed, usually with scattered bristles on the disc and several pairs of spines on the front margin 9



Figs. 362–367. **Trichoptera,** *Larvæ*

362. **Phylocentropus,** tarsal claw of front leg (Krafka) Polycentropodidæ.
363. **Timeodes,** tarsal claw (Rousseau) Psychomyiidæ.
364. **Psilotreta,** dorsal view of metathorax showing chitinous plates. (Krafka) Odontoceridæ.
365. **Leptocella,** front leg. *a*, coxa; *b*, trochanter; *c* and *d*, femur. (Krafka) Leptoceridæ.
366. **Arctæcia,** anterior view of prothorax in section showing prosternal horn (Krafka) Sericostomatidæ.
367. **Philopotamus,** larva (Rousseau) Philopotamidæ.

9. Labrum much longer than broad. Pronotum and mesonotum chitinized; metanotum with four chitinized plates (Fig. 364). **ODONTOCÉRIDÆ**
Labrum much broader than long; upper side of thorax not as above 10
10. Body suberuciform; mesonotum generally soft like the metanotum, rarely with two small chitinous plates; abdominal constrictions well marked; lateral gills on segments 2 to 7 covered with black hairs. Larval case tubular, open at both ends, straight or but little bent; living in tranquil water. **PHRYGANÈIDÆ**
Body eruciform; mesonotum generally entirely corneous, sometimes with only chitinized plates or rarely entirely soft; gills not pubescent with black hairs..... 11

11. Mesonotum entirely corneous; metanotum with three pairs of chitinous plates; middle legs stouter and longer than the hind ones; gills never with black hairs..... **LIMNEPHÍLIDÆ**

Mesonotum not entirely corneous; metanotum generally soft; middle legs not longer than the hind ones.....12

12. Femur of hind leg divided into a short basal and long apical piece (Fig. 365); right mandible without inner bristles; no accessory bristles on back of mandibles ..... **LEPTOCÉRIDÆ**

Femur not divided.....13

13. Prosternum with a horn or spine that projects downward between the front coxæ (Fig. 366) ..... Some **SERICOSTOMÁTIDÆ**

Prosternum unarmed.....14

14. First abdominal segment with three nipple-shaped protuberances, one above and one at each side.....15

First abdominal segment narrower than the following ones and without such protuberances... Some **SERICOSTOMÁTIDÆ**

15. Body slender; claws of anal prolegs small, simple. **MOLÁNNIDÆ**

Body robust; claws of anal prolegs stout, formed of two or three large superimposed hooks ....Some **SERICOSTOMÁTIDÆ**

LITERATURE ON TRICHOPTERA

BANKS, N. Genera of Nearctic Leptoceridæ. Trans. American Entom. Soc., **25**, pp. 199–218 (1898).

Genera of Nearctic Hydropsychidæ. Trans. American Entom. Soc., **32**, pp. 1–20 (1906).

Genera of Nearctic Sericostomatidæ. Proc. Entom. Soc. Washington, **8**, pp. 117–133 (1906).

Classification of Nearctic Limnephilidæ. Canadian Entom., **48**, pp. 117–122 (1916).

DÖHLER, W. Systematik und Biologie der Trichopteren. Sitzb. naturf. Ges. Leipzig, **41** (1915).

EATON, A. E. Review of Hydroptilidæ. Trans. Entom. Soc. London, 1873, pp. 125–151 (1873).

HAGEN, H. A. Phryganidarum synopsis. Verh. k. k. zool.-bot. Ges. Wien, **14**, pp. 799–890 (1864).

Beiträge zur Kenntnis der Phryganiden. Verh. k. k. zool.-bot. Ges. Wien, **23**, pp. 377–452 (1873).

IWATA, M. Trichopterous larvæ from Japan. Annot. Zool. Japonenses, **11**, pp. 202–233 (1927).

KRAFKA, J. Key to the families of Trichopterous larvæ. Canadian Entom., **47**, pp. 217–225 (1915).

KUWAYAMA, S. The Stenopsychidæ of Japan. Ins. Matsumarana., **4**, pp. 109–119 (1930).

LESTAGE, J. A. Trichoptera, in Rousseau, Larves et Nymphes aquatiques des Insectes d'Europe, pp. 343–964 (1921).

Catalogue des Trichoptères d'Afrique. Rev. Zool. Africaine, **6**, pp. 251–335 (1919) and Ann. Soc. Entom. Belgique, **59**, pp. 130–135 (1919).

Note Trichoptérologique. Bull. and Ann. Entom. Soc. Belgique, **65**, pp. 363–386 (1926).

LLOYD, J. T. Larvæ of North American Trichoptera. Bull. Lloyd Libr., Cincinnati, Entom. Ser., No. 1 (1921).

MARTYNOV, A. V. Preliminary revision of Phryganeidæ. Ann. Mag. Nat. Hist. (9), **14**, pp. 209–224 (1924).

On the family Stenopsychidæ. Eos, **2**, pp. 281–308 (1926).

MCLACHLAN, R. A monographic revision and synopsis of the Trichoptera of the European fauna. London. Van Voorst (1874–80).

MORTON, K. J. North American Hydroptilidæ. Bull. New York State Mus., No. 86, pp. 63–75 (1905).

ULMER, G. Trichoptera. Gen. Insectorum, fasc. 60, 289 pp. (1907).

Trichoptera. Süsswasserfauna Deutschlands, Lief. 5 and 6, 326 pp. (1909).

Literature on Trichoptera (1910–14). Zeits. wissensch. Insektenbiol., **15** (various parts) (1919–21).

Trichoptera. In Tierwelt Mitteleuropas, **6**, Lief. 1, pp. XV 1–46 (1928).

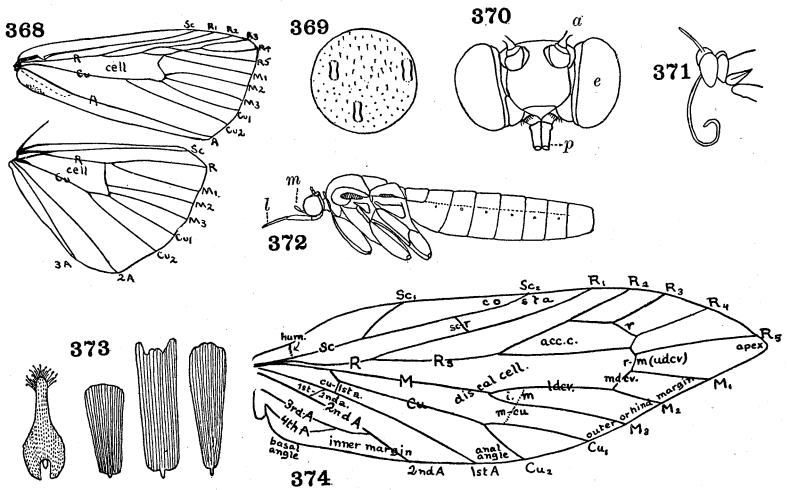
ORDER **LEPIDÓPTERA**

(*GLOSSÀTA*)

Rather large, sometimes small, or very large insects; wings and body thickly clothed with scales that form a color pattern, the wings opaque, with the venation obscured by the scales; scaly covering rarely restricted to certain portions of the wings or absent in a very few unusual forms; wings very rarely absent. Antennæ long, many-jointed, variously modified, filiform, pectinate or clubbed; ocelli sometimes present. Mouthparts suctorial, frequently vestigial or absent, when not in use coiled under the head; the maxillæ incorporated into an unjointed tongue; mandibles absent, except in a few primitive forms; palpi usually well developed, the labial ones generally larger than the maxillary. Prothorax small; wings large, membranous, similar, the fore pair somewhat longer; venation complete, but not complex, few crossveins. Legs similar, tarsi ordinarily five-jointed. No cerci. Metamorphosis very great; larvæ with biting mouthparts, usually caterpillar-like, and with paired false-legs on some of the abdominal segments in addition to three pairs of thoracic legs; larvæ almost always plant-feeders. Moths, Butterflies and Skippers.

Adults

1. Fore and hind wings (if wings are absent or greatly reduced in size, see couplet 169) with four or five radial veins, rarely with three, Sc and R_1 separate (Fig. 374); wings of similar shape,



Figs. 368–374. **Lepidoptera**

368. **Noctua,** wings (Forbes): Sc, subcosta, R, radius, M, media, Cu, cubitus (their branches indicated by numbers), A, 2A, 3A, anal veins; cell, discal cell. Noctuidæ.
369. Portion of bleached wing membrane, showing attachments of three scales and numerous aculeæ.
370. **Danais,** head in frontal view: a, base of antenna; e, eye; p, base of proboscis. Danaidæ.
371. **Hamadryas,** head, prothorax and part of mesothorax (Scudder) Nymphalidæ.
372. **Crambus,** lateral outline of body (Fernald): m, maxillary palpus; l, labial palpus.
373. Scales from the wings of various Lepidoptera (Scudder).
374. **Micropteryx** (Forbes): Sc, subcosta; R, radius; M, media; Cu, cubitus; A, anal (their branches indicated by numbers); hum, humeral crossvein; udcv, upper discocellular vein (radio-medial crossvein); ldcv, lower discocellular vein; i, intercalated cell; ac. c, accessory cell. Micropterygidæ.

more or less pointed at tip, with ten or more veins, the membrane with minute spines (Fig. 369); fore wings with a thumb-

like lobe at basal angle (jugum); a spiral proboscis never developed. (Suborder JUGATÆ) (*MICROPTERYGÌNA, HOMONEÙRA, ARCHILEPIDÓPTERA, ZEUGLÓPTERA*)....2

Fore and hind wings dissimilar in shape and venation, hind wings with Sc and R_1 fused at least at tip (not to be confused with R_s which is usually the only free radial vein (Fig. 368)), rarely two free radial veins present, at most six veins arising from the cell; jugum and mandibles not developed. (Suborder FRENATÆ) (*HETERONEÙRA*).....8

2. Wings usually hardly wider than the fringe of hairs on their hind margin; small species, wing-expanse about one-half inch; tibial spurs usually present; jugum usually minute, frenulum present. (Superfamily MICROPTERYGÒIDEA). (*MICROJUGÀTÆ, JUGOFRENÀTÆ*).....3

Wings ample, fringe narrow; larger species, wing expanse about one to nine inches; tibial spurs usually wanting; jugum usually underlapping the hind wing, no frenulum. (Superfamily (HEPIALÒIDEA). (*MACROJUGÀTÆ*).....5

3. Middle tibiæ without spurs, but with an apical group of bristles; functional mandibles present; Sc forked near middle. (**Epimartýria**, No. Am.; **Micrópteryx** (=*Eriocéphala*) (Fig. 374), holarc.; **Sabatínca**, Austr.). (*ERIOCEPHÁLIDÆ*).

MICROPTERÝGIDÆ

Middle tibiæ with one or two spurs; mandibles vestigial or wanting; Sc simple or forked near tip.....4

4. Middle tibiæ with one spur; Sc forked near tip, at least in fore wing; jugum large, overlapping the hind wing; scales not scalloped nor coarsely striated. (**Mnemónica**, holarc.; **Eriocrània**, holarc.; **Neopseùstis**,[1] indomal.) .....**ERIOCRANÌIDÆ**

Middle tibiæ with two spurs; Sc simple; jugum much reduced, underlapping the hind wing; scales with scalloped border and coarse striation. (**Mnesarchæa**, Austr.).

MNESARCHÆIDÆ

5. R_1 arising near base of wings, discal cell containing a large intercalated cell formed by the basal petiolate branch of the media, *i.e.* three cells present (Fig. 375).....6

R_1 arising near middle of wing, discal cell undivided or containing a single medial vein.....7

6. Hind wing with two anal veins; third discal cell pointed (Fig. 375).

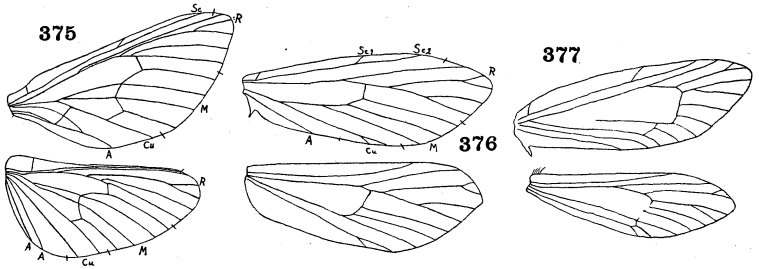
[1] The genus Neopseustis with broad wings, having the jugum reduced or vestigial, has recently been regarded as a distinct family.....**NEOPSEUSTIDÆ**

(**Hepìalus**, cosmop.; **Sthenòpis, Phássus**, widespr.; **Cháragis**, austr., S. Afr.; **Lèto**, austr., S. Afr.; **Porìna**, austr., Patagonia; **Dálaca**) ..... **HEPIÁLIDÆ**

Hind wing with one short anal vein; third discal cell blunt. (**Prototheòra**, S. Afr.) ..... **PROTOTHEÓRIDÆ**

7. Tibial spurs present (Fig. 377). (**Anómoses**, austr.). **ANOMOSÉTIDÆ**

Tibial spurs absent (Fig. 376). (**Palæoses**, austr.). **PALÆOSÉTIDÆ**



Figs. 375–377. **Lepidoptera**

375. **Phassus,** wings (Hampson) Hepialidæ.
376. **Palæoses,** wings (Turner) Palæosetidæ.
377. **Anomoses,** wings (Turner) Anomosetidæ.

8. Antennæ simple or variously modified (Figs. 378, 379, 380), only rarely swollen at the tip, and in such cases a frenulum is present; most forms with a frenulum; the subcosta of the hind wing either relatively little arched at the base or there is a large area between it and the fore margin of the wing; wings at rest overlapping the abdomen, sloping roof-like against the sides, or horizontally outspread; body relatively stout. Moths. (HETERÓCERA) 9

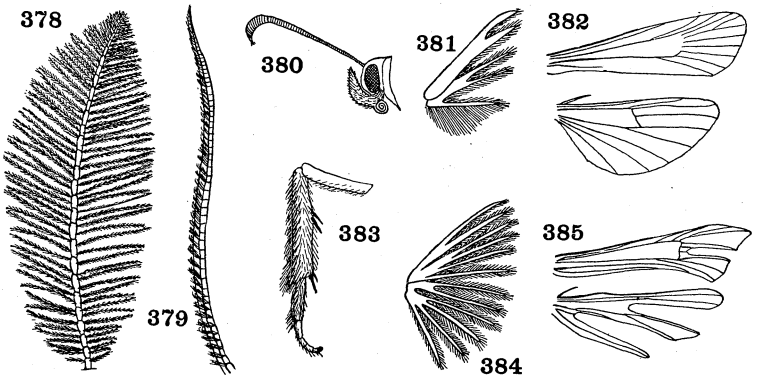
Antennæ knobbed at the tip, or thickened a little before the tip (Figs. 431, 432), without pectinations, projecting processes or conspicuous arrangements of hairs; hind wings without a frenulum, but with the Sc strongly arched forward at the base; at least the fore wings erect when at rest; no ocelli. Butterflies and Skippers. (RHOPALÓCERA) 154

9. Wings, especially the hind ones, deeply cleft, or divided into plume-like divisions (Figs. 384, 385); legs very long. Featherwing moths 10

Wings entire, not cleft nor divided into finger-like divisions, rarely (Gelechiidæ) the fore wings moderately cleft.....12

10. Wings divided into two to four divisions.....11

Each wing divided into six plumes; small, silvery white moths. (**Orneòdes,** widespr.) (Fig. 384).....**ORNEÓDIDÆ**



Figs. 378–385. **Lepidoptera**

378. Plumose antenna of moth (Duncan).
379. Pectinate antenna of moth (Duncan).
380. **Melittia,** head, in lateral view (Beutenmüller) Ægeriidæ.
381. **Bembecia,** middle leg (Beutenmüller) Ægeriidæ.
382. **Melittia,** wings (Beutenmüller) Ægeriidæ.
383. **Pterophorus,** wings (Berlese) Pterophoridæ.
384. **Orneodes,** wings (Berlese) Orneodidæ.
385. **Platyptilia,** wings (Fernald) Pterophoridæ.

11. Fore wings divided into two plumes, rarely four, hind wings into three; small, delicate moths, usually prettily colored. (**Oxýptilus,** cosmop.; **Platyptília,** cosmop.; **Pteróphorus,** widespr.). (Figs. 381, 385, 404). (*ALUCÍTIDÆ*).

PTEROPHÓRIDÆ

Each wing divided into two plumes. (**Cenóloba,** indomal., austr.) (See couplet 43d) ..... **OXYCHIRÓTIDÆ,** part

12. Underside of hind wing with a double series of enlarged and divergent scales along the cubital vein; tibiæ exceptionally long, thin and with long spurs. (**Agdístis,** palæarc., ethiop.).

AGDÍSTIDÆ

Underside of wings without such specialized scales.....13

13. Wings in large part transparent and usually devoid of scales, except on margins and veins; fore wing narrow, at least four times as long as wide; inner margin of fore wing and costal margin of hind wing with a row of recurved, interlocking spines; Sc of hind wings close to cell and to next vein, hidden in a fold and apparently absent; frenulum well developed; ocelli present; wasp-like, day-flying moths (Figs. 380, 381, 382). Clear-wing moths. (**Paranthrène,** widespr.; **Trochílium,** holarc., ethiop.; **Ægèria,** cosmop.). (*SESÌIDÆ*).

ÆGERÌIDÆ

Wings scaled throughout, or if clear, the fore wings are triangular; wings not interlocking by series of spines; Sc of hind wing present, though sometimes close to or in part fused with R. 14

14. Antennæ thin, swollen at tip to form a more or less distinct club, as in the butterflies, or even recurved at tip, as in the skippers. 15

Antennæ variously modified, if swollen subapically or toward the middle they gradually taper on distal portion. 18

15. Fore wing with some branches of R stalked. 16

Fore wing with all veins arising from discal cell, medial stem reduced; both wings with first anal vein lacking; eyes not ciliated; male alone with frenulum (see couplet 155). (**Euschèmon,** austr.) . . . . . Males of **EUSCHEMÓNIDÆ**

16. Fore wings with M_2 arising nearer M_3 than M_1. 17

Fore wings with M_2 arising midway between M_1 and M_3, or closer to M_1; hind wings with first A wanting. African. (**Apoprógenes, Pemphegóstola**) . . . . . **APOPROGÉNIDÆ**

17. Both wings with first A present, discal cell small and closed; proboscis developed. (**Cástnia,** neotrop.; **Synèmon,** Austr.).

CASTNÌIDÆ

Both wings with first A reduced; discal cell open; proboscis vestigial. (**Táscina** (=*Neocástnia,* India)). (*NEOCASTNÌIDÆ*).

TASCÍNIDÆ

18. Hind wings with three anal veins (if less than three anals, small species with narrow wings, the hind pair with reduced venation and bearing a long fringe of hairs on the hind margin almost as wide as, or wider than, the wing, and the tibial spurs more than twice the width of the tibiæ); fore wings usually with first anal vein complete, *i.e.* usually two anal veins reaching the margin. (MICROFRENATÆ). 19

Hind wings with two anal veins, rarely with one, in addition to a possible unthickened fold in the membrane, or in the Aus-

tralian genus *Oxychirota* both wings lack all anals; wings almost never very narrow, the hind wing not more than half longer than wide, except rarely in large species when a tail-like projection is developed, and not long-fringed; fore wings usually with but one complete anal vein, when accessory cell is present it is not completely contiguous with the discal cell (if accessory cell is completely contiguous refer to couplet 109, Cecidosidæ). (MACROFRENATÆ) 43

19. Hind wings with veins Sc + R_1 and R_s widely separate beyond discal cell 20

Hind wings with veins Sc + R_1 and R_s fused or very closely parallel for a greater or less distance between the end of the discal cell and the tip of the wing, the base of R sometimes evanescent. (If R_1 of fore wing is as long as cell, see Drepanidæ, couplets 65, 81, 95). (PYRALÍDIDÆ, *s. lat.*) 79

20. Hind wings ribbon-like, with a long apical tail (Fig. 386). (**Himantópterus, Semióptila** African). **HIMANTOPTÉRIDÆ**

Wings normal 21

21. Hind wings with veins Sc + R_1 and R_s fusing to near the end of the discal cell, or fusing beyond the middle of the cell, or these veins coincident throughout 22

Hind wings with veins Sc + R_1 and R_s separate from the base, or fusing only a short distance along the discal cell, the fusion located at the base or before the middle of the cell, or sometimes connected by a bar 23

22. Proboscis well developed; wings thinly scaled, translucent; hind wings with basal part of R represented as a spur in the cell, or entirely lost. (**Acolòithus, Pyromórpha,** Am.) (see couplet 45). (*ZYGÆNIDÆ*, of authors).. **PYROMÓRPHIDÆ**, part

Proboscis obsolete; hind wings with Sc + R_1 and R_s separate in part; wings heavily and loosely clothed with soft scales, mixed with curly hair in the northern species; hind wings (in American species) with R free at base. Flannel moths. (**Nòrape, Megalopỳge**). (*LAGÔIDÆ*) ..... **MEGALOPÝGIDÆ**

Proboscis and palpi absent; veins Sc + R_1 and R_s coincident throughout. (**Engyóphlebus,** ethiop.) ..... **ENGYOPHLÉBIDÆ**

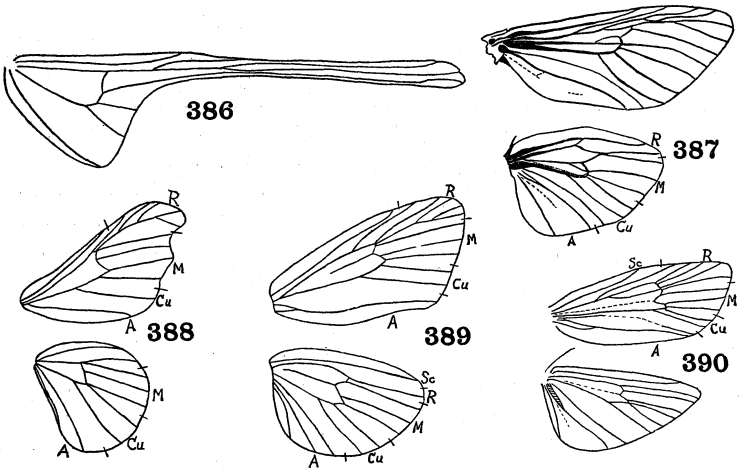
23. The fringe on the anal angle of the hind wings not or but slightly longer than elsewhere; tibial spurs at most about as long as the width of the tibiæ 24

The fringe on the anal angle of the hind wings distinctly longer than elsewhere; tibial spurs more than twice the width of the

tibiæ; when the accessory cell is present its longest side is contiguous with the discal cell. (TINEÒIDEA) 97

24. Fore wings with accessory (radial) cell.....25
Radial cell not formed 34

25. Mouthparts vestigial.....26
Mouthparts usually developed, with scaled proboscis; tibial spurs long; small to minute moths. (TINEÒIDEA) 97



Figs. 386–390. **Lepidoptera**

386. **Himantopterus,** hind wing (Westwood) Himantopteridæ.
387. **Prionoxystus,** wings (Comstock and Needham) Cossidæ.
388. **Bombyx,** wings. Bombycidæ.
389. **Metarbela,** wings (Hampson) Metarbelidæ.
390. **Simaethis,** wings (Spuler) Glyphipterygidæ.

26. Tibial spurs short or wanting; large moths, except Epipyropidæ. 27
Hind tibiæ with two pairs of spurs; small species, 9–18 mm.; R 4-branched; ♀ wingless. (**Talæpòria,** cosmop.; **Solenòbia,** holarc.; **Lúffia,** palæarc.) ..... **TALÆPORÌIDÆ**

27. Fore wings with some branches of R stalked; accessory cell extending beyond the discal cell; body heavy, or wings ample..28
Fore wings with no stalked radial branches; accessory cell not extending beyond the discal cell; antennæ bipectinate in both sexes; small moths, larvæ living on Fulgoridæ. (**Epipỳrops,** indoaustr., Am.).....**EPIPYRÓPIDÆ**

28. Wings strong and more or less lanceolate; body heavy and surpassing the hind wings; median cell and strong medial stem nearly always present in discal cell of each wing; larvæ borers. Carpenter moths 29

Wings ample, the subtriangular fore wings about half longer than wide and with the tip more or less acute, the hind pair with nearly straight end; abdomen not extending beyond the hind wings; mainly South American. (**Dálcera, Ácraga,** S. Am.; **Dalcérides, Pincònia,** Ariz.). (*ACRÁGIDÆ*).
DALCÉRIDÆ

29. Fore wings with first and second anal veins free, or first anal wanting 30

Fore wings with first and second anal veins connected by a cross-vein near the margin. (**Gívira**) ..... **HYPÓPTIDÆ**

30. Fore wings with first anal vein present 31

Fore wings with first anal vein absent 33

31. Frenulum present 32

Frenulum absent. (**Ratárda,** indoaustr.) ..... **RATÁRDIDÆ**

32. Hind wings with R_s and M_1 widely separate; palpi very short. (**Zeùzera** (*Z. pyrìna,* Leopard moth, holarc., ind.), **Phragmatœcia,** palæarc.) ..... **ZEUZÉRIDÆ**

Hind wings with R_s and M_2 stalked beyond apex of discal cell or close together; palpi upturned to middle of front (Fig. 387). (**Cóssus** (= *Trýpanus*), cosmop., **Prionoxýstus**).
CÓSSIDÆ

33. Frenulum present. (**Argyrótypus, Chrysótypus,** Madagascar). (*CHRYSOTÝPIDÆ*) ..... **ARGYROTÝPIDÆ**

Frenulum absent; tropical distribution (Fig. 389). (**Metarbèla; Teràgra; Salágena**). (*ARBÉLIDÆ, HOLLÁNDIDÆ, TERÁGRIDÆ*) ..... **METARBÉLIDÆ**

34. Frenulum absent or vestigial, humeral angle of hind wing more or less expanded; M_2 of fore wings arising midway between M_1 and M_3 or closer to M_1; chætosema absent; moderately large moths with broad hind wings 35

Frenulum present (if absent in moths of small size with narrow and more or less oblong wings, refer to couplet 90) 37

35. Fore wings with radial branches $R_{2+3+4+5}$ united on a common stalk; hind wings with Sc and R connected by a bar (Fig. 388). (See couplet 64) ..... **BOMBÝCIDÆ**

Fore wing with radial branches R_{2+3}, R_{4+5} stalked independently of R_{1+2}; hind wings with Sc and R free beyond base 36

36. The five branches of R very long, occupying more than one-third the apical edge of the wing, only R_3 and R_4 on a short stalk, the other radial branches free; wings large. (**Chrysopóloma, Éctropa**, ethiop.). (*ECTRÓPIDÆ*) . . **CHRYSOPOLÓMIDÆ**

Radial branches occupying one-fourth of the apical edge of the fore wings, R_{2+3}, or R_{4+5}, or R_{3+4+5} stalked, tip of fore wings extended and rather pointed, the apical margin sinuate. American, mostly neotropical. (See couplet 67) . . **MIMALLÓNIDÆ**

37. Fore wings with M_2 arising midway between M_1 and M_3, M_3 and Cu_1 united for a considerable distance beyond the discal cell, $R_{2,3,4,5}$ united, and first A absent; hind wings with Sc free from R_s from base, and first A evanescent on basal half. (See couplet 56). (**Phryganídia**, Cal.) . . . . . **DIÓPTIDÆ**

Fore wings with M_2 arising closer to M_3 than to M_1, thus causing the cubitus to appear four-branched 38

38. Hind wings very small, with Sc and R separate beyond the base; hind tibiæ with strong middle and apical spurs; antennæ dilated apically; chætosema absent. African. (**Charídea, Toòsa**). **CHARIDÈIDÆ**

Hind wings with Sc and R connected by a bar, or by fusion before the middle of the discal cell 39

39. Fore wings with all five branches of the radius arising from the discal cell. (**Hyblæa**, nearc.) . . . . . **HYBLÆIDÆ**

Fore wings with some of the radial branches absent or coalesced beyond the end of the discal cell 40

40. Fore wings with first and second anals connected by a crossvein, or fusing before the tip. (Fig. 391). Bagworm moths. (See couplet 46). (**Pachythèlia**, palæarc.; **Fùmea**, palæarc.). **PSÝCHIDÆ**, part

Fore wings with first and second anals not connected, nor apically fusing, or 1A absent 41

41. Proboscis well developed; chætosema present; antennæ dilated or pectinate in the male. (**Cyclòsia**; **Gíngla**; **Campylòdes**; **Erásmia**; **Zygæna**, palæarc.; **Pròcris**, palæarc., indoaustr.; **Chalcòsia**; **Aglàope**). (Including *CHALCOSÌIDÆ*). **ZYGÆNIDÆ**

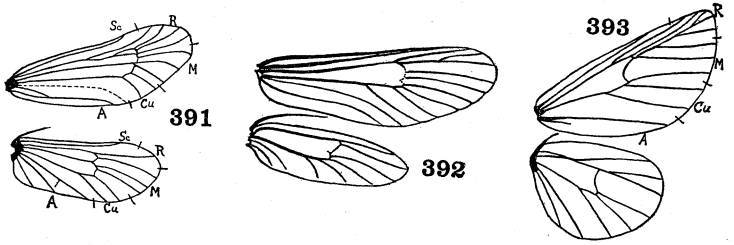
Proboscis and palpi much reduced 42

42. Fore wings with R_3, R_4 and R_5 stalked or united. (**Sabìne**; **Phobètron**; **Eùclea**; **Adonèta**; **Prolimacòdes**; **Heterogènea**, palæarc.; **Ápoda**). (*COCHLIDÌIDÆ, HETEROGENÈIDÆ, LIMACÓDIDÆ*) . . . . . **EUCLÈIDÆ**

Fore wings with only three simple branches of the radius, all arising from the cell. (**Heterógynis** ♂, **Somábrachys** ♂, S. Eur.). (See couplet 170). (*EPICNOPTERÝGIDÆ*).

HETEROGÝNIDÆ

43. Antennæ thickened, spindle-shaped, sometimes hooked or recurved at the tip, the joints usually carinated beneath, sometimes pectinated; hind wings with Sc and R_s connected by a strong crossvein near the middle of the discal cell, then extending closely parallel to the end of the cell or beyond; proboscis and palpi present; chætosema absent; stout, often large moths, with rather narrow wings, the hind pair much shorter than the fore wings. Hawk moths, Humming bird moths. (**Phlegethóntius** (=*Protopárce*); **Sphínx** (=*Hylòicus*), cosmop.; **Hémaris**



Figs. 391–393. **Lepidoptera**

391. **Solenobia,** wings (Spuler) Psychidæ.
392. **Harrisina,** wings (Jones) Pyromorphidæ.
393. **Hemiceras,** wings (Hampson) Notodontidæ.

(=*Hæmorrhàgia*), holarc.; **Smerínthus, Celèrio** (=*Deiléphila*), cosmop.; **Macroglóssa; Acherόntia,** holarc., ethiop. (*A. átropos,* Death's head moth)). . . . . **SPHÍNGIDÆ**

Antennæ simple, thin, serrate, or pectinate, rarely swollen gradually near apex; wings proportionally larger; hind wings with Sc and R_s rarely connected by a strong crossvein, and if so, strongly divergent beyond it. 44

44. Fore wings with one or two anal veins. 45

Fore wings with no anal veins. (**Oxychiròta,** Austr.). See couplet 11) . . . . . **OXYCHIRÓTIDÆ**

45. Fore wings with two distinct free anal veins. (**Harrisìna** (Fig. 392)). (See couplet 22) . . . . . **PYROMÓRPHIDÆ,** part

Fore wings with the anal veins more or less fused, or with but one complete anal vein. 46

46. Fore wings with the anal veins more or less fused or connected by a crossvein so as to end as a single vein. (**Eurycýttarus, Thyridópteryx**). (See couplet 40)..... **PSŸCHIDÆ**, part

Fore wings with a single complete anal vein, *i.e.* 2A, the first anal always reduced, at most represented by a fold, and the third anal short or wanting, generally connecting with the second anal so that the latter appears to have a basal fork. .47

47. Fore wings with M_2 arising from the middle of the end of the discal cell, or in front of the middle, *i.e.* the cubitus apparently three-branched 48

Fore wings with M_2 arising behind the middle of the discal cell, *i.e.* the cubitus apparently four-branched..... 73

48. Hind wings with Sc strongly angled, or rarely swollen and sinuous, at the base, usually with a strong humeral brace-vein at the bend, thence very close to or fusing with R_s for a greater or less distance along the cell; palpi and proboscis well developed; chætosema present 49

Hind wings with Sc and R_s fused from base to beyond the middle of the wing, swollen at base, then rapidly diverging; rather small, very slender species, with finely scaled wings, the fore pair narrow, the hind pair broad; the apparent three-branching of the cubitus of the fore wings due to the absence of M_2 and M_3. (See couplet 90) ..... **LITHOSÌIDÆ**, part

Hind wings with Sc straight or gently curving at base, separate from R_s, no connecting bar present; proboscis often weak or undeveloped; chætosema weak or absent..... 55

49. Antennæ dilated toward tip; eyes hairy and ciliated. (**Sematùra,** Madagasc.; **Anurápteryx,** Am.). (*MANIDÌIDÆ*).

SEMATÙRIDÆ

Antennæ slender or feathered, if dilated toward tip the eyes are bare. (GEOMÉTRIDÆ, *s. lat.*) 50

50. Eyes small and oval. (**Bréphos,** holarc.; **Erânnis,** holarc.). (*MONOCTENÌIDÆ*) ..... **BRÉPHIDÆ**

Eyes round and usually large..... 51

51. Hind wings with M_2 reduced or absent, the cubitus apparently three-branched. (**Macària** (=*Semiothìsa*), widespr.; **Boármia,** cosmop.; **Selidosèma,** cosmop.; **Geómetra,** holarc.; **Abráxas,** holarc., ind.; **Campœa** (=*Metrocámpa*), holarc.; **Énnomos** (=*Eugònia*), holarc.; **Paleácrita** (*P. vernàta,* (Spring canker-worm)). (*BOARMÌIDÆ, SELIDOSEMÁTIDÆ*).

GEOMÉTRIDÆ, *s. str.*

Hind wings with M_2 well developed, the cubitus apparently four-branched.....52

52. M_2 of hind wings and often of both pairs arising very close to M_1. (**Chloríssa** (=**Nemòria**), *widespr.*, **Euchlòris**, widespr.; **Hemíthea, Mesòthea**). (*GEOMÉTRIDÆ* Meyrick, Tillyard). **HEMITHÈIDÆ**

M_2 of hind wings arising nearly midway between M_1 and M_3. .53

53. Hind wings with Sc and R_s fused to or beyond the middle of the cell, or connected by a bar beyond the middle, or fused for a short distance toward the end of the cell. (**Hydriómena**, widespr.; **Tephroclýstis** (=*Eupithècia*), widespr.; **Trichópteryx**, holarc.; **Xanthorhòe**, cosmop.; **Laréntia, Eucymátoge, Eucéstia**, palæarc., ind.). (*HYDRIOMÉNIDÆ*). **LARENTÌIDÆ**

Hind wings with Sc and R_s free, or with a connecting bar, or fused for a short distance before the middle of the discal cell 54

54. Hind wings with Sc free from R_s, though close to it along the second fourth of the discal cell. (**Dýspteris**, nearc.). **ŒNOCHROMÁTIDÆ**

Hind wings with Sc and R_s fused for a short distance. (**Ptychópoda, Leptómeris**, cosmop.; **Leucophthálmia**, holarc.; **Cínglis** (=*Acidàlia*)). (*STÉRRHIDÆ*) ..... **ACIDALÌIDÆ**

55. Frenulum well developed, more than one-fifteenth the length of the wing 56

Frenulum vestigial or absent; hind wings with Sc never fusing with R_s, but sometimes connected by a weak bar.....61

56. M_3 and Cu_1 of both wings usually stalked for a considerable distance beyond the cell, stem of M indicated through the cell; fore wing with R_{2-5} or R_{3-5} stalked; proboscis present; tympana small and subdorsal, or absent; hind tibiæ with both middle and apical spurs; slender, butterfly-like species. Neotropical. (**Myònia, Orícia, Tithraùstes, Phryganídia**). (See couplet 37) ..... **DIÓPTIDÆ**, part

Of other conformation.....57

57. Hind wings with Sc widely separated from R_s from near the base; fore wings with R_5 stalked with M_1 and well separated from R_4; proboscis present; no tympanum. Tropical. (**Epiplèma, Medùsia, Melèaba**) ..... **EPIPLÉMIDÆ**

Hind wings with Sc close to R_s; fore wings with M_1 not stalked with R_s 58

58. Hind wings with R_s and M_1 stalked beyond the cell; fore wings commonly with a radial areole. (If R_1 of fore wings is much shorter than discal cell, see couplet 79, Pyralididæ) 59

Hind wings with M_1 free, R_s arising before or at the end of the discal cell 60

59. Proboscis present, often weak, sometimes absent; tympanum present; fore wings fully scaled, usually with R_{2-5} stalked, often with a radial areole. (Fig. 393). Principally neotropical. (**Cerùra**, palæarc., Am., Indo-austr.; **Notodónta**, **Drymònia**, holarc.; **Stauròpus**, palæarc., indomal.; **Phalèra**, palæarc., indomal.; **Datàna** (*D. minístra*, Yellow necked apple worm); **Schizùra** (*S. concínna*, Red humped apple worm); **Heterocámpa**). (*CERÙRIDÆ*) ..... **NOTODÓNTIDÆ**

Proboscis wanting; tympanum absent; fore wings with $R_{2,3}$ and $R_{4,5}$ stalked together; wings of northern species with clear spots. (See couplet 63). (**Apatelòdes**, **Thaumetopœa** (=*Cnethocámpa*), **Euptérote**)). (*THAUMETOPŒIDÆ*). **EUPTERÓTIDÆ**

60. Fore wings with discal cell large, reaching much beyond the middle of the wing; hind wings with cubitus apparently three-branched. (**Áxia**, **Epicimèlia**, S. Eur.) ..... **AXÌIDÆ**

Discal cell not or scarcely extending beyond the middle of the wing; hind wings with cubitus apparently four-branched; frenulum of male knobbed. (Fig. 398). (See couplet 76). (**Polýploca**, **Palimpséstia**, palæarc.; **Habrósyne**, holarc.; **Cymatóphora**.) *CYMATOPHÓRIDÆ, POLYPLÓCIDÆ* .. **THYATÍRIDÆ**

61. Fore wings with M_1 stalked with R_5 and hind wings with two complete anal veins; if M_1 and R_5 are short-stalked, the second anal diverges widely from Cu_2 and a vestige of the first anal is present 62

Fore wings with M_1 arising from R at or before the end of the discal cell, or M_1 is free from R_5; if M_1 and R are stalked beyond the cell, the hind wings have but one complete anal vein... 65

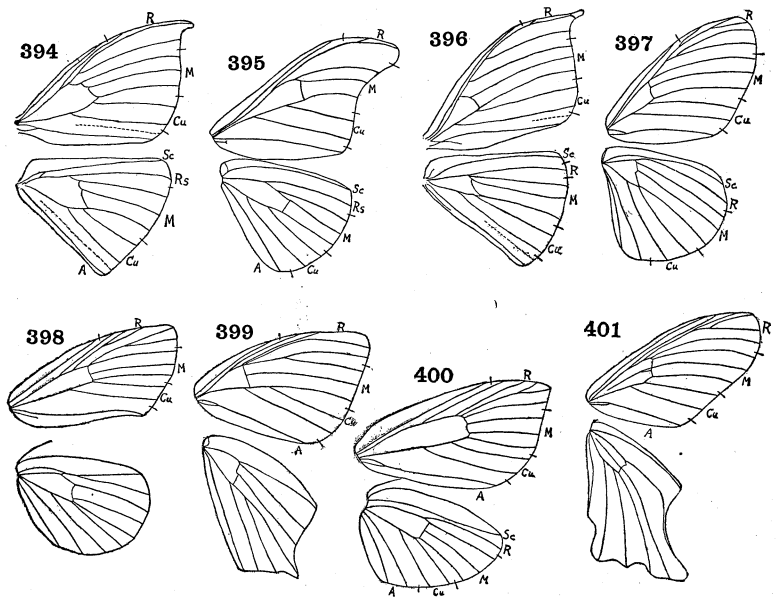
62. Frenulum vestigial 63

Frenulum entirely absent. American. (**Èacles** (=*Basilòna*) (*E. imperiàlis*, Imperial moth); **Citheròn**ia (=*Ceratocámpa*); **Sýssphinx**; **Anisòta**; **Adelocéphala**). (*CERATOCÁMPIDÆ, SYSSPHÍNGIDÆ*) ..... **CITHERONÌIDÆ**

63. Hind wings with Sc and R_s close together but not joined by a bar; fore wings with $R_{2,3}$ and $R_{4,5}$ joined on a common stalk. (See couplet 59) ..... **EUPTERÓTIDÆ**, part

Hind wings with a bar connecting Sc and R ; fore wings with the radius branching seriately.....64

64. Fore wings with R_{2-5} and M_1 stalked. (**Lemònia**). **LEMONÌIDÆ**
Fore wings with M_1 joined to R on a short stalk, or free. (Fig. 388). (**Bómbyx** (*B. mòri,* Domesticated silkworm). (See couplet 35) .....**BOMBŸCIDÆ**



Figs. 394–401. **Lepidoptera**

394. **Janiodes,** wings (Jordan) Cercophanidæ.
395. **Antheræa,** wings (Hampson) Saturniidæ.
396. **Oxytenis,** wings (Jordan) Oxytenidæ.
397. **Brahmæa,** wings (Hampson) Brahmæidæ.
398. **Thyatira,** wings (Hampson) Thyatiridæ.
399. **Urapteroides,** wings (Hampson) Uraniidæ.
400. **Addæa,** wings (Hampson) Thyrididæ.
401. **Epicopeia,** wings (Hampson).

65. Hind wings with the cubitus apparently three-branched.....66
Hind wings with the cubitus apparently four-branched; one anal vein; outer margin of fore wings strongly sinuous; tympanum present. (Fig. 405). (See couplets 81, 95) . . **DEPÁNIDÆ,** part

66. Fore wings with $R_{4,5}$ stalked 67
Fore wings with R_5 free, arising from the discal cell 71
67. Fore wings with $R_{2,3}$ long-stalked, separated from $R_{4,5}$. (**Mimállo**; **Cicínnus** (= *Peróphora*); **Lacosòma**). (See couplet 37). (*PROTOPSÝCHIDÆ, PEROPHÓRIDÆ, LACOSÓMIDÆ, LACOSMÁTIDÆ*) ..... **MIMALLÓNIDÆ**
Fore wings with $R_{3,4}$ stalked 68
68. Fore wings with the radial branches stalked in two groups, $R_{1,2,3}$ and $R_{4,5}$ which groups are again stalked; M_1 arising from the upper angle of the cell; hind wings with Sc close to R_s but free; proboscis present. (Fig. 397). (**Brahmæa**, Asia, Afr.). **BRAHMÆIDÆ**
Fore wings with only three or four branches of the radius developed, of which two or three are on a common stalk; hind wings with Sc more or less distant from R_s. (Fig. 396) 69
69. Proboscis bearing carinate papillæ; antennæ bipectinate ventrally in both sexes. (Fig. 396). (**Asthénida**; **Oxýtenis**, neotrop.). **OXYTÉNIDÆ**
Proboscis thin and reduced 70
70. Hind wings with Sc and R connected by a bar. (Fig. 394). (**Cercóphana, Janiòdes**, neotrop.) ..... **CERCOPHÁNIDÆ**
Hind wings with Sc and R_s not connected by a bar. (Fig. 395). Principally neotropical and ethiopian. (**Antheræa**; **Áttacus** (*A. átlas*, Atlas moth); **Autómeris**; **Callosàmia** (*C. promèthea*, Promethea moth); **Hemileùca**; **Philosàmia** (= *Sàmia* auctt.) (*P. walkeri* (*cýnthia*), Ailanthus moth); **Pseudohàzis**; **Sàmia** (= *Platysàmia*) (*S. cecròpia*, Cecropia moth); **Satúrnia**; **Tèlea** (*T. polyphèmus*, Polyphemus moth); **Tropæa** (= *Áctias*) (*T. lùna*, Luna moth). (Including *ATTÁCIDÆ, ARSENÙRIDÆ, HEMILEÙCIDÆ*)) ..... **SATURNÌIDÆ**
71. Fore wings with M_1 free, not stalked with R_5 72
Fore wings with M_1 stalked with R_5, or arising very close to R_5 at the apex of the discal cell (Fig. 399). (**Uràmia, Alcìdis, Nyctálemon, Urapteròides**) ..... **URANÌIDÆ**
72. Fore wings with $R_{3,4}$ stalked ..... **LONOMÌIDÆ**
Fore wings with $R_{2,3,4}$ stalked. (Fig. 401). (**Epicopèia**, indomal.). **EPICOPEÌIDÆ**
73. All branches of R, M and Cu of both wings arising from the open or closed discal cell, rarely $R_{3,4}$ or $R_{4,5}$ short-stalked; maxillary palpi minute; wings often with unscaled spots. (Fig. 400).

Mainly tropical. (**Thỳris, Striglìna, Adæa, Rhodoneùra, Dysòdia, Risàma, Méskea**). (See couplet 124).

THYRÍDIDÆ

Veins variously fusing beyond the discal cell. 74

74. Frenulum present, more than one-fifteenth the length of the wing 75

Frenulum vestigial or absent. 92

75. Hind wings with Sc and R_s separate from near the base, or fused beyond the cell, when joined near the base the fusion not extending to the middle of the cell. 76

Hind wings with Sc and R_s fused to near or beyond the middle of the cell, sometimes forming a small basal areole (in Euchromiidæ completely fused so that Sc appears to be absent). 87

76. Shaft of antennæ tapering evenly from base to tip. 77

Antennæ thickened before tip, usually ending in a recurved hook 91

77. Hind wings with Sc free from R_s along the cell, though sometimes approaching it, or briefly touching near the apex of the cell, sometimes fused for a greater or less distance beyond the cell. 78

Hind wing with Sc fused with R_s for a short distance before the middle of the cell. 84

78. Hind wings with Sc dipping toward R_s, sometimes fused with it beyond the cell, but not connected with it by a bar; proboscis present (if proboscis is vestigial, compare Lymantriidæ, couplets 83, 85) 79

Hind wings with Sc and R_s connected by a bar before the discal cell. (Fig. 402) 82

79. Fore wings with R_1 about as long as the cell, or longer. 80

Fore wings with R_1 much shorter than the cell. (Fig. 406). (See couplets 19, 58). A very large, widespread group.

PYRALÍDIDÆ,[1] part

a. Fore wing with A1 present; proboscis weak or absent; hind wings with the fringe on Cu weak or absent; larvæ bore in aquatic or marsh plants. (**Schœnòbius, Acéntropus, Ràmila**). (*SIGÌNÆ*) . . . . . **SCHŒNOBIÌNÆ**

Fore wings with A1 absent. . . . . b

b. Fore wings with A3 curving forward to meet A2 and forming a small elongate cell near the base of the wing. c

Fore wing with A3 free or curving into A2 toward the middle of the wing to form a wide loop, often vestigial. . . . . f

[1] This family is sometimes divided into a series of families, but its numerous well-marked groups are generally regarded as of only subfamily rank.

c. Proboscis and ocelli absent; male usually with third joint of the palpi vestigial ..... d
Proboscis and ocelli present; labial palpi normal ..... e
d. Front with a conical tuft; general vestiture deep and mixed; larvæ living as scavengers in nests of social Hymenoptera or in dried foods. (**Gallèria** (*G. melonélla*, Bee moth), **Paralíspa, Achròia**). (*TINEÌNÆ*, Hampson) ..... **GALLERIÌNÆ**
Front and thorax smooth-scaled; larvæ feeding on scale insects. (**Macrothèca**) ..... **MACROTHECÌNÆ**
e. Maxillary palpi rather well developed; hind wings with Sc free. (**Pýralis** (*P. farinàlis*, Meal moth), **Aglóssa, Hercùlia, Cledeòbia, Omphalócera, Hypsopỳgia** (*H. costàlis*, Clover-hay worm) ..... **PYRALIDÌNÆ**
Maxillary palpi absent; hind wings with Sc and R usually fusing. (**Árta, Chrysaùge, Clydonópteron, Gephỳra, Náchaba**). (*SEMNIÌNÆ*) ..... **CHRYSAUGÌNÆ**
f. Hind wings with M_1 arising from the vein closing the cell, widely separated from Sc, cell closed by a weak but distinct vein, R more or less weakened; labial palpi beak-like, maxillary palpi triangular; mainly Old World species. (**Ancylolòmia, Prionápteryx, Eufernáldia**) ..... **ANCYLOLOMIÌNÆ**
Hind wings with M_1 closely approximate to R ..... g
g. Fore wings with R_5 stalked with R_{3+4}; only one free vein below the forked vein which runs to the apex from the radial stem ... h
Fore wings with R_5 free; two free veins from the radial stem below the forked one; hind wings with Sc and R almost always fusing ..... m
h. Fore wings with R_3 and R_4 completely fused; hind wing with strong fringe on Cu i
Fore wings with R_3 and R_4 stalked, separating apically ..... k
i. Cell in hind wing closed by a delicate but nearly complete vein; frenulum of female consisting of a single spine ..... j
Cell in hind wing widely open; frenulum of female multiple. (See couplets k, m). (**Raphíptera**) ..... **CRAMBÌNÆ**, part
j. Proboscis strong, separating the palpi toward the base: larvæ usually leaf-rollers, a few feeding in stored foods. (**Phỳcita, Ephéstia** (Fig. 406) (*E. kuehniélla*, Mediterranean flour moth), **Plòdia** (*P. interpunctélla*, Indian-meal moth, world wide pest of dried fruits, nuts, corn and other cereals), **Acróbasis, Dioryctria, Nephrópteryx**). (*ANERASTIÌNÆ*, Hampson). **PHYCITÌNÆ**
Proboscis weak or vestigial, not separating the palpi and concealed by them when coiled. (**Peòria, Ponjàdia, Anerástia, Hypsótropa**). (*HYPSOTROPÌNÆ*) ..... **ANERASTIÌNÆ**
k. Hind wings with a heavy fringe on the base of Cu; labial palpi

beak-like, the maxillary palpi triangular. (**Argýria, Crámbus, Diatræa** (corn and sugar cane borers), **Thauamtópsis**). (See couplets i, m) ..... **CRAMBÌNÆ**, part

Fringe on base of Cu very light or wanting; maxillary palpi plumose, or small and concealed 1

l. Fore wings with raised scale-tufts. (**Epipáschia, Tetrálopha, Oneìda, Pocócera**). (*POCOCERÌNÆ*) .... **EPIPASCHIÌNÆ**

Fore wings smooth, without raised scale-tufts. (See couplet e). **PYRALIDÌNÆ**, part

m. Hind wings with fringe on Cu heavy; labial palpi beak-like, the maxillary palpi triangular. (See couplets i, k). **CRAMBÌNÆ**, part

Fringe on Cu light or absent; labial palpi rarely beak-like, the maxillary palpi usually moderate or small, not triangular.... n

n. Hind wings without loose, spatulate hairs on the upper surface.. o

Some loose hair near the inner margin of the hind wing, part of it forming a weak fringe on Cu which runs into a group of spatulate hairs or scales below Cu. (**Glaphýria, Dicymolòmia, Lipocósma**) ..... **GLAPHYRIÌNÆ**

o. Fore wings with R_2 stalked with R_3 and R_4: larvæ aquatic. (**Elóphila, Nýmphula** (= *Hydrocámpa*), **Eurrhýpara, Musotìma**). (*HYDROCAMPÌNÆ*) ..... **NYMPHULÌNÆ**

Fore wings with R_2 free..... p

p. Labial palpi beak-like; maxillary palpi large and triangular; fore wing usually slightly rough-scaled, with M_1 well separated from R_5 at origin, about as far from base of R_{3+4} as from M_2. (**Scopària, Xeróscopa**) ..... **SCOPARIÌNÆ**

Labial palpi often upturned; maxillary palpi very rarely large and triangular (*Loxostegópsis*) and in that case with R_{3+4} and M_1 closely approximate. (**Loxóstege** (Web-worms), **Désmia, Phlyctænia, Agrótera, Sylépta, Margaròmia, Héllula, Pantógrapha, Diaphània** (Melon and Pickle-worms), **Pyraùsta** (*P. nubilàlis*, European corn borer)). (*AGROTERÌNÆ*) ..... **PYRAUSTÌNÆ**

80. Tympanum developed; chætosema reduced or wanting; dip in Sc of hind wings located beyond the discal cell and sometimes resulting in a fusion with R_s 81

Tympanum not developed; chætosema present; dip in Sc of hind wings opposite the middle of the discal cell, humeral vein present; day flying, butterfly-like moths. (See couplet 96). **CALLIDÙLIDÆ**

81. Ocelli well developed; frenulum of male knobbed. (**Thyatìra**, palæarc.). (See couplet 60) ..... **THYATÍRIDÆ**, part

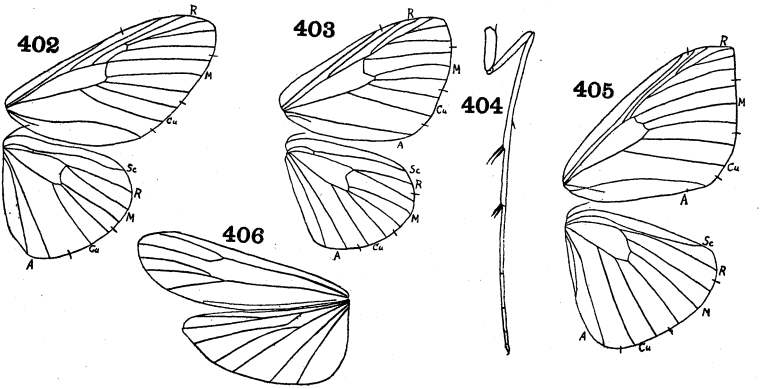
Ocelli vestigial; fore wings commonly with recurved tip. (Fig.

405). (See couplets 65, 95). (**Euchèra, Edápteryx, Drépana, Cìlix,** palæarc.; **Falcària,** holarc.). (*DREPANÙLIDÆ*).

DREPÁNIDÆ

82. Proboscis present, palpi recurved above the vertex, with bare third joint; ocelli present, eyes bare; thorax and abdomen clothed with smooth scales; day-flying, often colored. (Fig. 402). (**Peridròmia, Callimórpha,** palæarc.; **Hýpsa** (=*Asòta*), **Agánais**). (*CALLIMÓRPHIDÆ, AGANÀIDÆ, ASÓTIDÆ*).

HÝPSIDÆ



Figs. 402–406. **Lepidoptera**

402. **Hypsa,** wings (Hampson) Hypsidæ.
403. **Lymantria,** wings (Hampson) Lymantriidæ.
404. **Pterophorus,** hind leg of male (Fernald) Pterophoridæ.
405. **Euchera,** wings (Hampson) Drepanidæ.
406. **Ephestia,** wings (Chittenden) Pyralididæ.

Proboscis absent (except in *Munichryia*); thorax and abdomen hairy 83

83. Fore wings with a single radial areole, apex of wings rounded. (See couplet 85) ..... **LYMANTRÌIDÆ,** part

Fore wings with two radial areoles, the basal one very long, apex of wing acute; female without frenulum. (See couplet 93). Australasian. (**Anthèla, Chelépteryx, Munichrỳia**).

ANTHÉLIDÆ, males

84. Tympanal hoods large, consisting of two rounded bosses separated by about one-third the width of the abdomen; black moths with light marks on the wings and often with metallic tints. West and South United States ..... **PERICÓPIDÆ**

Tympanal hoods less conspicuous and more lateral; fore wings with radial areole usually present. 85

85. Ocelli present; hind wings with M_2 sometimes weak, or rarely absent, M_1 independent or very short-stalked with R_s, basal areole formed by Sc and R very small, less than one-sixth the length of the discal cell 86

Ocelli absent; hind wings with M_2 as strong as the other veins, M_1 stalked with R_s, basal areole more than one-sixth the length of the discal cell. (Fig. 403). (See couplet 83). Principally indomalayan and ethiopian, but containing the following important species of holarctic distribution: (**Lymántria** (=*Líparis*) (*L. mónacha*, Nun moth); **Porthètria** (=*Ocnèria*) (*P. díspar*, Gipsy moth); **Nýgmia** (=*Eupróctis*) (*N. phœorrhœa*, =*chrysorrhœa*, Browntail moth); **Stilpnòtia** (*S. sálicis*, Satin moth); **Orgỳia** (= *Notólophus*); **Hemerocámpa** (Tussock moths). (*LIPARÍDIDÆ, LIPÁRIDÆ, OCNERIIDÆ*).
LYMANTRÌIDÆ

86. Hind wings with vein M_2 imperfect or obsolete. (*CARADRÍNIDÆ*) . . . . . **NOCTÙIDÆ**. . . . a

Hind wings with vein M_2 well developed . . **PLUSÌIDÆ** . . . . d

a. Eyes hairy. (**Alètia, Círphis** (=*Leucània*), cosmop. (*C. unipúncta*, Army worm)) . . . . . **MELANCHRÌNÆ**

Eyes bare . . . . . b

b. Eyes not ciliated c

Eyes furnished with a marginal row of long cilia curving over them. (**Pòlia, Conístra, Orthòsia**, holarc.; **Cucúllia**, holarc., ethiop.) . . . . . **POLIÌNÆ**

c. The four posterior tibiæ spinose. (**Helìothis** (*H. obsolèta*, Corn earworm, Cotton boll-worm), **Eùxoa, Agròtis**, widespr.; **Triphæna**, holarc.; **Nóctua**). (*AGROTÌNÆ*). . . . . **NOCTUÌNÆ**

Tibiæ not spinose. (**Acronýcta** (=*Apátela*), **Luperìna**, holarc.; **Nonàgria**, widespr.; **Monòdes**, mainly Amer.; **Hadèna**, cosmop.; **Caradrina**) . . . . . **CARADRINÌNÆ**

d. Hind wings with M_2 and M_3 parallel. (**Hermínia, Bomólocha**, holarc.; **Hypèna**, cosmop.) . . . . . **HYPENÌNÆ**

Hind wings with M_2 and M_3 close together at base, diverging apically . . . . . e

e. Eyes glabrous . . . . . f

Eyes hairy. (**Colocàsia**, holarc.; **Mòma**) . . . . . **MOMÌNÆ**

f. Eyes not ciliated. (**Catocàla**, holarc.; **Grammòdes**, mainly tropical; **Erástria**, cosmop.; **Eustròtia, Eublémma**, widespr.).
CATOCALÌNÆ

87. Hind wings small, with Sc apparently wanting; tympanal hoods very large, the abdomen sometimes constricted behind them; day-flying, usually brightly colored moths. (Fig. 407). Mainly indoaustr. (**Euchròmia, Ctenùcha, Amàta** (=*Syntomis*), **Scépsis, Cosmosòma**). (*SYNTÓMIDÆ, AMÁTIDÆ, SYNTOMÍDIDÆ*) ..... **EUCHROMÌIDÆ**

Hind wings with Sc well developed; tympanal hoods not exceptionally large. Widespread 88

88. Hind wing with Sc and R fused from near the base to the middle or near the middle of the cell, leaving a small basal areola. (Fig. 410). Mainly tropical. (**Hylóphila**, palæarc.; **Eàrias**, Old World; **Sarrothrìpus**, palæarc., indoaustr.). **HYLOPHÍLIDÆ**

Hind wings with Sc and R fused from extreme base to near or beyond the middle of the cell 89

89. Ocelli present. Large, widespread group. (**Phægóptera** (= *Ophàrus*), **Parasèmia** (= *Hyphoràia*), **Nemeóphila** (= *Parasèmia*, pt.), **Árctia, Háploa, Utetheìsa, Apántesis, Hyphántria** (Webworms), **Euprèpia, Autómolis, Halisidòta, Estígmene, Diacrísia**) ..... **ARCTÌIDÆ**

Ocelli absent 90

90. Fore wings smoothly scaled, rarely M_2 or M_3 wanting. (See couplet 48). (**Eudésmia** (=*Cisthene*, auct.), **Císthene** (= *Íllice*), **Lithòsia, Hypoprèpia, Chionàema**, widespr.). **LITHOSÌIDÆ**

Fore wings with tufts of raised scales. (Fig. 411). (**Nòla, Rœsèlia, Ũraba, Célama**) ..... **NÓLIDÆ**

91. Hind wings with Sc entirely free from R. Indomalayan. (**Cocýtia**). (*EUCOCYTÌIDÆ*) ..... **COCYTÌIDÆ**

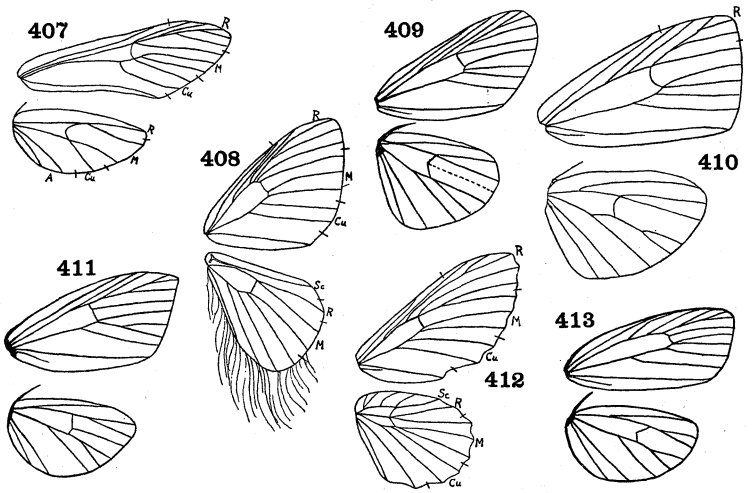
Hind wings with Sc and R connected for a short distance at base, sometimes forming a very small basal areolet; rather small or medium-sized day-flying moths of brilliant colors, often dark, ornamented with large pale spots. (Fig. 409). Forester moths. Principally ethiopian and indoaustralian. (**Agarísta, Alýpia, Androlòma, Eusèmia, Phalænòides**). (*PHALÆNÒIDIDÆ*) ..... **AGARÍSTIDÆ**

92. Hind wings with the straight Sc connected with the cell by a bar near or before the middle of the discal cell. 93

Hind wings with Sc free from R or fusing for a greater or less distance, but not joined to the cell by a bar near the base of the cell 94

93. Fore wings with two radial areoles; a simple medial stem indicated through the discal cell; margin of fore wings notched just below the tip. Australian. (Male with frenulum, see couplet 83) ..... **ANTHÉLIDÆ,** females

Fore wings with no radial areole, R_{2-5} and M_1 seriately stalked; a forked medial stem indicated in the discal cell; wings not notched. Palæarctic. (**Éndromis,** monotypical). (*ENDRÓMIDÆ*) ..... **ENDROMÍDIDÆ**



Figs. 407–413. **Lepidoptera**

407. **Euchromia,** wings (Hampson) Euchromiidæ.
408. **Pterothysanus,** wings (Hampson) Pterothysanidæ.
409. **Alypiodes,** wings (Hampson) Agaristidæ.
410. **Earias,** wings (Hampson) Hylophilidæ.
411. **Nigetia,** wings (Holland) Nolidæ.
412. **Epicnaptera,** wings (Hampson) Lasiocampidæ.
413. **Hypoprepia,** wings (Hampson) Lithosiidæ.

94. Fore wings with R_4 long and free, or arising from base of the stalked $R_{2,3}$; R_5 and M_1 short-stalked; hind wings with Sc and R_s fused for a greater or less extent near the middle of the discal cell, humeral angle wide and strengthened by one or more humeral veins. (Fig. 412). Widespread, mainly tropical.

(**Tólype, Epicnáptera** (=*Gastrópacha*), **Lasiocámpa, Eriogáster, Malacosòma** (=*Clisiocámpa*). Tent caterpillars). (*LACHNÈIDÆ*) ..... **LASIOCÁMPIDÆ**

Fore wings with R_4 short and arising apically from R_3 or from R_{2+3} 95

95. Fore wings with R_5 free, R_4 remote from R_3 and ending beyond tip of the wing, outer margin not sinuate; hind wings with Sc dipping toward R_s in front of cell 96

Fore wings with R_{2-5} stalked, R_4 very close to R_3 and entering the costal margin; hind wings with Sc dipping toward or fusing with R_s beyond the cell. (See couplets 65, 81). (**Orèta**).

DREPÁNIDÆ, part

96. Fore wings with R_2 free, only R_{3+4} stalked; hind wings with lower margin bearing a double fringe of long woolly hairs. (Fig. 408). Indian and African. (**Pterothýsanus, Hibrílides**).

PTEROTHYSÁNIDÆ

Fore wings with R_{2-4} stalked; hind wings without long fringe. Indomalayan. (See couplet 80). (**Callídula, Clèis**). **CALLIDÙLIDÆ**

97. Maxillary palpi conspicuous, folded in resting position 98

Maxillary palpi straight and porrect, or vestigial (if of folded type, inconspicuous or invisible) 104

98. Basal segment of antennæ enlarged and concave beneath, forming an eye-cap, larger than the eye; wing-membrane aculeate ... 99

Eye-cap small or undeveloped; fore wings usually with large cell and branched veins 100

99. Fore wings with branched veins, normally with short trapezoidal aculeæ distributed over entire membrane; cell sometimes absent; media usually dipping deeply into wing; extremely small moths, the wing expanse as little as 3 mm. (Fig. 414). Leaf miners. (**Neptícula,** cosmop.; **Scoliaùla,** Eur.; **Glaucólepis; Ectœdèmia; Obrússa; Trifúrcula**). (*STIGMÉLLIDÆ*).

NEPTICÙLIDÆ

Fore wings with three or four simple veins only, aculeæ pointing forward, in rows and confined to a small area at the base of the wing; hind wings linear; mostly oriental, three North American species. Larvæ legless miners in bark or rind. (**Opóstega**) ..... **OPOSTÉGIDÆ**

100. Fore wings with R_5 extending to outer margin, wing-membrane not aculeate; head with a few erect hairs behind. (**Acrolèpia,** cosmop.) ..... **ACROLEPÌIDÆ**

Fore wings with R_5 extending to the costa, sometimes absent. 101

101. Head usually entirely smooth; strongly flattened species, coxæ flat and appressed, fore wings curved down at apex, hind wings narrow-lanceolate; venation sometimes reduced; mostly oriental. (**Opógona,** ethiop.; **Phæoses,** nearc.; **Œnóphila,** ethiop., indomal.). (*OINOPHÍLIDÆ*) ..... **ŒNOPHÍLIDÆ**

Head tufted, at least on the vertex, sometimes with a naked area above the eyes behind the antennæ, in which case the hind wings are ample; venation complete, accessory cell commonly present, four or five branches of R extending to the costal margin. . . 102

102. Wing-membrane aculeate (Fig. 369); hind wings with Sc having a strong basal fork (the lower branch being R_1) or considerably swollen at the base, R and Sc usually sharply divergent from the base; vertex roughly hairy 103

Wing-membrane not aculeate; hind wings with R_1 rarely as strong as the other veins and when distinct placed well out from the base of the wing, connecting Sc and R which are closely parallel toward the base. Widespread. (See couplet 112). (**Isocórypha, Diachorísia, Leucómele, Œnoe**). **TINÈIDÆ**

103. Folded part of maxillary palpi half as long as the width of the head. (**Eudárcia, Incurvària,** holarc.; **Phyllopòria,** palæarc.; **Lamprònia,** holarc., ethiop.; **Nemóphora, Paracleménsia**). (*LAMPRONÌIDÆ*) ..... **INCURVARÌIDÆ**

Folded part of maxillary palpi two-thirds as long as the width of the head. (Fig. 415). Yucca moths; larvæ boring in seed pods of Yucca. (**Prodóxus, Tegetícula** (= *Pronùba*), Amer.). **PRODÓXIDÆ**

104. Basal joint of the antennæ enlarged and concave beneath, forming an eye-cap 105

Basal joint of the antennæ not forming an eye-cap, sometimes provided with tufts of scales or a pecten of bristles. 107

105. Venation complete and nearly parallel, hind wings with Sc ending at apical fourth and discal cell reaching the middle of the wing. (**Calósima,** holarc.). (see couplet 146). **BLASTOBÁSIDÆ**

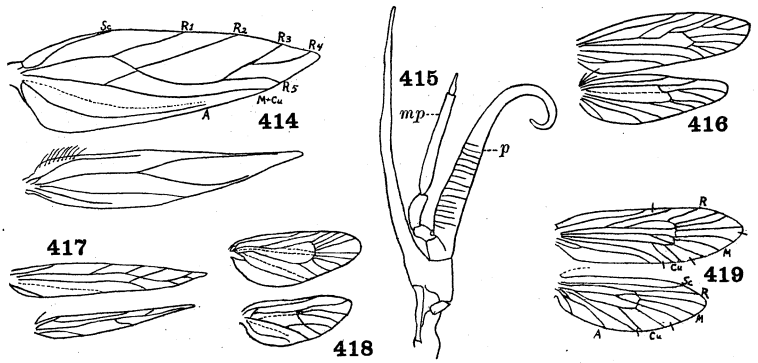
Venation reduced, wings linear-lanceolate with sharply pointed apex, fore wings with the veins at the apex of the discal cell radially diverging; hind wings without discal cell, the principal vein axial. (Fig. 417) 106

106. Labial palpi minute and drooping, or absent; fore wings typically with a closed anal cell, or the vertex rough. (Fig. 417). (**Bucculàtrix** (Ribbed cocoon makers), **Lyonètia,** cosmop.; **Be-**

déllia, Leucóptera (= *Cemióstoma*), widespr.; **Phyllobróstis**). (*BEDELLÌIDÆ, CEMIOSTOMÁTIDÆ, ERECHTHÌIDÆ, HIEROXÉSTIDÆ*). (Including *BUCCULATRÍGIDÆ*).

LYONETÌIDÆ

Labial palpi moderate, upcurved; no anal cell; vertex smooth; eye-cap small, no pecten. (**Phyllocnístis,** part). (See couplet 139) ..... **PHYLLOCNÍSTIDÆ**



Figs. 414–419. **Lepidoptera**

414. **Ectœdemia,** wings (Braun) Nepticulidæ.
415. **Tegeticula,** mouthparts of female (Packard): m p, maxillary palpus; p, palpifer.
416. **Setomorpha,** wings (Busck) Setomorphidæ.
417. **Bedellia,** wings (Clemens) Lyonetiidæ.
418. **Cecidoses,** wings (Brethes) Cecidosidæ.
419. **Tinea,** wings (Spuler) Tineidæ.

107. Vertex and upper face at least tufted with dense bristly hairs (with flattened short hair in Amydridæ, which have strongly bristly palpi) 108
At least the face smooth and with short scales even though the vertex may be rough-crowned.....109

108. Labial palpi with the first joint short, and the second joint bristly, on the outer side and equal to the fusiform third joint.....110
Mouthparts wholly vestigial. South American gall-making species, with very indistinct venation. (**Ridiáschina**).

RIDIASCHÍNIDÆ

109. Labial palpi scaled or short-hairy, the third joint usually long and pointed, or very short in the species with roughest vestiture 113

Mouthparts wholly undeveloped; front and hind wings each with a single anal vein, fringe short; larvæ gall-makers. (Fig. 418). South American. (**Cecidòses, Olièra**) ..... **CECIDÓSIDÆ**

110. Wing-membrane aculeate over all; female with piercing ovipositor; antennæ often longer than the wings. (**Adèla,** palæarc., neotrop.; **Nemotòis,** Old World; **Chalcèopla,** nearc.). **ADÉLIDÆ**

Wing-membrane not generally aculeate; ovipositor membranous, retractile 111

111. Fore wings with R_3 free, arising from the accessory cell. (Fig. 419) 112

Fore wings with a hyaline aculeate fovea in the accessory cell distorting the venation, $R_{3,4,5}$ seriately stalked. (Fig. 416). (**Setomórpha,** widespr.) ..... **SETOMÓRPHIDÆ**

112. Vertex with high, rough, bristling vestiture. (Fig. 419). (**Tínea** (Clothes moths), **Monòpis, Scárdia,** cosmop.; **Tinèola** (*T. bisseliélla,* Clothes moth), **Trichóphaga** (*T. tapetzélla,* Case-bearing clothes moth), **Ténaga,** widespr.; **Elatòbia,** holarc.). (See couplet 102). (Including *MONÓPIDÆ*) ..... **TINÈIDÆ**

Vertex with short, flattened hair. (**Amýdria**) .. **AMYDRÌIDÆ**

113. Labial palpi elongate, deeply scaled, but not bristly, with the first joint at least subequal to the second joint, or much longer, of female typically porrect, of male upturned; eyes sometimes hairy or scaly 114

Labial palpi with the first joint small; eyes bare 117

114. Proboscis absent or obsolete; neuration complete; moderate-sized species; no ocelli 115

Proboscis well developed 116

115. Slender, long-legged Sesiid-like moths; vestiture not spatulate or tufted; antennæ exteriorly ciliated on apical half; third joint of labial palpi minute and bare. (**Ashinàga,** Formosa). **ASHINÁGIDÆ**

Vestiture deep and spatulate on the thorax, with well marked anterior and posterior tufts; eyes more or less distinctly hairy; stout, Noctuid-like moths; American, mostly tropical. (**Acrólophus,** Burrowing webworms) ..... **ACROLÓPHIDÆ**

116. Hind wings trapezoidal, apex pointed, outer margin strongly sinuate, veins R_s, M_1 and M_2 nearly parallel; fore wings with

R_4 and R_5 stalked or coincident; hind tibiæ thinly clothed with long hairs above, densely rough-haired between spurs beneath. Indomalayan. (**Amphithèra, Agriothèra, Telethèra**). **AMPHITHÉRIDÆ**

Hind wings with greatly reduced venation, frenulum of female simple; ocelli posterior; larvæ on cocoanut. Austromal. (**Aganóxena, Hæmolỳtis**). (See couplet 153) . **AGONOXÉNIDÆ**

117. Hind wings relatively ample, with well developed anal region, rounded at apex or trapezoidal, or more or less deeply notched below the apex, often wider than their fringe; venation more or less complete 118

Hind wings narrow-lanceolate and pointed, or linear, never much wider than their fringe; sometimes without closed cell, venation often much reduced.....134

118. Hind wings with M_1 and sometimes also M_2 absent.....119

Hind wings with M_1 present, associated with R_s (if M_1 of the hind wings and A1 of the fore wings are rarely absent (Gelechiidæ) the outer margin of the hind wings is more or less emarginate) 120

119. Hind wings with the cell closed, M_1 and M_2 both wanting, R_s extending alone, the outer margin not concave; fore wings heavily tufted, all the branches of R free, R_5 ending beyond the wing tip, Cu_2 from near end of cell, A1 absent; mostly Australian and Hawaiian. (**Carposìna** (*C. fernaldàna*, American currant fruit worm), **Bóndia**)..... **CARPOSÍNIDÆ**

Hind wings trapezoidal-ovate, with cell open and M_1 and sometimes also M_2 absent; fore wings with R_5 absent. (**Metachánda, Ancylomètis, Chanýstis**, ethiop., ind.) . **METACHÁNDIDÆ**

120. Hind wings with 3A distally forked; venation complete, accessory cell present, all veins separate; front wings with two medial stems in cell. (Larvæ at first parasitic in Homoptera, later myrmecophilous). (**Cyclotórna**, austr.). **CYCLOTÓRNIDÆ**

Anal vein not distally forked.....121

121. Hind wings with radial vein shortly furcate at apex; labial palpi with second joint thickened and with rather appressed scales, last joint very short, filiform, obtuse; front tarsi much longer than their tibiæ. (**Anomóloga**, ethiop.) . . **ANOMOLÓGIDÆ**

Hind wings with radial vein not furcate at apex.....122

122. Fore wings with Cu_2 arising before the last fourth of the cell; labial palpi beak-like, with the third joint short and blunt and the second joint closely or roughly scaled and usually porrect

or oblique (short and nearly smooth in *Laspeyresia,* which usually has a strong fringe on the base of Cu of the hind wings) 123

Fore wings with Cu_2 arising further out on the cell (except Glyphipterygidæ, part, which have no fringe on the base of Cu) 125

123. Upper side of the hind wings with a fringe of long hairs on the basal part of Cu (if rarely absent in somes pecies of *Laspeyresia* the fore wings have M_1 and M_2 rather close together at the tip); fore wings with R_4 and R_5 separate, or with veins M_2, M_3 and Cu_1 converging strongly toward the margin. (Fig. 420). A cosmopolitan group. (**Áncylis** (*A. comptàna,* Strawberry leaf-roller), **Evètria** (Pine twig moths), **Carpocápsa** (=*Cýdia*) *C. pomonélla,* Codling moth; *C. sáltitans,* Mexican jumping bean moth); **Rhyaciònia** (=*Evètria,* = *Retínia*), **Anarmònia** (=*Epinòtia*), **Laspeyrèsia** (*L. prunívora,* Lesser apple worm; *L. interstinctàna,* Clover-seed worm), **Spilonòta** (=*Tmetócera*) (*S. ocellàna,* Budmoth), **Olethreùtes, Melíssopus, Polychròsis** (*P. viteàna* Grape-berry moth), **Gypsónoma, Eucósma, Argyróploce, Hemímene, Pámmene**). (*EUCÓSMIDÆ, EPIBLÉMIDÆ, GRAPTOLÍTHIDÆ*).

OLETHREÙTIDÆ

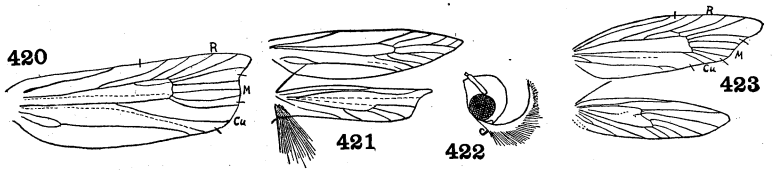
Hind wings without a fringe of long hairs on the basal part of Cu (if rarely present the fore wings have R_4 and R_5 stalked or united); fore wings with veins M_2, M_3 and Cu_1 divergent or parallel 124

124. Fore wings with R_3 and R_4 stalked or coincident; hind wings with M_2 and M_3 parallel, R_s and M_1 stalked. (**Chlidanòta,** Ceylon; **Trymáltis,** austr.) ..... **CHILDANÓTIDÆ**

Fore wings with R_3 and R_4 separate or rarely stalked, if stalked then hind wings with M_2 amd M_3 arising close together from the cell; distal end of 1A usually present (if wings are close-scaled, 1A absent, and 2A simple, and the second joint of labial palpi is broad, refer to Thyrididæ, couplet 73). A large widespread family. (**Cacœcia** (=*Árchips*) (*C. argyrospìla,* Fruit tree leaf-roller; *C. rosaceàna,* Oblique-banded leaf-roller), **Eùlia, Harmóloga** (*H. fumiferàna,* Spruce bud-worm), **Peronèa, Rhopóbota** (*R. nævàna,* Cranberry fireworm), **Pándemis, Tórtrix** (*T. citràna,* Orange tortrix; *T. franciscàna,* Apple-skin worm), **Cnephàsia, Argyrotóxa, Sparganòthis**). (*SPARGANÓTHIDÆ*) ..... **TORTRÍCIDÆ**

125. Labial palpi beak-like, with the second joint rough-scaled on the upper side and smooth within, and the third joint porrect and inconspicuous; fore wings with A1 lost, all veins independently arising from the discal cell, rarely R_4 and R_5 stalked; hind wings with R and M_1 approximate or stalked and widely distant from M_2. (If the second joint of the palpus is bristly on the outer side and third joint is well set off refer to couplet 101; if R_{4+5} are stalked and both terminate in the costa and M_2 of the hind wings is not widely separate from M_1 see *Anarsia* ♂ of the Gelechiidæ, couplet 126). Mainly holarctic. (**Commóphila, Hysteròsia, Phalònia** (=*Cónchylis*), **Phármacis, Chlidònia, Phtheóchroa, Euxánthis**). (*COMMOPHÍLIDÆ, CONCHÝLIDÆ*).

PHALONÌIDÆ



Figs. 420–423. **Lepidoptera**

420. **Hystricophora,** fore wing (Heinrich) Olethreutidæ.
421. **Agnippe,** wings (Busck) Gelechiidæ.
422. **Gnormoschema,** head from side (Busck) Gelechiidæ.
423. **Glyphipteryx,** wings (Spuler) Glyphipterygidæ.

Palpus upturned to the middle of the front or beyond, the third joint long and slender, usually tapering. (If the palpi and proboscis are obsolete, see couplets 20, 40, 46, *Talæporìidæ, Psýchidæ* 126

126. Both wings with A1 lost (extreme tip present in *Symmoca,* spp.); outer margin of hind wing usually concave, sometimes quite emarginate and the apex produced; fore wings with R_5 running into the costa, stalked with R_4. (Figs. 421, 422). The largest family of Microfrenatæ, with about 400 genera and 3,700 species including many destructive species. (**Anacámpsis** (Leaf-rollers), **Anársia** (*A. lineatélla,* Peach twig-borer), **Aristotélia** (*A. fragàriæ,* Strawberry crown-miner), **Dùvita, Dichómeris, Glyphidócera, Recurvària, Sitotròga** (*S. cerealélla,* Angoumois grain-moth), **Pectinóphora** (*P. gossypiélla,* Pink boll-

worm), **Phthorimæa** (*P. operculélla*, Potato tuber moth), **Telphùsa, Thiótricha, Gnorimoschèma** (Goldenrod gall moth), **Geléchia, Sophrònia, Sýmmoca, Trichótaphe**). (See couplet 149). (*DICHOMÉRIDÆ*). Most **GELECHĬIDÆ**

A1 preserved, at least at margin 127

127. Hind wings with R and M_1 close together, connate, or stalked. 128

Hind wings with R and M_1 well separated at origin, at least half as far apart as at the margin 130

128. Fore wings elongate triangular, costa slightly bent near middle where R_5 terminates, Sc, R_1 and R_2 short, ending before middle of wing, M_1 absent, M_2 and M_3 both ending in costal margin; maxillary palpi vestigial. (**Strepsímana**, India). **STREPSIMÁNIDÆ**

Fore wings with anterior veins longer, M_3 at least ending beyond wing tip 128a

128a. Wings relatively ample, fore wings blunt; maxillary palpi of the folded type 129

Wings rather narrow, fore wings sometimes falcate; maxillary palpi porrect. (**Cerόstoma**, holarc., neotrop.). (See couplet 133) ..... **PLUTÉLLIDÆ**, part

129. Fore wings with R_5 long-stalked and extending to the outer margin, Cu_1 and Cu_2 widely separated; mainly Old World. (**Ptochorýctis, Cryptóphasa, Xyloríctes**). (*CRYPTOPHÁSIDÆ, UZÙCHIDÆ*) ..... **XYLORÍCTIDÆ**

Fore wings with R_5 usually free and usually extending to the costa, Cu_1 and Cu_2 usually connate or stalked; mostly New World species. (**Stenòma, Menésta, Setiόstoma**). (*STENOMÁTIDÆ*) ..... **STENÓMIDÆ**

130. Ocelli small or absent 131

Ocelli usually very large and conspicuous; fore wings with R_5 ending beyond the wing-tip (Fig. 423). Largely oriental. (*CHOREÙTIDÆ, HEMEROPHILIDÆ, SIMAÉTHIDÆ*). **GLYPHIPTERÝGIDÆ**

Two well-marked subfamilies may be distinguished:

a. Wings relatively narrow, the apex of the fore wings more or less extended as a lobe-like prolongation. (**Glyphípteryx**, cosmop., mainly austr.) ..... **GLYPHIPTERYGĬNÆ**

Wings broad and triangular, the apex not lobed. (**Choreùtis**, widespr., **Simaèthis** (=*Allonónyma*), cosmop., mainly tropical) ..... **CHOREUTĬNÆ**

131. Fore wings with R_4 and R_5 stalked.....132
Fore wings with R_4 and R_5 separate, R_5 ending beyond the wing-tip.....133

132. Hind wings with M_2 arising nearer M_1 than to M_3. (**Éthmia**, cosmop.) ..... **ETHMÌIDÆ**
Hind wings with M_2 arising nearer M_3 than to M_1; palpi long, reaching or surpassing the vertex. (**Œcóphora**, palæarc.; **Depressària**, widespr.; **Agonópteryx**, **Dasýcera**, **Pleùrota**). (See couplet 149). (*DEPRESSARÌIDÆ*).
Most **ŒCOPHÓRIDÆ**

133. Hind wings with M_1 and M_2 stalked; antennæ extending forward in repose. (**Plutélla** (*P. maculipénnis* (=*cruciferàrum*), Diamond-back cabbage moth), cosmop.). (See couplet 128).
PLUTÉLLIDÆ
Hind wings with M_1 and M_2 separate. (**Yponomeùta**, widespr.; **Átteva**, tropicopol.; **Orthotælia**, palæarc.; **Uròdus**). (*ATTÉVIDÆ*, based on pupal characters only, *HYPONÓTIDÆ*, misprint, *HYPSELÓPHIDÆ*, *HYPONOMEÙTIDÆ*, *ORTHOTÆLÌIDÆ*) ..... **YPONOMEÙTIDÆ**

134. Fore wings without closed cell.....135
Fore wings with discal cell formed.....136

135. Hind tibiæ heavily spined; tarsi spinose at apex of joints; fore and hind wings linear, with three or four unbranched veins only; middle or hind legs commonly displayed when at rest. (See couplet 141) ..... **HELIODÍNIDÆ**, part
Hind tibiæ hairy; fore wings lanceolate, with seven veins reaching the margin. (**Coptodísca**, "Shield-bearers"). (See couplet 139) ..... **HELIOZÉLIDÆ**, part

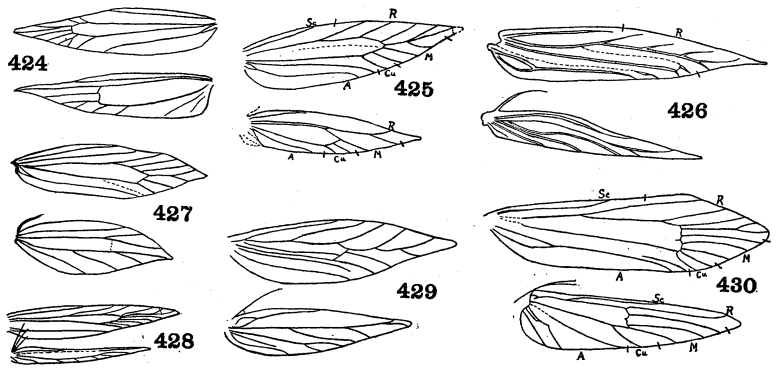
136. Hind wings lanceolate, sometimes very small, at least one-sixth as wide as long, with the R-stem axial, widely separated from Sc.....137
Hind wings with the R-stem closely associated with Sc at the base, or lost; or wing linear and the veins crowded or much reduced, the R-stem not prominently axial.....140

137. Hind wings without discal cell, Cu-stem often simple; palpi drooping.....138
Hind wings usually lanceolate, with a discal cell, the Cu-stem at least two-branched; fore wings with R_1 arising before the middle of the cell; palpi usually upturned beyond the middle of the front, often strongly divergent. (Fig. 425). (**Elachísta**, cosmop.; **Cycnòdia**, **Aphelosètia**, **Chrysopelèia**, nearc.; **Per-**

íttia, palæarc.). (*APHELOSETÌIDÆ, CYCNODÌIDÆ, CHRYSOPELEÌIDÆ*) ..... **ELACHÍSTIDÆ**

138. Hind wings with an oblique branch from the R-stem to the costa near the middle of the wing, and sometimes another nearer the tip. (**Tinágma**, nearc.; **Douglasia**, palæarc.). **DOUGLASÌIDÆ**

Hind wings with R-stem not sending a branch to the costa near the middle of the wing-length, but sometimes with a branch near the tip 139



Figs. 424–430. **Lepidoptera**

424. **Scythris,** wings (Walsingham) Scythrididæ.
425. **Elachista,** wings (Spuler) Elachistidæ.
426. **Coleophora,** wings (Forbes) Coleophoridæ.
427. **Coptotriche,** wings (Walsingham) Tischeriidæ.
428. **Mompha,** wings (Busck) Cosmopterygidæ.
429. **Antispila,** wings (Spuler) Heliozelidæ.
430. **Holcocera,** wings (Forbes) Blastobasidæ.

139. Discal cell two-thirds the wing-length, lanceolate; hind tibiæ hairy. (Fig. 429). (**Antispìla, Heliozèla,** widespr.). (See couplet 135) ..... Most **HELIOZÉLIDÆ**

Discal cell reaching almost to the end of the wing, its posterior edge straight, the branches of R, M and Cu very short; hind tibiæ with a row of strong bristles. (Some species of *Phyllocnistis*). (See couplet 106) ..... **PHYLLOCNÍSTIDÆ**

140. Accessory cell unusually large, extending halfway to the base of the wing and hind wing without closed cell and with reduced

venation; hind tibiæ very hairy; antennæ long, those of the male heavily ciliate; vertex often with a large loose semi-erectile tuft. (Fig. 427). (**Tischèria,** widespr. (*T. malifoliélla,* Apple leaf-miner) ..... **TISCHERÌIDÆ**

Accessory cell smaller, or more often absent (if long, hind wing with closed cell and complete venation); otherwise of different conformation 141

141. Hind tarsi with more or less distinct groups of bristles near the ends of the several joints, the hind tibiæ smooth-scaled or with stiff bristles; middle or hind legs displayed when in resting position, either raised or held out sideways. (**Heliodînes,** holarc., austr.; **Schreckensteînia,** holarc.; **Pancàlia, Augásma,** palæarc.; **Strathmópoda,** indoaustr., ethiop., palæarc.; **Idioglóssa, Eucleménsia**). (*TINÆGERÌIDÆ*).

Most **HELIODÍNIDÆ**

Hind tarsi without evident groups of bristles 142

142. Fore wings with four veins or less, either free or stalked, extending from the cell to the costa, and five or six from the cell to the inner margin, the last branch of R ending beyond the tip of the wing; hind wings with R and M usually widely separated at the margin 143

Fore wings with five veins extending from the cell to the costa, or with only three or four to the inner margin, the last branch of R ending before the tip of the wing (except Epimarptidæ) .. 145

143. Fore wings with R_1 arising beyond the middle of the cell, about as long as R_2. (Fig. 424). (**Scỳthris** (=*Butàlis*), cosmop.; **Paralogístis,** ethiop.). (*SCÝTHRIDÆ, BUTÁLIDÆ*).

SCYTHRÍDIDÆ

Fore wings with R_1 arising before the middle of the cell, longer than R_2 144

144. Hind tibiæ stiffly bristled, normally in tufts at the spurs; hind wings with M_1 and M_2 separate. (**Epermènia** (=*Chauliòdus*), widespr.; **Acanthèdra,** nearc.; **Catapléctica,** palæarc.).

EPERMENÌIDÆ

Hind tibiæ with long loose hair; palpi small and drooping; hind wings with M_1 and M_2 united or long-stalked. (**Argyrésthia** (*A. conjugélla,* Apple fruit-miner), widespr.; **Zellèria,** cosmop.; **Hofmánnia**) ..... **ARGYRESTHÌIDÆ**

145. Fore wings with the discal cell set obliquely, the end distinctly closer to the hind margin than to the costa, Cu_2 very short and usually extending directly back to the margin 146

Fore wings with the discal cell axial and central, Cu_2 normally longer and continuing parallel with the medial veins, rarely obsolete, 148

146. Fore wings with blunt discal cell, R_1 arising from the middle of the wing, veins R_2 to Cu arising from the end of the discal cell, with a long stigmal thickening between the costa and R_1; hind wings with Sc and R normally fused for a short distance near the base; antennæ with a heavy pecten on the basal joint. (Fig. 430). Mainly tropical species. (**Blastóbasis**, widespr.; **Auximóbasis**, Am.; **Dryopèria**, **Holcócera**, **Pigrítia**, **Valentínia**). (See couplet 105) ..... Most **BLASTOBÁSIDÆ**

Fore wings without stigma, R_2 arising distinctly before the end of the discal cell; hind wings with R not fused with Sc, sometimes vestigial. (Fig. 426) 147

147. Front tibiæ slender, with the epiphysis small and apical or wanting, the hind tibiæ with the upper spurs above the middle; antennæ porrect in repose. (Fig. 426). (**Coleóphora** (= *Haploptília*) cosmop. (*C. fletcherélla*, Cigar case-bearer; *C. malivorélla*, Pistol case-bearer); **Goniodòma**, **Metriòtes**, palæarc.). (*EUPÍSTIDÆ*, *HAPLOPTILÌIDÆ*) .. **COLEOPHÓRIDÆ**

Front tibiæ stouter, with the epiphysis at the middle; antennæ turned back in repose. (**Batráchedra**, **Blastodácna**, **Pyrodérces**). (See couplet 153) .... **COSMOPTERÝGIDÆ**, part

148. Labial palpi with the third joint normally blunt, fusiform and more or less angulate with the second, the joints not curving; maxillary palpi porrect but not folded across the proboscis, or reduced, sometimes absent; A2 not forked at the base. (**Acrocércops**, **Gracilària** (*G. syringélla*, Lilac leaf-miner); **Lithocollètis** (= *Phyllonorýcter*) (Leaf blotch-miners); **Mármara** (*M. pomonélla*, Apple-skin miner); **Paréctopa**; **Parórnix**, **Órnix**). (*EUCÉSTIDÆ*, *LITHOCOLLÉTIDÆ*, *PHYLLORYCTÉRIDÆ*) ..... **GRACILARÌIDÆ**

Labial palpi with the third joint long, tapering, pointed, the second joint curving up; maxillary palpi small, but of folded type, curving over the base of the proboscis; A2 commonly formed at the base 149

149. Both wings with A1 preserved at the margin and A2 forked at the base; basal joint of the antennæ with a strong pecten of bristles. (**Borkhausènia**, **Éndrosis**). (See couplet 132). **ŒCOPHÓRIDÆ**, part

Hind wings and usually also the fore wings lacking A1; antennæ often without a pecten 150

150. Fore wings with no veins emerging from the end of the discal cell between the continuations of the R and Cu + M stems. (**Hèlice, Theísoa**). (See couplet 126) ..... **GELECHÌIDÆ**, part

The oblique end of the discal cell of the fore wings emitting several veins between the R and Cu stems.....151

151. Labial palpi with appressed scales, the second joint with a projecting pencil of scales above; antennæ with the basal joint elongate, a notch near the base of the stalk covered by an oblique tooth beneath it; hind tibiæ rough-haired above; fore wings with R_5 ending beyond the wing-tip. (**Epimárptis**, India) ..... **EPIMÁRPTIDÆ**

Labial palpi without dorsal tuft; base of antennæ not toothed; R_5 ending before wing-tip 152

152. Hind wings elongate-ovate or ovate-lanceolate with the costal margin simple, regularly arched. Hawaiian. (**Hyposmócoma, Diplósara, Aphthonètus**). (*DIPLOSÁRIDÆ*). **HYPOSMOCÓMIDÆ**

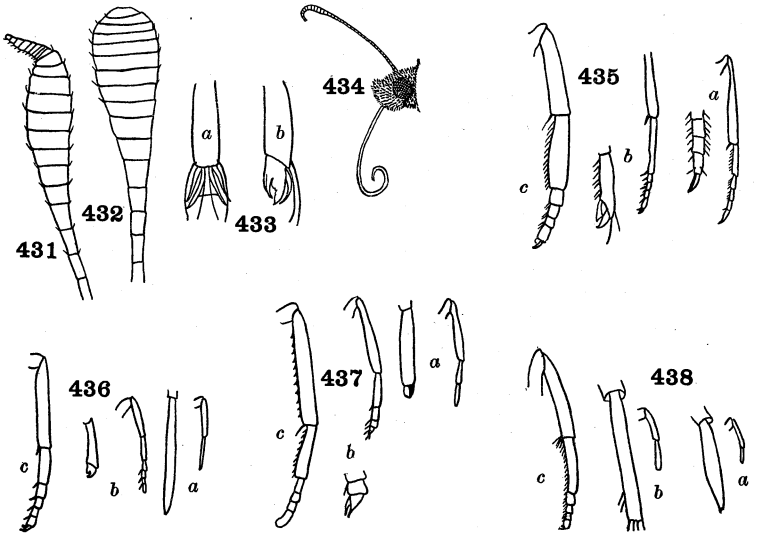
Hind wings lanceolate or linear, at most with a slightly developed costal lobe toward the base, accentuated by a tuft of stiff scales beyond which the costa is straight or slightly concave, the apex always acute.....153

153. Hind wings with reduced neuration, R, M and Cu apparently simple veins, no crossveins, subcosta very short, frenulum simple; labial palpi strongly flattened and rather rough-scaled on anterior edge throughout. Austromalayan. (**Agonóxena, Hæmólytis**). (See couplet 116) ..... **AGONOXÉNIDÆ**

Hind wings, except when linear, with several branches of Cu and M and the crossvein preserved, frenulum usually multiple; palpi with the second joint smooth or tufted below. (Fig. 428). A large cosmopolitan group. (**Cosmópteryx, Chrysoclísta, Homalèdra, Synallágma, Wálshia, Stagmatóphora, Lavérna, Lophóptilus, Mómpha, Perimède, Psacáphora, Limnècia** (*L. fragmitélla*, Cat-tail moth)). (Compare couplet 147). (*LAVÈRNIDÆ*). Most **COSMOPTERÝGIDÆ**

154. Fore wings with R five-branched, all the branches simple, unforked, and arising from the discal cell; eyes strongly lashed in front; antennæ separated at the base by a distance greater than half the width of the eye, usually hooked at the tip; stout bodied butterflies of rapid, erratic flight; hind tibiæ usually with a middle spur. Skippers. (HESPERIÒIDEA)..... 155

Fore wings with some of the branches of R stalked or absent;



Figs. 431–438. **Lepidoptera**

431. Antenna of skipper, apical portion (Duncan) Hesperiidæ.
432. Antenna of butterfly, apical portion (Duncan).
433. **Epargyreus,** last joint of tarsus of male (Scudder): *a*, dorsal view; *b*, lateral view. Hesperiidæ.
434. **Epargyreus,** side view of head (Scudder) Hesperiidæ.
435. **Lycæna,** details of legs (Scudder): *a*, front leg of male with tarsal joints at left more enlarged; *b*, front leg of male with last tarsal joint at left more enlarged; *c*, middle leg of male. Lycænidæ.
436. **Calephelis,** details of legs (Scudder): *a*, tibia and tarsus of front legs of male, with tarsus at left more enlarged; *b*, tibia and tarsus of front leg of female, with last joint at left more enlarged; *c*, tibia and tarsus of middle leg of male.
437. **Euphydryas,** details of legs (Scudder): *a*, tibia and tarsus of front leg of male, with last joints of tarsus on left more enlarged; *b*, tibia and tarsus of front leg of female with last joints of tarsus below more enlarged; *c*, tibia and tarsus of middle leg of male. Nymphalidæ.
438. **Megisto,** details of legs (Scudder): *a*, tibia and tarsus of front leg of male, with tarsus at left more enlarged; *b*, tibia and tarsus of front leg of female, with tarsus at left more enlarged; *c*, tibia and tarsus of middle leg of male. Satyridæ.

eyes rarely lashed; antennæ closer together, the antennal club never pointed and recurved at the tip (Fig. 432); hind tibiæ never with a middle spur. Butterflies. (PAPILIONÔIDEA) 157

155. Hind wings with the discal cell divided by the forked base of the media; M_2 fully developed; male with frenulum. Australian. (**Euschèmon**). (See couplet 15).

Females of **EUSCHEMÓNIDÆ**

Hind wings with the base of the media wanting and M_2 more or less reduced, often wanting 156

156. Head much narrower than the metathorax; antennal club large, not drawn out at the tip nor recurved; wing expanse 40 mm. or more; fore wings with M_2 nearer to M_3 than to M_1; palpi porrect. Giant skippers. (**Megathỳmus,** N. Am.).

MEGATHÝMIDÆ

Head large; antennal club usually drawn out at the tip and with a distinct recurved apical crook (rarely the crook is not formed in some species whose small size distinguishes them from the Megathymidæ). (Figs. 431, 433, 434) ..... **HESPERÌIDÆ**

a. Antennal club large, and cylindrical or cylindrical-conical, usually reflexed before the swollen part. Mostly South and Central American. (**Pyrrhopỳge, Mysòria, Mýscelus, Jemàdia, Apýrrothrix**). (*THAMYRÍDIDÆ*) .... **PYRRHOPYGÌNÆ**

Antennal club not wholly reflexed ..... b

b. Antennal club bent near the middle, ending in a long hooked or bent point, often as long as the swollen part; palpi stout, the second joint raised against the face, the third joint long, slender, bare and porrect; male without costal fold; discal cell of fore wing two-thirds as long as the wing-length, M_2 ending somewhat closer to M_1 than to M_3. (**Ísmene,** indomal.; **Hasòra,** indoaustr.; **Rhopalocámpa,** ethiop.) ..... **ISMENÌNÆ**

Antennal club without a long hooked terminal portion, and fore wings with discal cell less than two-thirds the wing-length. If the antennal club has a long hooked terminal part and the discal cell is more than two-thirds the wing-length, the palpi are not upturned against the face c

c. Fore wings with discal cell at least two-thirds as long as the wing, when shorter M_2 arises closer to M_1 than to M_3. (Figs. 433, 434). (**Achlyòdes,** neotrop.; **Telégonus, Thỳmele,** neotrop.; **Eùdamus, Epargýreus,** Am. mostly trop.; **Urbànus** (= *Hespèria,* = *Pýrgus,* auct.) widespr.; **Erýnnis** (= *Thánaos*) palæarc. Am.; **Tagìades,** Old World tropic.; **Pholisòra,** nearct.; **Celœn-**

orrhìnus, tropicopol.). (*ACHLYÓDIDÆ, EUDÁMIDÆ, PÝRGIDÆ, TELECÓNIDÆ, THYMÉLIDÆ, URBANÌNÆ, HESPERIÌNÆ*) ..... **ERYNNÌNÆ**

Fore wings with discal cell less than two-thirds as long as wing, M_2 arising closer to M_1 than to M_3; and usually with an oblique brownish brand across the disk of the fore wings. Cosmopolitan. (**Cænides, Cyclópides**, ethiop.; **Ancylóxipha, Atrytòne, Thymèlicus**, Am.; **Ochlèdes**, nearc.; **Hespèria** (= *Pámphila*) holarc.; **Hálpe**, indomal.; **Dálla, Thràcides**, neotrop.; **Párnara**, ethiop., indomal.). (*CYCLOPÍDIDÆ, PAMPHILÌNÆ*, auct.) ..... **HESPERIÌNÆ**

157. Front legs normal, or if slightly reduced in size and structure, with the claws toothed or bifid 158

Front legs, at least in the male, more or less strikingly different from the other pairs, usually not used for walking, the claws of their tarsi, when present, never toothed or split 160

158. Tarsal claws large, not toothed or bifid; anterior tibiæ with pads; fore wings with Cu apparently four-branched and with two or three anal veins; hind wings with the anal area reduced, one anal vein present 159

Tarsal claws bifid; anterior tibiæ without pads; fore wings with Cu apparently three-branched and one anal vein present; hind wings with two anal veins: medium sized or rather small butterflies with broad wings, typically yellowish or white with blackish marginal markings. Cosmopolitan. (**Áscia** (= *Póntia, Pìeris*) (*A. ràpæ*, Cabbage butterfly), **Eùrymus** (= *Còlias*), **Eurèma, Nathàlis, Catopsília, Zerène, Anthócharis, Synchlòe** (Orange-tips)). (*PIÉRIDÆ*) ..... **ASCÌIDÆ**

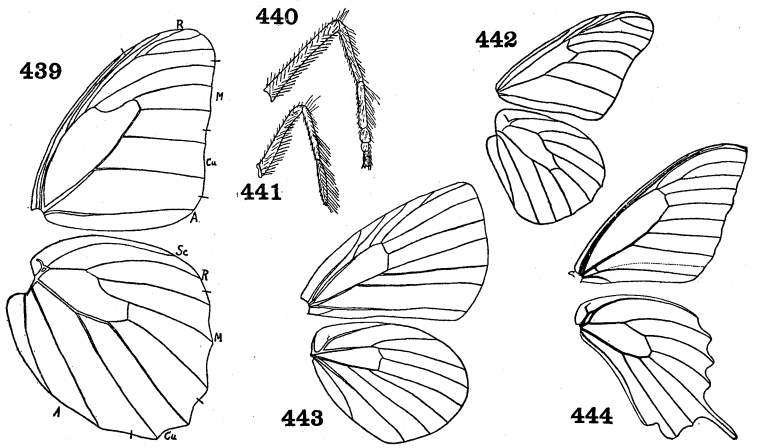
159. Fore wings with radius five-branched, anal crossvein present; hind wings usually with a wavy margin and a tail-like prolongation; ground color of wings yellow or black; large showy butterflies with contrasting color pattern. (Fig. 444). Swallowtails. (**Iphiclìdes, Tròides** (= *Ornithóptera*), **Laértias, Papílio**). (*EQUÍTIDÆ*) ..... **PAPILIÓNIDÆ**

Fore wings with radius four-branched, no crossvein between the base of the discal cell and the anal vein; medium sized butterflies, ground color of wings cream-white, marked with dusky and usually with a red eye-spot on the hind wing; mainly alpine species. Parnassians. (**Parnássius**, holarc.). **PARNASSÌIDÆ**

160. Front legs much reduced in size in both sexes and without tarsal

claws, folded against the thorax and not used in walking, their tarsi with only one joint in the male, usually with five joints in the female; fore wings with the radius five-branched. (Fig. 437). (NYMPHÁLIDÆ, *s. lat.*) 161

Front legs of female functional, with tarsal claws; of male more or less reduced, sometimes with a single claw; fore wings with the radius three- or four-branched. (Fig. 436)..... 167



Figs. 439–444. **Lepidoptera**

439. **Caligo,** wings (Stichel) Brassolidæ.
440. **Caligo,** tibia and tarsus of front leg of female (Stichel) Brassolidæ.
441. **Caligo,** tibia and tarsus of front leg of male (Stichel) Brassolidæ.
442. **Danais,** wings (Scudder) Danaidæ.
443. **Calephelis,** wings (Stichel) Riodinidæ.
444. **Papilio,** wings (Comstock) Papilionidæ.

161. Hind wings with the discal cell closed by a well developed vein 162

Hind wings with the discal cell open, or closed by a vestigial vein 166

162. Front feet of female ending in a corrugated knob; fore wings with the subcostal vein forked at the extreme base, A3 preserved; antennæ not scaled above; generally large butterflies with bold contrasting coloration; mainly tropical. (Figs. 370, 442). (See couplet 166). (**Dánais** (=*Anòsia*) (*D. plexíppus,* Milkweed

butterfly), **Helicònius, Acrǽa**). (*ACRÆIDÆ, EUPLŒIDÆ, LYMNÁDIDÆ, MANIÓLIDÆ*) ..... **DANÀIDÆ**

Front tarsi of female present, though more or less abbreviated; fore wings with A3 lacking. (Fig. 438)..... 163

163. Fore wings elongate oval, twice as long as broad; mainly tropical 164

Fore wings much less than twice as long as broad..... 165

164. Antennæ clothed with scales, at least above; front tarsi of the female four-jointed; wings opaque; medium sized, brightly colored butterflies. Almost entirely neotropical. (**Apostràphia, Colænis, Diòne** (=*Agraulis*), **Migonìtis** (=*Helicònius*, auct.); **Cethòsia**, indomal.). (*PALÆOTRÓPIDÆ, HELICONÌIDÆ*) ..... **EUEÍDIDÆ**

Antennæ naked; wings often in great part translucent and destitute of scales. (**Dircénna, Ithòmia**) ..... **ITHOMÌIDÆ**

165. Fore wings with some of the veins greatly swollen at the base: usually small butterflies, rarely rather large, feeble fliers, frequently of brownish colors, with yellowish eye-spots or ringed marks. (Fig. 438). (**Megísto** (=*Cissia, Neonympha*), **Cœnonýmpha, Sátyrus** (=*Cercyonis*), **Árgus** (=*Satyròdes*), **Œneis, Enòdia**). (*AGAPÉTIDÆ*)..... **SATÝRIDÆ**

Fore wings with the veins not swollen at the base: large, tropical species with very broad wings, above with deep rich colors, below with eye-spots and intricate lines. (Figs. 439, 440, 441). Neotropical. (**Calìgo, Brássolis, Opsíphanes**). (*CALIGÓNIDÆ*) ..... **BRASSÓLIDÆ**

166. Hind wings with a large, cradle-like depression along the anal edge in which the abdomen rests: large species, usually with brilliant metallic blue color; tropical. (**Mórpho**, neotrop.; **Amathùsia, Amathuxídea**, indoaustr.). (*ÁRGIDÆ*). **MORPHÒIDÆ**

Hind wings without a structure of this sort: usually moderate-sized species without brilliant blue coloration; many common brightly colored butterflies. (Figs. 437, 371). (**Drỳas** (=*Argýnnis*), **Bréntheis, Euptoièta** (Fritillaries); **Euphýdryas** (=*Lemònias, Melitœa*), **Phyciòdes** (=Crescent-spots); **Hamàdryas** (=*Aglais, Euvanéssa, Vanéssa*), **Eugònia, Junònia, Polygònia** (=*Grápta*), **Vanéssa** (=*Pyrámeis*), (Angle-wings) **Basilárchia** (=*Limenìtis*), **Heteróchroa** (Sovereigns), **Chloríppe** (=*Apatùra*) (Emperors); **Anǽa** (Goatweed butterflies). (*ARGYRÈIDÆ*)..... **NYMPHÁLIDÆ**

167. Palpi very long, porrect, from one-fourth to one-half as long as the body and thickly hairy. Snout butterflies. Cosmopolitan. (**Libýthea, Hýpatus**) ..... **LIBYTHÈIDÆ**

Palpi not elongated, of ordinary size.....168

168. Hind wings with the costa thickened out to the humeral angle, Sc with a spur at the base, the humeral vein. (Figs. 426, 443). (*ERYCÌNIDÆ, LEMONÌIDÆ, RHIODÍNIDÆ, NEMEOBÌIDÆ, PLEBÈJIDÆ*, auct.)..... **RIODÍNIDÆ**

a. Hind wings with base of costa developed (Fig. 443); almost wholly neotropical. (**Mesosèmia, Riodìna** (=*Erycìna*, auct.), S. Am.; **Eurýbia, Cària, Bæotis, Caléphelis, Lýmnas**). **RIODINÌNÆ**

Hind wings without basal vein. (**Dodòna, Zémeros**, indomal.; **Abísara**, indomal., ethiop.; **Euselàsia**, nearct.; **Hàdes, Helicòpis** (=*Plebèius*), neotrop.; **Nemeòbius**, Eur.; **Dicallaneùra**, malay.) ..... **NEMEOBIÌNÆ**

Hind wings with the costa not thickened at the base and without the humeral vein; fore wings with M_1 almost always arising from the anterior angle of the discal cell: generally small, delicate species, the antennæ ringed with white; often brightly colored and with very slender tail-like appendages on the hind wings. Widespread. (**Strỳmon** (=*Thècla*), **Átlides, Incisàlia, Mitoùra** (Hair-streaks); **Lycæna** (=*Heòdes, Chrysóphanus*), **Tharsàlea** (Coppers); **Evères, Lycænópsis, Glaucopsỳche** (Blues). (*CUPIDÍNIDÆ, RURÁLIDÆ*).

LYCÆNIDÆ

169. Head of female moth of the usual form and structure.....170

Head of female of abnormal form and structure, resembling that of the caterpillar. (See couplet 42).

Females of some **HETEROGÝNIDÆ**

170. Moth developing in and frequently never leaving a sack or case constructed by the larva and carried about by the latter during growth. (See couplets 26, 40, 42). Females of **PSÝCHIDÆ, TALÆPORÌIDÆ** and some **HETEROGÝNIDÆ**

Moth not developing in such a sack constructed by the larva, the latter entirely free-living 171

171. Body scaly or hairy; or if woolly, without ocelli.....172

Body densely woolly; ocelli present. (**Trichiosòma**). (See couplet 89) ..... Females of some **ARCTÌIDÆ**

172. Palpi usually long and extended forward.....173

Palpi short, almost concealed. (See couplet 124).

Females of some **TORTRÍCIDÆ**

173. Body stout, densely woolly, with short legs. (See couplet 85). Females of some **LYMANTRÌIDÆ**

Body slender, hairy or scaly, with relatively long legs. (See couplet 50) ..... Females of a few **GEOMETRÒIDEA**

Lepidoptera, Larvæ

The key given below follows closely that used by Forbes in his Lepidoptera of New York state, which is based on the system elaborated by Fracker. It includes the more important families as they may be distinguished on the basis of those genera whose larvæ have been carefully and systematically studied. Wherever possible other families have been added, but at present a knowledge of even the European and North American forms is so incomplete that the present key must be used only as a guide in identification, and must in no way be relied upon as presenting characters of definite and final accuracy. Many families are necessarily omitted.

1. Thoracic legs present, formed of distinctly chitinized segments; abdominal prolegs usually present or indicated by crochets...2

Thoracic legs wanting or reduced to fleshy swellings without chitinized segments; prolegs frequently vestigial or absent.....7

2. Body segments bearing setæ, stiff hairs, or spines, arising from small tubercles or plates 3

Body setæ absent, replaced by large, ovate scales, arranged in pairs; body slug-like, polygonal in cross section. **MICROPTERÝGIDÆ**

3. Prolegs vestigial or absent, entirely without crochets.....4

Prolegs present, or at least indicated by crochets which may be reduced but never entirely absent.....14

4. Front not extending upwards to the vertex, except in cases where the vertex forms a very narrow slit.....5

Front extending upwards to the vertex; small species, the larvæ living in portable cases from which they protrude the anterior part of the body to feed externally or eat into the tissues of leaves, fruits, etc. Case-bearers..... **COLEOPHÓRIDÆ**

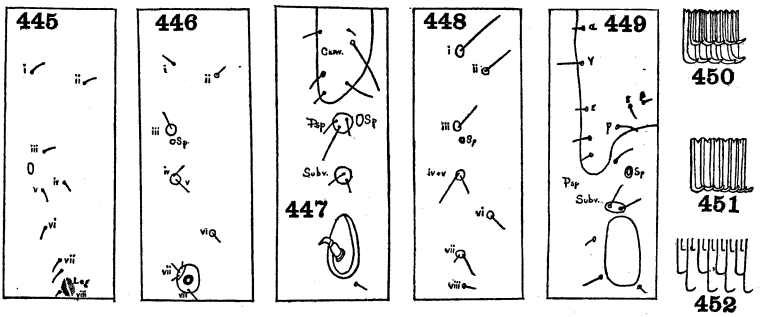
5. Head free, exposed in front of the thorax; body segments separated by strong incisures; only the primary body setæ present, these usually distinct.....6

Head concealed within the prothorax which bears a slit below through which the mouthparts are protruded for feeding; body almost always with spines or secondary hair, the primary setæ

obsolete; body with obscure incisures, but usually with pits. Slug-caterpillars ..... **EUCLÈIDÆ**

6. Setæ iv. and v. distant on the abdominal segments (Fig. 51); prolegs present, but without hooks; living in the pods of Yucca. *Tegetícula* of the **PRODÓXIDÆ**

Setæ iv. and v. adjacent (Fig. 446); prolegs absent. A few **GELECHÌIDÆ**



Figs. 445–452. **Lepidoptera,** *Larvæ*

445. **Adela,** setal map of third abdominal segment (Forbes) Adelidæ.
446. **Dichomerus,** setal map of sixth abdominal segment (Forbes) Gelechiidæ.
447. **Dichomerus,** setal map of prothorax (Forbes) Gelechiidæ.
448. **Dicymolomia,** setal map of third abdominal segment (Forbes).
449. **Sthenopis,** setal map of prothorax (Fracker).
450. Biordinal or double-rowed arrangement of crotchets on abdominal proleg (Forbes).
451. Uniordinal or single-rowed arrangement of crochets on abdominal proleg (Forbes).
452. Triordinal or triple-rowed arrangement of crochets of abdominal proleg (Forbes).

7. Body fusiform, thickest at the middle; head small, the front reaching only about two-thirds of the way to the vertex, closed above and separated from the vertex by the epicrania; living in the pods of Yucca. (**Prodóxus**) ..... **PRODÓXIDÆ**

Body cylindrical or flattened; if somewhat fusiform, the front extends upwards to the vertex..... 8

8. Head with two ocelli on each side, or with one large one or with the ocelli obsolete..... 9

Head with six small ocelli on each side..... 13

9. Two ocelli on each side of the head; front not extending to the vertex; larvæ leaf-miners, forming blotch mines. . **HELIOZÉLIDÆ**
   One large ocellus on each side of head or ocelli obsolete. 10
10. Front triangular, the ocellus frontal; larva making a large blotch mine from which it drops to spin a cocoon in the ground. **ERIOCRANÌIDÆ**
    Front quadrangular; ocellus lateral in position. 11
11. Front narrowed behind, wider in front; body cylindrical; prolegs, if present, vestigial and borne on the second to seventh abdominal segments 12
    Front widest behind; body usually depressed; prolegs, if present, borne on the third to fifth segments of abdomen. See couplet 13) . . . . . **GRACILARÌIDÆ**
12. Body not greatly lengthened, about five times as long as thick; prolegs usually present; larvæ mining in leaves, bark or fruits, or forming galls in twigs or petioles . . . . . **NEPTICÙLIDÆ**
    Body very slender, about ten times as long as thick; prolegs absent; larvæ mining near the surface of the stems of herbaceous or other plants . . . . . **OPOSTÉGIDÆ**
13. Vestigial prolegs, bearing hooks, present on the third to sixth abdominal segments; larvæ mining in leaves, usually making a blotch mine. . . . . **TISCHERÌIDÆ**
    Abdomen without prolegs on the sixth segment; larvæ leaf miners, at least in the early stages, the older larvæ sometimes spinning a shelter on the surface of the leaf. . . . . **GRACILARÌIDÆ**
14. Body without secondary or tufted setæ; tubercle vi. with a single seta; vii. with at most three setæ, unless the proleg has a multiserial circle of hooks when it may bear four setæ. 15
    Body bearing tufted or secondary hairs; at least two setæ on tubercle vi. on the sixth abdominal segment, or with additional setæ on the proleg. 52
15. Sixth abdominal segment bearing prolegs, although prolegs may be absent on the more anterior segments. 16
    Sixth abdominal segment without prolegs. (See couplet 13). **GRACILARÌIDÆ**
16. Hooks (crochets) of the prolegs arranged in a circle or ellipse, which may be incomplete, or in transverse band. 17
    Crochets forming a single band, sometimes with a few vestigial ones in addition. 46
17. Prespiracular wart of prothorax with two setæ. 18
    Prespiracular wart of prothorax bearing three setæ. 19

18. Hooks on prolegs uniordinal, *i.e.* with their tips forming a single line (Fig. 25); body cylindrical; tubercle vii. of mesothorax bearing a single seta; surface of body rough and granular. **ORNEÓDIDÆ**

Hooks on prolegs biordinal or triordinal, *i.e.* with their tips forming two or three parallel lines (Figs. 26, 27), or uniordinal in larvæ with stout body and bisetose tubercle vii. of mesothorax. Chrysauginæ of the **PYRALÍDIDÆ**

19. Hooks on prolegs forming two transverse bands, rarely reduced to one 20

Hooks on prolegs forming a circle or ellipse which is sometimes broadly interrupted 26

20. Prolegs with the hooks either in a single transverse row, or in two multiserial bands 21

Prolegs with the hooks arranged in two simple (uniordinal) series 22

21. Prolegs represented by one uniserial band of very small hooks, the prolegs practically absent; leaf-miners or case-bearers. **INCURVARÌIDÆ**

Prolegs with many, short, vestigial hooks arranged in two transverse multiserial bands (Fig. 458); case-bearers living in a portable lenticular case made of a piece of leaf. . . **ADÉLIDÆ**

22. Setæ iv. and v. of abdomen remote; young larvæ living in serpentine mines in leaves, later feeding externally. *Bucculatrix* of the **LYONETÌIDÆ**

Setæ iv. and v. of abdomen adjacent (Fig. 448) 23

23. Hooks on the anal prolegs disposed in two groups; habits various. **GELECHÌIDÆ**

Hooks on the anal prolegs in a single series 24

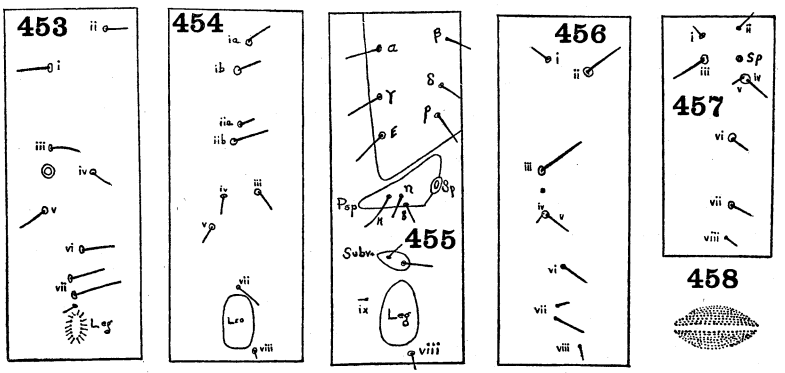
24. Front long, extending upwards at least two-thirds of the way to the vertex 25

Front short extending about one-third the way to the vertex. *Cossula* of the **CÓSSIDÆ**

25. Spiracles elliptical, normal in size, those of the eighth abdominal segment placed higher up than the others; body white, without markings; boring in woody, or more rarely in the stems of herbaceous plants . . . . . **ÆGERÌIDÆ**

Spiracles very small, circular, the last pair about in line with the others; larvæ usually living in portable cases and feeding externally or sometimes mining, but never boring into the stems of plants . . . . . **COLEOPHÓRIDÆ**

26. Setæ iv. and v. on abdomen remote, or very rarely absent in minute species 27
Setæ iv. and v. adjacent, often on a common tubercle; no small hooks at the base of the principal series on the prolegs 32
27. Hooks on prolegs arranged in a single, complete ellipse 28
Hooks on prolegs forming an incomplete ellipse, or with additional minute series at the base of the large ones 30



Figs. 453–458. **Lepidoptera,** *Larvæ*

453. **Scardia,** setal map of third abdominal segment (Forbes) Tineidæ.
454. **Acrolophus,** setal map of mesothorax (Fracker) Acrolophidæ.
455. **Acrolophus,** setal map of prothorax (Fracker) Acrolophidæ.
456. **Carposina,** setal map of first abdominal segment (Forbes) Carposinidæ.
457. **Carposina,** setal map of eighth abdominal segment (Forbes) Carposinidæ.
458. **Adela,** arrangement of crochets on proleg (Forbes) Adelidæ.

28. Setæ of prespiracular group on prothorax about as far from the spiracle as from one another; seta i. of abdomen placed at a higher level than ii. ..... **LYONETÌIDÆ**
Setæ of prespiracular group on prothorax about twice as far from the spiracle as from one another. (Fig. 449) 29
29. Seta i. of abdomen much lower than ii. (Fig. 453); larvæ generally case-bearers; the case usually ending in a triangular valve, more rarely lenticular; often living on animal matter, fungi, etc. **TINÈIDÆ**
Seta i. of abdomen not lower than ii.; habits varied. **HELIODÍNIDÆ**

30. Meso- and metathorax with setæ i.a and i.b close together (Fig. 454); abdomen with seta iv. below the level of the spiracle. .31
Meso- and metathorax with seta i.a in front of i.b and well separated from it; larvæ boring in woody plants, commonly in the roots ..... **HEPIÂLIDÆ**

31. Prothorax with seta *beta* at a higher level than *alpha* (Fig. 455). **ACROLÓPHIDÆ**
Prothorax with seta *beta* at a lower level than *alpha*. The Plutellidæ, Argyresthesiidæ and Acrolepiidæ will also run out here. Families related to the **YPONOMEÙTIDÆ**

32. Last pair of spiracles placed very high up, nearer to the middorsal line than setæ i. of the anterior abdominal segments; larvæ internal feeders in the fruits of various plants. (Figs. 456, 457) ..... **CARPOSÍNIDÆ**
Last pair of spiracles placed lower down, in the normal position. 33

33. Mesothorax with two setæ on tubercle vii., above base of leg. 34
Mesothorax with only a single seta on tubercle vii. (Fig. 549); seta ii. on ninth abdominal segment placed higher up than i. (Fig. 463) 36

34. Prothoracic spiracle higher than wide, *i.e.* with its longer axis vertical; seta i. of ninth abdominal segment placed higher up than ii.; larvæ boring in the tissues of plants, or leaf-rollers. **THYRÍDIDÆ**
Prothoracic spiracle with its longer axis horizontal; larvæ living in a portable case, from the anterior end of which they protrude the anterior end of the body when feeding 35

35. Thoracic legs with the last two segments stout; seta i. on abdominal segments below the level of seta ii. (Fig. 460). . **PSÝCHIDÆ**
Thoracic legs with the last two segments very slender; seta i. on abdominal segments above the level of seta ii. (as in Fig. 461) ..... **TALÆPORÌIDÆ**

36. Setæ ii. of ninth segment nearer together across the dorsum than these setæ are on the preceding segments, frequently on the same plate 37
These setæ as far apart across the dorsum on the ninth segment as on any of the preceding segments, very rarely on the same plate 38

37. Setæ iv. and v. on abdomen placed at almost the same level (Fig. 461); prolegs with the hooks forming a uniordinal row (Fig. 451); larvæ boring in herbaceous plants or feeding in the seeds. **PHALONÌIDÆ**

Setæ iv. and v. on abdomen not at the same level, a line connecting them diagonal or vertical; hooks on prolegs usually multiordinal (Fig. 452). (Including the Olethreutidæ and several other related families) ..... **TORTRÍCIDÆ**

38. Coxæ of the metathoracic legs separated by less than twice their own width.....39

Coxæ of the metathoracic legs separated by twice their own width; prolegs small; small species; larvæ with varied habits, mining in leaves, boring in stems, rolling leaves or feeding in seeds. **COSMOPTERÝGIDÆ**

39. Setæ i. and ii. on abdomen widely separated.....40

Setæ i. and ii. on abdomen close together. (See couplet 29). **HELIODÍNIDÆ**, part

40. Front short, not extending more than half way to the vertex, usually much less than half way.....41

Front longer, extending almost or fully two-thirds of the distance to the vertex, narrowly pointed above; small species with uniordinal or biordinal hooks on the prolegs.....43

41. Species boring in plants, usually in wood; setæ iv. and v. placed on separate tubercles on the ninth abdominal segment; body white 42

Leaf feeders; setæ iv. and v. together on the same tubercle on the ninth abdominal segment; body brightly colored. **STENÓMIDÆ**

42. Setæ ii. of the ninth abdominal segment placed on a common dorsal plate; adfrontal plates short, not attaining the vertex. **ZEUZÉRIDÆ**

Setæ ii. of the ninth abdominal segment on separate tubercles on each side of the mid-dorsal line adfrontal plates attaining the slightly cleft vertex ..... **CÓSSIDÆ**

43. Hooks of prolegs biordinal, *i.e.* of two lengths, their tips forming two parallel lines (Fig. 450) 44

Hooks of prolegs uniordinal, all of the same length with their tips forming one continuous line.....45

44. Ocelli irregularly arranged, three of them closer together in a group (Fig. 464); larvæ usually webbing or rolling leaves. **ŒCOPHÓRIDÆ**

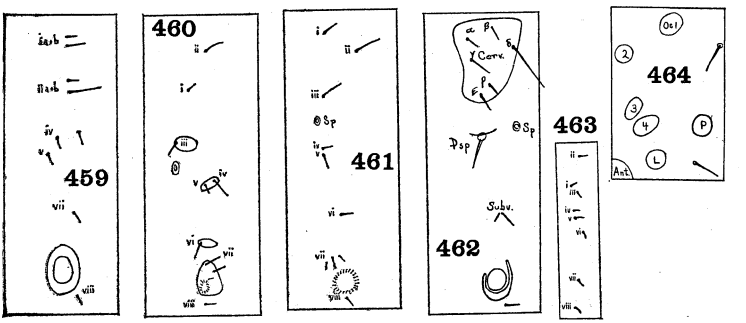
Ocelli evenly spaced in a single group on each side of the head; habits various ..... **GELECHÌIDÆ**

45. Seta iii. on the eighth segment of the abdomen usually placed above and behind the spiracle; habits varied, often scavengers, feeding in nuts, or predaceous on scale insects. .... **BLASTOBÁSIDÆ**

Seta iii. on eighth segment of abdomen usually placed just above or slightly before the spiracle; larvæ leaf-rollers or feeding generally on foliage ..... **GLYPHIPTERÝGIDÆ**

46. Prespiracular wart of prothorax bearing three setæ.....47
Prespiracular wart of prothorax bearing two setæ.....48

47. Setæ iv. and v. of abdomen remote, or if approximate the setæ *beta* of the two sides of the body much closer together than the setæ *alpha* of the two sides of the body on the prothorax (Fig. 462); prolegs long and slender. (See couplet 31).
YPONOMEÙTIDÆ



Figs. 459–464. **Lepidoptera,** *Larvæ*

459. **Phalonia,** setal map of mesothorax (Forbes) Phaloniidæ.
460. **Thyridopteryx,** setal map of fourth abdominal segment (Forbes) Psychidæ.
461. **Phalonia,** setal map of third abdominal segment (Forbes) Phaloniidæ.
462. **Argyresthesia,** setal map of prothorax (Forbes) Yponomeutidæ.
463. **Phalonia,** setal map of ninth abdominal segment (Forbes) Phaloniidæ.
464. **Depressaria,** arrangement of larval ocelli (Forbes) Œcophoridæ.

Setæ iv. and v. of abdomen placed close together; *beta* about as far apart as *alpha*; prolegs usually short..... **ETHMÌIDÆ**

48. Tubercle vii. on meso- and metathorax with two setæ.....49
Tubercle vii. on meso- and metathorax with a single seta.....51

49. Body setæ minute, the tubercles placed in obscure rings; head unusually wide; prolegs reduced; larvæ forming nests in loosely rolled leaves ..... **THYATÍRIDÆ**
Body setæ heavy, almost always spinulose, on conspicuous tubercles 50

50. Tubercle iii. of abdomen bearing two setæ; larvæ usually feeding on lichens ..... **LITHOSÌIDÆ**

Tubercle iii. of abdomen with a single seta. (See couplet 69). *Utetheisa* of the **ARCTÌIDÆ**

51. Body usually with enlarged contrasting tubercles; eighth abdominal segment with a conspicuous hump; banded or spotted with black; larvæ feeding externally on foliage. **AGARÍSTIDÆ**

Body not as above; usually dully colored and not with conspicuous transverse bands of black; usually external feeders on the leaves of plants, sometimes boring into fruits, or cutworms. **NOCTÙIDÆ**

52. Less than four pairs of ventral prolegs or with the first pair greatly reduced 53

Four pairs of ventral prolegs bearing hooks, and sometimes with additional ones not bearing hooks 54

53. Body hairs tufted; hooks on prolegs uniordinal (Fig. 25); three pairs of ventral prolegs; larvæ feeding externally on foliage. **NÓLIDÆ**

With only a few accessory hairs or sometimes with fine secondary hair; usually only one pair of ventral prolegs (on the sixth abdominal segment) in addition to the anal pair (on the eighth segment). Including also most of the families of Geometroidea. **GEOMÉTRIDÆ**

54. Four pairs abdominal prolegs; anal prolegs sometimes reduced or absent 55

Four pairs of abdominal prolegs on segments three to six and in addition a pair without hooks on segments two and seven; body bearing stinging hairs mixed with tufts of dense, soft hair. **MEGALOPÝGIDÆ**

55. Anal prolegs entirely absent; body with secondary hair below, but none above except on the few enlarged tubercles. **DREPÁNIDÆ**

Anal prolegs present as a pair of large tubercles, or flagella at least normally fully developed 56

56. Hooks on the prolegs uniordinal, all of equal length, their tips forming a single continuous line (Fig. 451) 57

Hooks on the prolegs biordinal or triordinal, of two or three lengths, their tips forming two or three parallel lines 71

57. Setigerous tubercles vestigial or absent, or obscured by secondary hair 58

At least tubercle vi. many haired and distinct; secondary hairs sparse or absent above the prolegs 65

58. Anal plate bifurcated; head roughly papillose; third ocellus very large .... **SATŸRIDÆ**
Anal plate simple; head smoother; third ocellus rarely much enlarged 59
59. Body caterpillar-like in form; vegetarian species, not parasitic on other insects 60
Body hemispherical, with a complete circle of uniordinal hooks; living as external parasites of Homoptera (Jassidæ and Fulgoroidea) ..... **EPIPYRÓPIDÆ**
60. Spiracles small, circular; ventral prolegs slender, more or less petiolate, with expanded walking surface; usually leaf-rollers, more rarely boring in the stems of plants. . **PTEROPHÓRIDÆ**
Spiracles elliptical, larger; ventral prolegs short 61
61. Body bearing dense secondary setæ 62
Secondary setæ very sparse or absent above the prolegs; with simple setæ or a few accessory ones 63
62. Notch of labrum deep, with parallel sides; anal prolegs as well developed as the ventral ones. (See couplet 51). A few **NOCTÙIDÆ**
Notch of labrum acute, with convergent sides; anal prolegs much reduced, not functional; body often with spines, long fleshy tubercles or humps, frequently brightly colored. **NOTODÓNTIDÆ**
63. Tubercle iv. much lower on the seventh abdominal segment than on the other segments; anal prolegs more or less reduced or modified 64
Tubercle iv. at about the same level on abdominal segments six, seven and eight. (See couplet 65). . A few **LYMANTRÌIDÆ**
64. Skin shagreened ..... **DIÓPTIDÆ**
Skin smooth, not shagreened. (See couplet 62). **NOTODÓNTIDÆ**
65. Sixth and seventh abdominal segments bearing eversible glands in the middle above; body hairy, usually with conspicuous tufts of brightly colored hairs; feeding externally on foliage. **LYMANTRÌIDÆ**
No dorsal eversible glands 66
66. Spiracles small, circular 67
Spiracles of the usual size, elliptical 68
67. Ventral prolegs short, with a straight band of heavy hooks. **PYROMÓRPHIDÆ**
Ventral prolegs slender, more or less petiolate, with expanded walking surface sometimes bearing a circle of hooks. (See couplet 60) ..... **PTEROPHÓRIDÆ**

68. Mesothorax with two or three setigerous tubercles above the level of the spiracles.....69
Mesothorax with only one such tubercle above the level of the spiracles; externally feeding species, commonly on grasses and low plants, also some on lichens .....**EUCHROMÏIDÆ**
69. Tubercle, or seta iv. placed much lower on the seventh abdominal segment than on the sixth or eighth segment, or absent.....70
Tubercle, or seta iv. placed at the same level on the seventh as on the adjacent abdominal segments; body clothed with dense clusters of hairs and often with long, brightly colored tufts; feeders on a great variety of plants ..... **ARCTÏIDÆ**
70. Hooks on prolegs of even length, or gradually decreasing in size toward the ends of the row. (See couplet 51).
A few **NOCTÙIDÆ**
Hooks on prolegs abruptly decreasing in size toward each end of the row; feeding externally on leaves, often brightly colored.
PERICÓPIDÆ
71. Body without noticeable accessory or secondary hair; with not more than eight hairs on the prolegs.....72
Body with numerous secondary setæ, at least on the prolegs; anal prolegs well developed.....77
72. Prolegs with the hooks arranged to form a complete circle.....73
Prolegs bearing a band of hooks on the inner side, and sometimes also a much weaker band on the outer side.....75
73. Subdorsal setæ of abdomen simple.....74
Subdorsal setæ of abdomen represented by warts; body with tufted hair from small warts; often webbing leaves.
SCYTHRÍDIDÆ
74. Surface of head rugose; body widest on the segments that bear the prolegs; larva spinning leaves together for a nest when young, later making a portable case of silk and pieces of leaf.
LACOSOMÁTIDÆ
Surface of head smooth; body widest on the first segment of the abdomen; larva constructing a portable case.
Some **XYLORÝCTIDÆ**
75. Prespiracular wart of prothorax bearing two setæ; setæ iv. and v. of abdomen usually distant from each other.....76
Prespiracular wart of prothorax bearing three setæ; setæ iv. and v. of abdomen approximate; anal prolegs well developed, with hooks; larva spinning a light web .....**ETHMÏIDÆ**
76. Spiracles subequal in size. (See couplet 49).....**THYATÍRIDÆ**

First and last spiracles twice as large as the others; young caterpillars living in a communal web, later feeding more or less exposed ..... **EPIPLÉMIDÆ**

77. Setæ very irregular in length, some ten times as long as the others; with obscure warts, at least in the earlier stages; sometimes provided with scale-like hairs 78

Setæ subequal or sometimes with setæ and prominent warts and spines 79

78. Labrum with a notch that extends for two-thirds of its length, or with the notch somewhat shallower and continued as a groove to the base of the labrum; body hairy, strongly depressed, often with slender dorsal hair tufts.
EUPTERÓTIDÆ, APATELODÌNÆ

Labrum with a shallower notch which is not continued as a groove; no dorsal hair-pencils; larva very hairy, with dense secondary hair; usually feeding on the foliage of trees, sometimes in a communal web ..... **LASIOCÁMPIDÆ**

79. Eighth abdominal segment bearing a median horn, process, plate, or tubercle 80

Eighth abdominal segment not thus armed on the mid-dorsal line 85

80. Body bearing numerous branching spines or enlarged tubercles. 81

Body not thus ornamented, at most with two pairs of small spines on the thorax 84

81. Head evenly rounded; hooks on prolegs biordinal (Fig. 26) 82

Head angulated or spined above, or the abdomen with several mid-dorsal spines; hooks of prolegs usually triordinal. (Fig. 27) ..... **NYMPHÁLIDÆ**

82. Ninth segment of abdomen with a median dorsal spine; spines on body strongly unequal, armed with short nodules or short spinules; large and brightly colored ..... **CITHERONÌIDÆ**

Ninth segment of abdomen without a median dorsal spine, or the body spines subequal and armed with dense, long spinules 83

83. Tubercles ii. of ninth abdominal segment from the two sides of the body fused into one on the dorsal line; body with bushy, branching spines, not brightly colored.
SATURNÌIDÆ, HEMILEUCÌNÆ

Tubercles ii. of ninth abdominal segment separate on each side of the median line; very large, brightly colored caterpillars.
SATURNÌIDÆ, SATURNIÌNÆ

84. Abdominal segments each divided into six or eight annulets; prolegs normal, not widely separated; body more or less cylindrical, usually with oblique stripes or bands of color. Sphinx caterpillars ..... **SPHÍNGIDÆ**

Abdominal segments with two or three obscure annulets; prolegs unusually widely separated; body without oblique color markings. Silkworms ..... **BOMBŸCIDÆ**

85. Head rounded, of the usual form 86

Head strongly elevated, triangular in outline.

Lapara of the **SPHÍNGIDÆ**

86. Ninth abdominal segment without a median dorsal spine 87

Ninth abdominal segment bearing a small median dorsal spine. (See couplet 80) ..... *Anisota* of the **CITHERONÌIDÆ**

87. Hooks on prolegs forming an ellipse, at most narrowly interrupted 88

Hooks on prolegs arranged in one band which is occasionally interrupted; or rarely forming two widely separated bands 89

88. Head much larger than the prothorax which forms a narrow "neck"; body widest at the middle, distinctly tapering toward both ends; larvæ commonly forming a nest in a folded leaf or in several leaves webbed together ..... **HESPERÌIDÆ**

Head smaller than the prothorax, partially retractile; body cylindrical; larvæ boring in the stems of Yucca ... **MEGATHŸMIDÆ**

89. Band of hooks on the prolegs reduced or interrupted at the middle and with a narrow, spatulate, fleshy lobe arising near the interruption; head small 90

Prolegs without a fleshy lobe near the middle of the band of hooks 91

90. Head about half as wide as the body; body bearing a considerable amount of secondary hair ..... **RIODÍNIDÆ**

Head smaller, rarely more than one-third as wide as the body; secondary hair less prominent; body short and broad, more or less slug-like, with the legs and prolegs very short.

LYCÆNIDÆ

91. Prothorax above bearing an eversible, forked scent gland; gland when retracted showing as a groove; body not hairy or spiny, but sometimes bearing fleshy filaments 92

Prothorax without a scent gland 93

92. Setæ minute, not borne on tubercles or warts (except in the early stages) ..... **PAPILIÓNIDÆ**

Setæ well developed; some warts present ..... **PARNASÌIDÆ**

93. Head and body entirely without spines, high tubercles or fleshy filaments 94
Spines, high tubercles or fleshy filaments well developed on the body; when reduced, large spines or tubercles are present on the head 97
94. Anal plate rounded, entire 95
Anal plate bifurcate at tip, bearing two distinct processes. **SATÝRIDÆ**
95. Prolegs with only a single row of hooks, forming a curved band. 96
Prolegs with reduced hooks on the outer side in addition to the well developed band; head small; setæ never borne on prominent warts ..... **LIBYTHÈIDÆ**
96. Head noticeably larger than the prothorax .... **NYMPHÁLIDÆ**
Head smaller than the prothorax; setæ usually borne on prominent warts ..... **ASCÌIDÆ**
97. Mesothorax and sometimes several other segments bearing fleshy filaments; secondary setæ short and confined to the prolegs. **DANÀIDÆ**
Body without fleshy filaments 98
98. Body spines slender, at least twelve times as long as wide; those on the abdomen as long as the width of the mesothorax; each abdominal segment with three lateral spines but no median ones above ..... **EUEÌDIDÆ**
Body spines, if present, not so slender; those on the abdomen shorter than the width of the metathorax; median spines usually present on the dorsum ..... **NYMPHÁLIDÆ**

LITERATURE ON LEPIDOPTERA, GENERAL

AURIVILLIUS, C. and WAGNER, H. Lepidoptorum Catalogus. Parts 1–28. W. Junk, Berlin (1911–23). (The parts so far as they have appeared are listed separately.)

BANG-HAAS, O. Katalog der im Seitz nicht enthaltenen paläarktische Macrolepidopteren. Novitates macrolep. Dresden, **1**, pp. 1–238 (1926).

BARNES, W. and MCDUNNOUGH, J. H. Check list of the Lepidoptera of Boreal America. Decatur, Ill. (1917).

BARRETT, C. G. The Lepidoptera of the British Isles. 11 vols. London (1893–1907).

CAMPOS, F. Catálogo preliminar de los Lepidópteros del Ecuador. Rev. Col. Rocafuerte, Guayaquil, **9**, pp. 3–106 (1927).

CANDÈZE, L. Lepidoptères Hétérocères de l'Indochine Française. (Catalogue) Encycl. Entom. Lepidop. II, fasc. 2, pp. 73–133 (1926–27).

COTES, E. C. and SWINHOE, C. Catalogue of the moths of India. 7 parts. Calcutta (1887–89).

DRUCE, H. H. J. C. Heterocera, in Biologia centrali-Americana, **1–3** (1881–1900).

DYAR, H. G. A List of North American Lepidoptera and key to the literature. Bull. U. S. Nat. Mus., No. 52, 723 pp. (1902).

EECKE, R. VAN. De Heterocera van Sumatra. I. Zool. Meded., **8**, pp. 153–217 (1925).

FORBES, W. T. M. Field Tables of Lepidoptera. 141 pp. Worcester, Mass. (1906).

Lepidoptera of New York and Neighboring States (Microlepidoptera, Pyraloids, Bombyces). Mem. Cornell Univ. Agric. Expt. Sta., No. 68, 729 pp. (1923).

FRACKER, S. B. The Classification of Lepidopterous Larvæ. Illinois Biol. Monog., **2**, No. 1 (1915) .

GAEDE, M. Lepidoptera Heterocera. Tierwelt Deutschlands, pt. 14, pp. 1–334 (1929).

HAMPSON, G. F. The Moths of India. Fauna of British India, 4 vols. (1892–96).

The Moths of South Africa. Ann. South African Mus., **2**, pp. 33–255; **3**, p. 389 (1900–05). (In three parts.)

Catalogue of the Lepidoptera Phalænæ in the British Museum, 12 vols. London (1898–1913). Supplement to Vol. 3 (1920).

HAMPSON, G. F. and DURRANT, J. H. List of the Families and Subfamilies of Lepidoptera. Novitat. Zool., **25**, pp. 366–394 (1918).

HEINRICH, CARL. Revision of North American Moths of Subfamily Eucosminæ of the Family Olethreutidæ. Bull. U. S. Nat. Mus., No. 123, 298 pp. (1923).

Revision of North American Laspeyresiinæ and Olethreutinæ. Bull. U. S. Nat. Mus., No. 132, 216 pp. (1926).

HERING, M. Lepidoptera. In Tierwelt Mitteleuropas, **6**, Lief. 3, pp. XVIII 1–94 (1928).

HOLLAND, W. J. The Moth Book. Doubleday, Page & Co., New York (1903).

HUDSON, G. V. The Butterflies and Moths of New Zealand. 386 pp. Wellington, Ferguson and Osborn (1928).

JANSE, A. J. T. Check-List of South African Lepidoptera Heterocera. Transvaal Mus. Pretoria, 219 pp. (1918).

A Key to the Families, Subfamilies and Tribes of the Order Lepidoptera with special reference to the South African Species. South African Journ. Sci., **22**, pp. 318–345 (1926).

KIRBY, W. F. A Synonymic Catalogue of the Lepidoptera Heterocera. 951 pp. London (1892).

KUSNEZOV, N. J. Faune de l'U. R. S. S. et des pays limitrophes. (Pub. by Mus. Zool. Acad. Sci., Leningrad) (1915). (Some parts on Lepidoptera have so far appeared).

LEDERER, G. Handbuch für den praktischen Entomologen., **2**, Rhopalocera, 172 pp., **3**, Heterocera, 172 pp. Frankfurt a. M. (1921–23).

MEYRICK, E. A Revised Handbook of British Lepidoptera. 914 pp. London, Watkins and Doncaster (1928).

MEYRICK, E. and WALSINGHAM, T. DE G. Lepidoptera. In Fauna Hawaiiensis, 2 vols. (1899–1907).

MOORE, F. Lepidoptera of Ceylon. 3 vols. London (1880–87).

MOSHER, EDNA. A Classification of Lepidoptera based on characters of the pupa. Bull. Illinois State Lab. Nat. Hist., **12**, pp. 12–159 (1916).

REBEL, H. Schmetterlingsbuch. Stuttgart. (1910).

SEITZ, A. Macro-Lepidoptera of the World (1906–). (Issued in a large number of parts containing many illustrations and much valuable material, but not yet indexed. Many families have so far been very completely treated. See also Closs, A. The Systematic Arrangement of Families in Seitz's "Macrolepidoptera." Entom. Mitteil., **9**, pp. 22–30 (1920).)

SPULER, A. Die Schmetterlinge Europas. 3 vols. and vol. 4 on Caterpillars. Stuttgart (1901–10).

STANDFUSS, M. Handbuch der palaärktischen Grossschmetterlinge. Jena (1896).

STANDINGER, O. and REBEL, H. Catalog der Lepidopteren des paläarktischen Faunengebietes. Berlin (1901).

SWINHOE, C. Catalogue of Eastern and Australian Lepidoptera Heterocera. 2 vols. Oxford (1895–1900).

TURNER, A. J. Revision of the Lepidoptera of Tasmania. Papers and Proc. Roy. Soc. Tasmania, 1925, pp. 81–151 (1925); Part 2, ibid., 1928, pp. 29–65 (1928).

SUBORDER JUGATÆ

MEYRICK, E. Micropterygidæ. Gen. Insectorum, fasc. 132, 9 pp. (1912).
Micropterygidæ. Lepid. Cat., pt. 6 (1912).

TURNER, A. J. Australian Lepidoptera Homoneura. Trans. Entom. Soc. London, 1921, pp. 592–603 (1922).

WAGNER, H. and PFITZNER, R. Hepialidæ. Catal. Lepid., pt. 4 (1911).

SUBORDER FRENATÆ

COSSOIDEA

BARNES, W. and MCDUNNOUGH, J. H. Revision of the Cossidæ of North America. Contrib. Nat. Hist. Lepidoptera N. Am., **1**, No. 1, Decatur, Ill. (1911).

DALLA TORRE, K. W. Cossidæ. Lepid. Catal., pt. 29 (1923).

DALLA TORRE, K. W. and STRAND, E. Metarbelidæ. Lepid. Catal., pt. 28 (1923).

JANSE, A. J. T. Revision of the South African Metarbelinæ. South African Journ. Nat. Hist., **5**, pp. 61–100 (1925).

STRAND, E. Catalogus Ratardidarum. Arch. f. Naturg., Jahrg. 82A, Heft. 4, pp. 53–54 (1917).

TURNER, A. J. Observations on Cossidæ and the classification of the Lepidoptera. Trans. Entom. Soc. London, 1918, pp. 155–190 (1918).

CASTNIOIDEA

DALLA TORRE, K. W. Castniidæ. Lepid. Catal., pt. 15 (1913).
HOULEBERT, C. Revision monographique des Castniinæ. In Oberthür, Études Lepidop. Comp., fasc. 15, 736 pp. (1918).
ROTSCHILD, W. Revision of the Castniidæ. Novitat. Zool., **26**, pp. 1–27 (1919).
TALBOT, G. Monograph of Castniinæ. Novitat. Zool., **26**, pp. 28–35 (1919).

PSYCHOIDEA

AURIVILLIUS, C. Chrysopolomidæ. Lepid. Cat., pt. 1 (1911).
BURGEFF, H. Zygænidæ, part. Lepid. Cat., pt. 33 (1926).
DALLA TORRE, K. W. and STRAND, E. Psychidæ. Lepid. Cat., pt. 34 (1927).
DYAR, H. G. and STRAND, E. Dalceridæ, Epipyropidæ. Lepid. Cat., pt. 16 (1913).
EECKE, R. VAN. Eucleidæ. Lepid. Cat., pt. 32 (1925).
FLETCHER, T. B. Zygænidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 9 (1925).
HERING, M. Revision der orientalischen Chalcosiinen. Arch. f. Naturg., Jahrg. 88A, Heft. 11, pp. 1–93 (1922).
HEYLAERTS, F. J. M. Monographie des Psychides paléarctiques. Ann. Soc. Entom. Belgique, **25**, pp. 29–73 (1881).
STRAND, E. Catalogus Heterogynidarum. Arch. Naturg., Jahrg. 88A, Heft. 3, pp. 47–50 (1922).
TURNER, A. J. Revision of Australian Limacodidæ and Zygænidæ. Proc. Linn. Soc. New South Wales, **51**, pp. 411–445 (1926).

TORTRICOIDEA

BUSCK, A. Review of Tortricid subfamily Phaloniinæ. Journ. New York Ent. Soc., **14**, pp. 173–182 (1906).
FERNALD, C. H. The genera of Tortricidæ. Mass. Agric. Expt. Sta. Special Bull., 69 pp. (1908).
KENNEL, J. Die paläarktischen Tortriciden. Zoologica, Heft, 54, 5 parts., 742 pp. (1908–21).
MEYRICK, E. Tortricidæ. Gen. Insectorum, fasc. 149, 81 pp. (1913).
Tortricidæ. Lepid. Cat., pt. 10 (1912).

PTEROPHOROIDEA

BARNES, W. and LINDSEY, A. W. The Pterophoridæ of North America. Contrib. Nat. Hist. Lepid. N. Am., Decatur, Illinois, **4**, pp. 281–452 (1921).
FERNALD, C. H. Pterophoridæ of North America. Mass. Agric. Sta. Spec. Bull. 84 pp. (1898).

MEYRICK, E. Pterophoridæ, Orneodidæ. Lepidop. Cat., pt. 17 (1913).
Orneodidæ. Gen. Insectorum, fasc. 108, 4 pp. (1910).
Pterophoridæ. Gen. Insectorum, fasc. 100, 21 pp. (1910).

PYRALIDOIDEA

DALLA TORRE, K. W. Thyrididæ. Lepidop. Cat., pt. 20 (1914).

DYAR, H. G. North American Nymphulinæ and Scopariinæ. Journ. New York Entom. Soc., **14**, pp. 77–107 (1906).

North American Chrysauginæ. Proc. Entom. Soc. Washington, **10**, pp. 92–96 (1908).

North American Pyralinæ. Proc. Entom. Soc. Washington, **10**, pp. 96–102 (1908).

FERNALD, C. H. Crambidæ of North America. Bull. Massachusetts Agric. Coll., Amherst, Mass., 93 pp. (1896).

HAMPSON, G. F. Classification of Schœnobiidæ and Crambidæ. Proc. Zool. Soc. London, 1895, pp. 897–974 (1895).

Classification of the Thyrididæ. Proc. Zool. Soc. London, 1897, pp. 603–632 (1897).

Classification of the Chrysauginæ. Proc. Zool. Soc. London, 1897, pp. 633–692 (1897).

Classification of some subfamilies of Pyralididæ, Epipaschiinæ, Endotrichinæ and Pyralidinæ. Trans. Entom. Soc. London, 1896, pp. 451–550. Hydrocampinæ, Scopariinæ, ibid., 1897, pp. 127–240 (1897).

Revision of the Pyraustinæ. Proc. Zool. Soc. London, 1898, pp. 590–761 (1898) and 1899, pp. 172–291 (1899).

Classification of the Pyralidæ, subfamily Galleriinæ. Novitat. Zool., **24**, pp. 17–58 (1917).

Classification of Pyralidæ, subfamily Hypsotropinæ. Proc. Zool. Soc. London, 1918, pp. 55–131 (1918).

HERING, E. Uebersicht der Sumatra-Pyraliden. Stettiner Entom. Zeitg., **62–64** (1901–03). (Three parts.)

HOLLAND, W. J. and SCHAUS, W. The Epipaschiinæ of the Western Hemisphere. Ann. Carnegie Mus., Pittsburgh, **16**, pp. 49–130 (1925).

HULST, G. D. Epipaschiinæ of North America. Entomologia Americana, 1889, pp. 41–52; 61–76 (1889).

The Phycitidæ of North America. Trans. American Entom. Soc., **17**, pp. 93–228 (1890).

SHIBUYA J. The Japanese Crambinæ and Pyralidinæ. Journ. Fac. Agric. Sapporo Univ., **21**, pp. 121–176 (1928).

Systematic Study of Formosan Pyralididæ. Journ. Fac. Agric., Sapporo Univ., **22**, pp. 1–300 (1928).

TURNER A. J. Studies in Australian Tineodidæ. Proc. Roy. Soc. Victoria, **35**, pp. 26–62 (1922).

A Revision of the Australian Anerastriinæ. Proc. Linn. Soc. New South Wales, **48**, pp. 451–461 (1923).

URANIOIDEA

DALLA TORRE, K. W. Epiplemidæ, Uraniidæ. Lepid. Cat., pt. 30 (1924).

JANET, A. and WYTSMAN, P. Epicopeiidæ. Gen. Insectorum, fasc. 16, 5 pp. (1904).

BOMBYCOIDEA

BOUVIER, E. L. Les Saturnioides de l'Afrique tropicale française. Faune Colon, franç. fasc. 2, pp. 449–708 (1928).

FLETCHER, T. B. Lasiocampidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 7 (1925).

JORDAN, K. On the Saturnoidian families Oxytenidæ and Cercophanidæ. Nov. Zool., **31**, pp. 135–193 (1924).

MATSUMURA, S. Generic revision of palæarctic Notodontidæ. Insecta. Matsum., Sapporo, **4**, pp. 78–93 (1929).

PACKARD, A. S. Monograph of the Bombycine moths of America north of Mexico. Mem. Nat. Acad. Sci., Washington, **7** (1895).

Monograph of the Bombycine moths of America. Family Ceratocampidæ, subfamily Ceratocampinæ. Pt. 2, Mem. Nat. Acad. Sci., Washington, **9** (1905).

Monograph of the Bombycine moths of North America. Pt. 3, Mem. Nat. Acad. Sci. Washington, **12**, 516 pp. (1914). (Edited by T. D. A. Cockerell).

PROUT, L. B. Provisional arrangement of the Dioptidæ. Nov. Zool., **25**, pp. 395–429 (1918).

SCHAUS, W. Revision of American Notodontidæ. Trans. Entom. Soc. London, 1901, pp. 257–344 (1901).

STRAND, E. Brahmæidæ. Lepidop. Cat., pt. 16 (1913).

TURNER, A. J. Revision of Australian Saturniidæ, Bombycidæ, Eupterotidæ, Notodontidæ. Proc. Linn. Soc. New South Wales, **47**, pp. 348–390 (1922).

Revision of Australian Lasiocampidæ. Proc. Linn. Soc. New South Wales, **49**, pp. 397–428 (1924).

GEOMETROIDEA

CULOT, J. Geometridæ of Europe. Vol. 3, 269 pp., Geneva (1919).

FORBES, W. T. M. The genera of Hydriomeninæ of the United States. Journ. New York Entom. Soc., **25**, pp. 44–67 (1917).

GOLDFINCH, G. M. Revision of Australian Geometridæ. Proc. Linn. Soc. New South Wales, **54**, pp. 378–407 (1929).

HULST, G. D. Classification of Geometrina of North America. Trans. American Entom. Soc., **23**, pp. 245–386 (1898).

MCDUNNOUGH, J. H. Studies on North American Cleorini. Bull. Canada Dept. Agric. Entom., No. 18, 64 pp. (1920).

MEYRICK, E. Classification of the Geometridæ of Europe. Trans. Entom. Soc. London, 1892, pp. 53–140 (1892).

PACKARD, A. S. Monograph of the Geometrid moths or Phalænidæ of the United States. Rept. U. S. Geol. Survey, **10** (1876).

PROUT, L. B. Geometridæ, Brephinæ. Gen. Insectorum, fasc. 103, 16 pp. (1910).

Œnochromatidæ. Gen. Insectorum, fasc. 104, 120 pp. (1910).

Hemitheidæ. Gen. Insectorum, fasc. 129, 274 pp. (1912).

Hemitheidæ. Lepidop. Cat., pt. 14 (1913).

TURNER, A. J. Revision of Australian Geometridæ. Proc. Linn. Soc. New South Wales, **44**, pp. 258–310; 383–413 (1919).

Australian Larentiidæ. Proc. Roy. Soc. South Australia, **46**, pp. 225–294 (1922).

Revision of Australian Œnochromatidæ. Proc. Linn. Soc. New South Wales, **54**, pp. 463–504 (1929); **55**, pp. 1–40 (1930); **55**, pp. 199–220 (1930).

SPHINGOIDEA

JORDAN, K. Monograph of the Ludiinæ. Nov. Zool., **29**, pp. 249–326 (1922).

ROTHSCHILD, W. and JORDAN, K. Sphingidæ. Gen. Insectorum, fasc. 57, 157 pp. (1907).

Revision of the Lepidopterous family Sphingidæ. 2 vols., Suppl. to Nov. Zool., **9**, London (1903).

SMITH, J. B. Monograph of Sphingidæ of North America. Trans. American Entom. Soc., **15**, pp. 49–242 (1888).

WAGNER, H. Sphingidæ, Subfamilies Philampelinæ, Acherontiinæ, Chœrocampinæ, pts. 12 (1913), 21 (1915) and 23 (1919).

TINEOIDEA

BEUTENMULLER, W. The Sesiidæ of North America. Mem. American Mus. Nat. Hist., **1** (1901).

BRAUN, A. F. Revision of North American species of Lithocolletis. Trans. American Entom. Soc., **34**, pp. 269–357 (1908).

The Nepticulidæ of North America. Trans. American Entom. Soc., **43**, pp. 155–209 (1917).

BRÈTHES, J. Lepidópteros argentinos productores de agallas. An. Soc. Sci., Argentina, **82**, pp. 113–140 (1916). (Cecidosidæ and Ridiaschinidæ).

BUSCK, A. Revision of American Gelechiidæ. Proc. U. S. Nat. Mus., **25**, pp. 767–938 (1903).

Synopsis of North American genera of Ægeriidæ. Proc. Entom. Soc. Washington, **11**, pp. 115–118 (1909).

Generic Revision of American Œcophoridæ. Proc. U. S. Nat. Mus., **35**, pp. 187–207 (1909).

CLEMENS, B. Tineina (Tineoidea) of North America. 282 pp., London (1872).

DALLA TORRE, K. W. and STRAND, E. Ægeriidæ, part. Lepidop. Cat., pt. 31 (1925)

DIETZ, W. G. Revision of Amydriinæ and Tineinæ of North America. Trans. American Entom. Soc., **31**, pp. 1–96 (1905).

Revision of Blastobasidæ of North America. Trans. American Entom. Soc., **36**, pp. 1–72 (1910).

DYAR, H. G. Revision of North American Prodoxidæ. Journ. New York Entom. Soc., **11**, pp. 103–105 (1903).

DYAR, H. G. and STRAND, E. Epipyropidæ. Lepidop. Cat., pt. 16 (1913).

ELY, C. R. Revision of North American Gracilariidæ. Proc. Entom. Soc. Washington, **19**, pp. 29–77 (1917).

FLETCHER, T. B. Cosmopterygidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 16 (1929).

Yponomeutidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 17 (1929).

MEYRICK, E. Gracilariidæ. Gen. Insectorum, fasc. 128, 36 pp. (1912).

Adelidæ. Gen. Insectorum, fasc. 133, 12 pp. (1912).

Gracilariidæ and Adelidæ. Lepidop. Cat., pt. 6 (1912).

Carposinidæ, Heliodinidæ, Glyphipterygidæ. Lepidop. Cat., pt. 13 (1913).

Yponomeutidæ, Plutellidæ, and Amphitheridæ. Lepidop. Cat., pt. 19 (1914).

Exotic Microlepidoptera. 4 vols., London (1912–1929).

Heliodinidæ. Gen. Insectorum, fasc. 165, 29 pp. (1914).

Revision of New Zealand Tineina. Trans. New Zealand Inst., **47**, pp. 205–244 (1915).

STAINTON, H. The Natural History of the Tineina. Vols. 1–13, London (1855–1873).

TURNER, A. J. Studies in Australian Ægeriidæ. Proc. Roy. Soc. Victoria, **35**, pp. 26–62 (1922).

WAGNER, H. Ægeriidæ, part. Lepidop. Cat., pt. 18 (1914).

WALSINGHAM, T. DE G. Heterocera (Tineoidea), in Biologia centrali-Americana, **4**, 168 pp. (1911–12).

NOCTUOIDEA

BARNES, W. and MCDUNNOUGH, J. Illustrations of North American species of the Genus Catocala. Mem. American Mus. Nat. Hist., **3**, 47 pp. (1918).

BEUTENMÜLLER, W. Descriptive Catalogue of Noctuidæ within 50 miles of New York City. Bull. American Mus. Nat. Hist., **14**, pp. 229–312; **16**, pp. 413–458 (1902).

CULOT, J. Noctuidæ of Europe. Vol. 1 and 2 (1910–12).

DALLA TORRE, K. W. Cymatophoridæ. Lepidop. Cat., pt. 25 (1921).

FLETCHER, T. B. Syntomidæ. Cat. Indian. Ins. Govt. India Centr. Pub. Br., Calcutta, pt. 8 (1925).

FORBES, W. T. M. Genera of Noctuidæ of Northeastern North America. Journ. New York Entom. Soc., **22**, pp. 1–33 (1914).

GROTE, A. R. Die Apateliden. Mitt. Römer. Mus. Hildesheim, No. 3, 18 pp. (1896).

HOULEBERT, C. Revision monographique de la famille des Cymatophoridæ. Études Lepidop. Comp., **18**, pt. 2, pp. 23–252 (1921).

HULSTAERT, P. G. Anthelidæ. Gen. Insectorum, fasc. 191, 13 pp. (1929).

KÖHLER, P. Agaristidæ de la república Argentina. Rev. Soc. Entom. Argentina, **2**, pp. 235–245 (1929).

MATSUMURA, S. Catalogue of Japanese Arctiidæ. Ins. Matsumura., Sapporo, Japan, **5**, pp. 58–94 (1930).

MCDUNNOUCH, J. H. Generic revision of North American Agrotid moths. Bull. Canada Dept. Mines, No. 55, 78 pp. (1929).

MEYRICK, E. Monograph of the Noctuidæ of New Zealand. Trans. New Zealand Inst., **19** (1886); **20** (1887).

PAGENSTECKER, A. Callidulidæ. Das Tierreich, Lief. 17, 27 pp. (1901).
Callidulidæ. Lepidop. Cat., pt. 2 (1911).

SMITH, J. B. Revision of the Deltoid moths. Bull. U. S. Nat. Mus., No. 48, 120 pp. (1895).

STRAND, E. Lithosiidæ. Lepidop. Cat., pt. 26 (1922).
Arctiidæ. Lepidop. Cat., pt. 22 (1919).
Agaristidæ. Lepidop. Cat., pt. 5 (1912).
Nolidæ. Lepidop. Cat., pt. 24 (1920).

SWINHOE, C. A Revision of the Genera of the Family Liparidæ. Ann. Mag. Nat. Hist. (9), **10**, pp. 449–484; **11**, pp. 47–97, 289–304, 400–442 (1922–23).

TURNER, A. J. A New Family of Lepidoptera (Anthelidæ). Trans. Entom. Soc. London, 1919, p. 415(1919).
Revision of the Australian Noctuidæ. Trans. Roy. Soc. South Australia, **44**, pp. 120–189 (1920).
Revision of Anthelidæ. Proc. Linn. Soc. New South Wales, **46**, pp. 164–191 (1921).
Revision of Australian Drepanidæ. Proc. Linn. Soc. New South Wales, **51**, pp. 411–445 (1926).

ZERNY, H. Euchromiidæ. Lepidop. Cat., pt. 7 (1912).

SUBORDER RHOPALOCERA, GENERAL

AURIVILLIUS, C. Rhopalocera Æthiopica. 561 pp. Stockholm (1898).

BARNES, W. and BENJAMIN, F. H. Check-list of the diurnal Lepidoptera of Boreal America. Bull. Southern California Acad. Sci., **25**, pp. 3–27; pp. 88–98 (1926).

BINGHAM, C. T. Rhopalocera. Fauna of British India, **1** and **2**, London (1905–07).

BUCKLER, W. (edited by G. T. Porritt). Larvæ of British Butterflies and Moths 9 vols., London (1886–1901).

DISTANT, W. L. Rhopalocera malayana, 481 pp., London (1882–86).
EDWARDS, W. H. Butterflies of North America, Boston, and New York. 3 vols. (1880–84–97).
EVANS, W. H. Identification of Indian Butterflies. Journ. Bombay Nat. Hist. Soc., **29**, pp. 230–260; 519–537; 780–797 (1923).
GODMAN, F. D. and SALVIN, O. Rhopalocera, In Biologia centrali-Americana, 3 vols. (1879–1901).
HOLLAND, W. J. The Butterfly Book (nearctic). Doubleday and McClure Co., New York (1898). Second edition (1931)
KAYE, W. J. The Butterflies of Jamaica. Trans. Entom. Soc. London, 1925, pp. 455–504 (1925).
KIRBY, W. F. Synonymical catalogue of Diurnal Lepidoptera. John van Voorst, London (1871–77). (Various parts.)
LANG, H. C. Rhopalocera Europæ. 2 vols., London (1884).
MABILLE, P. Lepidoptères Rhopalocères de Madagascar. Grandidier, Hist. Nat. Madagascar, **18**, 364 pp. (1885–88).
MARSHALL, G. F. L. and NICEVILLE, L. The Butterflies of India. 3 vols., Central Press, Calcutta (1882–1890).
MOORE, F. Lepidoptera indica (Rhopalocera). 8 vols., London (1890–1911).
MOULTON, J. C. Butterflies of Borneo. Sarawak Mus. Journ., **2**, pp. 197–266 (1915).
OBERTHÜR, C. and HOULEBERT, C. Rhopalocères. Faune Entom. Amoricaine **3**, pp. 47–260 (1922).
SCHATZ, E. and RÖBER, J. Die Familien und Gattungen der Tagfalter. 284 pp. Furth (1885–92).
SCUDDER, S. H. Butterflies of Eastern United States and Canada. 3 vols., Cambridge (1889).
TRIMEN, R. and BOWKER, H. South African Butterflies. 3 vols., London (1887–1889).
TUTT, J. W. British Butterflies. 10 vols., London (incomplete) (1899–1909).
WATERHOUSE, G. A. and LYELL, G. The Butterflies of Australia, 239 pp. (1914).
WRIGHT, W. G. Butterflies of the West Coast of the United States. San Bernardino, California, 257 pp. (1906).

HESPERIOIDEA

BARNES, W. and MCDUNNOUGH, J. H. Revision of the Megathymidæ. Contrib. Nat. Hist. Lepidoptera N. Am., **1**, No. 3, Decatur, Ill. (1912).
DYAR, H. G. Review of Hesperiidæ of the United States. Journ. New York Entom. Soc., **13**, pp. 111–141 (1905).
ELWES, H. J. and EDWARDS, J. Revision of oriental Hesperiidæ. Trans. Zool. Soc. London, **14**, pp. 101–324 (1897).
HOLLAND, W. J. Revision and catalogue of African Hesperiidæ. Proc. Zool. Soc. London, 1896, pp. 2–107 (1896).

LINDSEY, A. W. The Hesperioidea of America North of Mexico. Univ. of Iowa Studies, **9**, No. 4, Iowa City (1921).

MABILLE, P. Hesperiidæ. Lepidop. Cat., pt. 9 (1904).
Hesperiidæ. Gen. Insectorum, fasc. 17, 210 pp. (1904).

MEYRICK, E. and LOWER, O. B. Revision of Australian Hesperiidæ. Trans. Roy. Soc. South Australia, **26**, pp. 38–129 (1902) and **31**, pp. 192–208 (1907).

WARREN, B. C. S. Revision of palæarctic Hesperiinæ. Trans. Entom. Soc. London, **74**, pp. 1–170 (1926).

WATSON, E. Y. Classification of Hesperiidæ. Proc. Zool. Soc. London, 1893, pp. 3–132 (1893).

WILLIAMS, R. C. Studies in neotropical Hesperoidea, II. Trans. American Entom. Soc., **53**, pp. 261–292 (1927).

PAPILIONOIDEA

BETHUNE-BAKER, G. T. Revision of the Amblypodia group of Lycænidæ. Trans. London Zool. Soc., **17**, pp. 1–164 (1903).

BRYK, F. Papilionidæ, part. Lepidop. Cat., pt. 27 (1923); pt. 35 (1928).
Parnasiidæ. Lepidop. Cat., pt. 27 (1923).

DRUCE, H. H. Monograph of Bornean Lycænidæ. Proc. Zool. Soc. London, 1895, pp. 556–627 (1895) and 1896, pp. 650–683 (1896).

ELTRINGHAM, H. and JORDAN, K. Acræidæ. Lepidop. Cat., pt. 11 (1913).

JORDAN, K. and ELTRINGHAM, H. Nymphalidæ, Acræinæ. Gen. Insectorum, fasc. 169, 81 pp. (1916).

NEUSTETTER, H. Eueididæ (Heliconiidæ). Lepidop. Cat., pt. 36 (1929).

PAGENSTECKER, A. Libytheidæ. Das Tierreich, Lief. 14, 18 pp. (1901).
Libytheidæ. Gen. Insectorum, fasc. 5, 4 pp. (1902).
Libytheidæ. Lepidop. Cat., pt. 3 (1911).

RIPPON, R. H. F. Monograph of Ornithoptera. 2 vols., London (18 98–1907).
Papilionidæ, Papilioninæ. Gen. Insectorum, fasc. 6, 15 pp. (1902).

ROTHSCHILD, W. A Revision of the Papilios of the eastern Hemisphere. Novitat. Zool., **2**, pp. 167–463 (1895).

ROTHSCHILD, W. and JORDAN, K. A Revision of the American Papilios. Novitat. Zool., **13**, pp. 411–752 (1906).

SEITZ, A. Das System der Schmetterlinge; III. Die Danaiden. Entom. Rundshau Jahrg. 44, p. 32 and various parts following (1927).

STICHEL, H. Brassolidæ. Das Tierreich, Lief. 25, 258 pp. (1908).
Nymphalidæ, Dioninæ. Gen. Insectorum, fasc. 63, 38 pp. (1908).
Parnasiidæ. Gen. Insectorum, fasc. 58, 60 pp. (1907).
Riodinidæ. Gen. Insectorum, fasc. 112, 452 pp. (1911).
Papilionidæ, Zerynthiinæ. Gen. Insectorum, fasc. 59, 27 pp. (1907).
Brassolidæ. Gen. Insectorum, fasc. 20, 48 pp. (1904).
Nymphalidæ, Discophorinæ. Gen. Insectorum, fasc. 31, 16 pp. (1905).
Nymphalidæ, Hyanthinæ. Gen. Insectorum, fasc. 39, 7 pp. (1906).

Morphoidæ. Gen. Insectorum, fasc. 36, 67 pp. (1906).

Eueididæ. Gen. Insectorum, fasc. 37, 74 pp. (1906).

Amathusiidæ, Morphoidæ. Das Tierreich, Lief. 34, 263 pp. (1912).

Beiträge zur Kenntnis der Riodinidenfauna Südamerikas. Deuts. Entom. Zeits., pp. 81–101 (1926).

Vorarbeiten zu einer Revision der Riodinidæ. Deuts. Entom. Zeits., 1926, pp. 385–396 (1927).

Nemeobiinæ. Das Tierreich, Lief. 51, 329 pp. (1928).

STICHEL, H. and EIFFARTH, H. Heliconiidæ (Eueididæ). Das Tierreich, Lief. 22, 305 pp. (1905).

WYTSMAN, P. Papilionidæ, Leptocircinæ. Gen. Insectorum, fasc. 4, 3 pp. (1902).

ORDER **DÍPTERA**

(*ANTLIÀTA, HALTERÀTA, HALTERÍPTERA, HAUSTELLÀTA*)

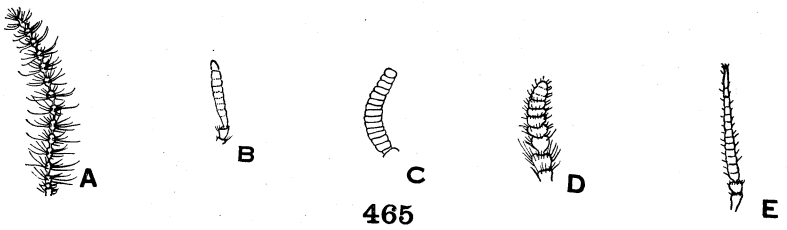
Minute to moderate-sized, rarely large (over one inch) insects, usually with good powers of flight: head usually vertical, freely movable; antennæ variable, comprising either many similar joints or frequently only three, the last joint sometimes annulated, sometimes provided with a sensory style or arista as a phyletic adaptation of the original terminal joints; mouthparts suctorial, incapable of mastication, usually constructed for lapping, sometimes for piercing; both prothorax and metathorax small and fused with the prominent mesothorax; only the mesothoracic pair of wings developed, the veins and crossveins not numerous, hind wings replaced by small knobbed structures (halteres), rarely wings vestigial or even absent; legs usually alike, the tarsi regularly five-jointed. Metamorphosis complete, the larvæ wholly unlike the adults; larvæ almost always legless maggots or grubs, never with true jointed legs, frequently with indistinct head and retracted mouthparts; pupæ with the appendages more or less adherent, the body either free or entirely encased in a seed-like capsule (puparium) formed of the indurated last larval moult. Food habits highly variable. Flies, Mosquitoes, Gnats, Midges.

Adults

1. Winged, *i.e.* wings functionally developed, the insect capable of flight 2

   Wingless, or with vestigial or abortive wings, incapable of functioning for flight (Figs. 662–678) 141

2. Antennæ generally longer than the thorax, usually consisting of a flagellum of 6 to 16, rarely up to 39, nearly similar free joints in addition to the two basal joints (Fig. 465a), rarely with a differentiated style or bristle, sometimes (*e.g. Bibio*, Fig. 465d; *Simulium*, Fig. 465b; *Anisopus*, Fig. 465e) the flagellar joints are crowded together; anal cell (cell Cu) widely open, rarely narrowed in the margin of the wing, discal cell usually absent, "second" vein (R_{2+3}) sometimes forked; calypters absent; palpi usually elongate, hanging downward and normally comprising 4 or 5 joints; body very rarely with bristles; pleural suture usually extending nearly straight between root of wing and middle coxæ. (Suborder NEMATÓCERA).....3



465

Fig. 465. **Nematocerous Antennæ**

A, **Perrisia** (Verrall) Cecidomyiidæ; B, **Simulium** (Lugger) Simuliidæ; C, **Ceroplatus** (Johannsen) Ceroplatidæ; D, **Bibio** (Verrall) Bibionidæ; E, **Anisopus** (Verrall) Anisopodidæ.

Antennæ shorter, usually three-jointed, the third joint occasionally complex, with more or less distinct annulations (Fig. 518b-e), or bearing a differentiated style (Fig. 518 f, g) or arista (Fig. 556), in Rhachicerinæ the third joint divided into about 25 segments (Fig. 518a); anal cell (Cu) distally narrowed or closed, sometimes retracted and very short, or even absent, discal cell usually present, "second" vein (R_{2+3}) never furcate; palpi short, one- or two-jointed, projecting forward; pleural suture between root of wing and middle coxæ twice bent at sharp angles. (Suborder BRACHÝCERA).....32

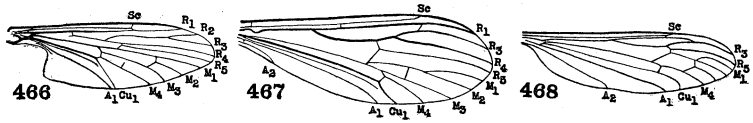
3. Mesonotum with a more or less distinct V-shaped transverse suture beginning on each side in front of root of wings, the pointed middle part close to the scutellum (Fig. 472); postpronotum well developed; female with a conical, generally protruding, chitinized ovipositor; male genitalia usually enlarged;

males dichoptic, eyes rounded, not excised at antennæ; legs very long and slender, easily breaking from the body at the trochanters; costa encompassing wing, nine or more veins terminating in wing-margin, subcosta long, ending beyond middle of wing. (Superfamily TIPULÒIDEA).....4

Mesonotum without such a transverse V-shaped suture, a distinct but interrupted suture present only in Blepharoceratidæ which have less than nine veins ending in the wing-margin; no discal cell 9

4. Radius with five branches all ending in the wing-margin, subcosta furcate at its extremity, Sc_2 appearing like a crossvein ending in R_1; first basal cell closed at middle of wing, second basal cell distinctly shorter; one anal vein. (**Tanydèrus,** neotrop.; **Peringueyomyìna,** ethiop.; **Protóplasa,** nearc. (Fig. 466)).

TANYDÉRIDÆ



Figs. 466–468. **Tanyderidæ, Trichoceratidæ, Cylindrotomidæ**

466. **Protoplasa,** wing (Alexander) Tanyderidæ.
467. **Paracladura,** wing (Edwards) Trichoceratidæ.
468. **Cylindrotoma,** wing (Alexander) Cylindrotomidæ.

Radius with only three or four branches ending in wing-margin; basal cells long, nearly always ending distinctly beyond middle of wing and coextensive or nearly so, or the second longer than the first; an accessory or marginal cell commonly present in front of the end of the first basal cell, formed by the erect or reflexed shortened R_2 or R_{2+3} located near the end of R_1.....5

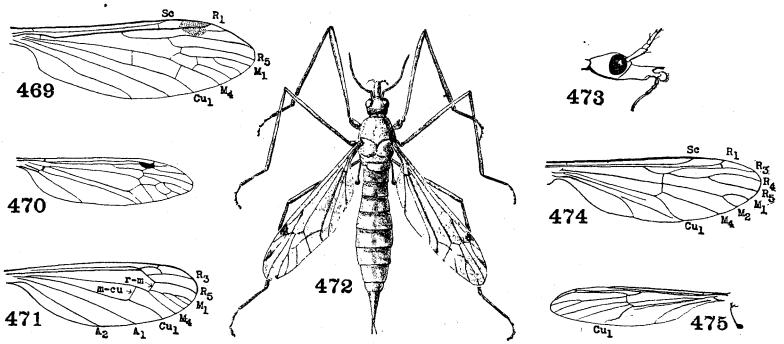
5. R_5 apparently simple (Fig. 467), R_4 in closer association with R_3 than with R_5; two distinct anal veins reaching hind margin of wing; discal cell usually present at end of first basal cell; empodium present, pulvilli absent.....6

R_4 and R_5 stalked together (Fig. 474); one distinct anal vein reaching hind margin; no discal cell formed between the branches of media; a longitudinal fold in the wing-membrane crossing anterior crossvein; ocelli absent; mesonotal suture not deep; empodium minute, pulvilli present. (LIRIOPÈIDAE).

PTYCHOPTÉRIDÆ

a. Antennæ 16-jointed; fourth vein forked as M_1 and M_2; legs not banded. (**Ptychóptera** (=*Liriòpe*) (Fig. 474), widespr.). **PTYCHOPTERÌNÆ**

Antennæ 20-jointed; fourth vein simple as M_{1+2}; legs banded with black and white. (**Bittacomórpha** (Fig. 475), **Bittacomorphélla**, nearc.) ..... **BITTACOMORPHÌNÆ**



Figs. 469–475. **Tipulidæ, Limoniidæ, Ptychopteridæ**

469. **Limnophila,** wing (Alexander) Limoniidæ.
470. **Tipula,** wing. Tipulidæ.
471. **Dolichopeza,** wing (Alexander) Limoniidæ.
472. **Tipula,** female. Tipulidæ.
473. **Tipula,** profile of head, showing palpus (Alexander) Tipulidæ.
474. **Ptychoptera,** wing (Alexander) Ptychopteridæ.
475. **Bittacomorpha,** wing. Ptychopteridæ.

6. Two or three ocelli present; last anal vein typically short, abruptly curving into the anal angle; antennal segmentation indistinct except at base; one pair of male claspers. (**Trichócera** (=*Petaurista*) Winter-gnats, **Diazósma, Nothotrichócera, Paracladùra** (Fig. 476), mostly holarc.; **Íschnothrix,** Cape Horn). (*PETAURÍSTIDÆ*) ..... **TRICHOCERÂTIDÆ**

Ocelli absent; last anal vein not retracted; two pairs of male claspers 7

7. Last joint of maxillary palpi lash-like, much longer than the three preceding together; Sc ending in R_1 by an abrupt curvature of the tip but almost never also in the costa (Fig. 470); antennæ usually with 12 or 13 joints, rarely more; nasus usually distinct. Many species, widespread, but principally holarctic. **TIPÙLIDÆ**

a. Vein R_2 absent, or else the second anal vein not more than one-third as long as the first anal vein; legs excessively long and slender. (**Dolichopèza, Brachyprémna, Megistócera, Tanyprémna**) ..... **DOLICHOPEZÌNÆ**

Vein R_2 present; second anal vein one-half as long as first anal vein; legs relatively shorter and stronger ..... b

b. Antennæ verticillate, *i.e.* with whorls of hairs, flagellum of male not pectinate. (**Típula** (Fig. 472), **Holorùsia, Longùrio, Nephrótoma** (= *Pachyrrhìna*)) ..... **TIPULÌNÆ**

Antennæ not verticillate; flagellum of male antennæ pectinate. (**Ctenóphora, Xiphosùra**) ..... **CTENOPHORÌNÆ**

Last joint of palpi shorter or not much longer than the two preceding together; Sc ending in costa and usually furcate at tip, the lower branch connecting as Sc_2 with R_1 (Fig. 468); antennæ 6- to 16-jointed, rarely more, usually with 14 to 16 joints 8

8. Tibiæ spurred; two branches of radius reaching margin, due to the apparent fusion of R_1 with R_{2+3}, rarely R_2 and R_3 separate, in which case three branches of radius reach margin, R_s long, arising near middle of wing; larvæ eruciform. Principally holarctic. (**Cylindrótoma** (Fig. 468), **Liógma, Triógma, Phalacrócera**; **Stibadócera**, oriental) .... **CYLINDROTÓMIDÆ**

Four branches of radius reaching margin, if but three branches reach margin R_1 ends in costa and R_s usually arises beyond middle of wing. A large, cosmopolitan family. (*LIMNOBÌIDÆ*). **LIMONÌIDÆ**

a. Tibiæ spurred at tip ..... b

Tibiæ not spurred at tip ..... d

b. Antennæ six- to ten-jointed. (**Hexátoma**, mainly European; **Eriócera, Penthóptera**) ..... **HEXATOMIÌNÆ**

Antennæ with more than ten joints c

c. Sc_2 located beyond origin of R_s (if before, *Ula*, the wings are pubescent). (**Limnóphila** (Fig. 469), **Adelphomỳia, Epiphrágma, Ùla, Ùlomórpha**, widespr.) .. **LIMNOPHILÌNÆ**

Sc_2 located before origin of R_s; wings glabrous. (**Pedícia, Dicranòta, Rhaphidólabis, Tricyphòna**, mainly nearc.). **PEDICIÌNÆ**

d. Radius with four branches reaching margin. (**Erióptera, Cladùra, Gnophomỳia, Helòbia, Molóphilus, Trimìcra**). **ERIOPTERÌNÆ**

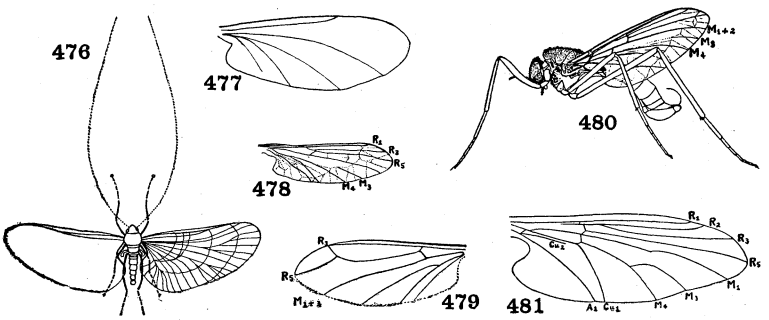
Radius with three branches reaching margin ..... e

e. Antennæ 14-jointed; claws with teeth on lower side. (**Limònia**, 1803 (=*Limnòbia*, 1818), **Dicranomỳia, Discóbola, Geranomỳia, Rhipídia**) ..... **LIMONIÌNÆ**

Antennæ usually 16-jointed, rarely 12-jointed (*Toxorhina*) or 15-jointed (*Elephantomyia*); tarsal claws usually without teeth beneath. (**Ántocha, Atárba, Dicranóptycha, Rhamphídia, Teuchólabis**) ..... **ANTOCHÌNÆ**

9. Wing membrane with a secondary venation due to creases from the folding of the wing in the pupa; legs long and slender; hygrophilous species, frequenting swift-running streams, where their larvæ live 10

Wings without an extensive secondary venation 11



Figs. 476–481. **Blepharoceratidæ, Deuterophlebiidæ**

476. **Deuterophlebia** (Edwards) Deuterophlebiidæ.
477. **Hammatorrhina,** wing (Bezzi) Blepharoceratidæ.
478. **Blepharocera,** wing (Comstock) Blepharoceratidæ.
479. **Paltostoma,** wing (Williston) Blepharoceratidæ.
480. **Bibiocephala** (Cole) Blepharoceratidæ.
481. **Edwardsina,** wing (Alexander) Blepharoceratidæ.

10. Wings large, densely covered with fine hairs, true veins almost absent but an elaborate fan-like development of secondary folds present; antennæ excessively long, six-jointed; ocelli and mouthparts absent. (**Deuterophlèbia,** India (Fig. 476)). **DEUTEROPHLEBÌIDÆ**

Secondary venation forming a delicate network like spider webbing, in addition to the primary veins; mesonotum with a V-shaped suture; ocelli and mouthparts present; eyes usually divided horizontally into two parts by an unfaceted stripe; hind coxæ broadly attached to thorax. Widespread, mainly holarctic and neotropical. (*ASTHÉNIDÆ, LIPONEÙRIDÆ*). **BLEPHAROCERÁTIDÆ**

a. Wings with M_3 arising from middle of upper branch of cubital fork (M_4) (Fig. 481), m-cu crossvein present and almost in transverse alignment with r-m crossvein and the short angulate bases of R_{4+5} and R_s, a long spur from R_s projecting basal to the angulation, radius four-branched; front trochanters scarcely half as long as coxæ. (**Edwardsìna,** neantarc. (Fig. 481)). **EDWARDSÌNÆ**

Wing with M_3 free or absent, when present disconnected from the other veins; if m-cu crossvein is present it is not in alignment with the angulations of the branches of the radius, R_s without basal spur; front trochanters nearly as long as coxæ.....b

b. Fourth vein bifurcate, the lower branch (M_3) disconnected from the upper (M_{1+2}); second and third veins subequal in length, usually arising separately from the cell; eight veins reaching margin. (**Blepharócera** (Fig. 478), **Bibiocéphala** (Fig. 480), **Liponeùra, Philòrus,** holarc.) ....**BLEPHAROCERATÌNÆ**

Fourth vein (M_{1+3}) simple; R_2 short or absent.....c

c. Labial palpi small, usually oval and pubescent, much shorter than basal part of labium, if somewhat longer the palpi are rigid and the whole labium is reduced; third vein forked, *i.e.* the second vein (R_{2+3}) short, arising from the third vein (R_{4+5}) near its tip; seven veins reaching margin.....d

Labial palpi very long, slender, bare, usually curled outwardly; basal part of labium also long; maxillary palpi one-jointed; no macrotrichia on R_1; R_s forked near tip, or simple, or absent; only five or six veins reaching margin. (**Apistomỳia,** widespr.; **Hammatorrhìna** (Fig. 477), Ind.; **Neocurùpira, Peritheàtes,** Austr.) ..... **APISTOMYÌNÆ**

d. Hind tibiæ spurred; claws of both sexes similar; female with strong mandibles. (**Paltóstoma** (Fig. 479), **Curùpira, Kelloggìna, Limonícola,** neotrop.) ... **PALTOSTOMATÌNÆ**

Hind tibiæ without spurs; male holoptic, claws wanting; female dichoptic, claws dentate, mouthparts atrophied. (**Hapálothrix,** Eur.) ..... **HAPALOTRICHÌNÆ**

11. Costa continuing around the wing-margin, although often weaker along hind margin 12

Costa disappearing beyond tip of wing.....17

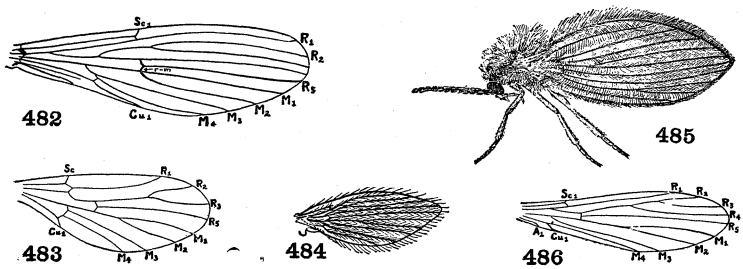
12. At least nine veins reaching wing-margin.....13

Less than nine veins terminating in the margin of the wing; often holoptic.....16

13. Wing-veins, including hind margin, very hairy or scaly (Figs. 484, 490); body and legs hairy or scaly; ocelli absent.....14

Veins not fringed with flat scales; body and legs not scaly; subcosta ending in costa at or beyond middle of wing; dichoptic; legs long and slender.....15

14. Wings short and broadly ovate or pointed (Fig. 484), held sloping roof-like against the body when at rest, no crossveins except sometimes near base, Sc very short, weak, ending free, radius usually five-branched; tibiæ without apical spurs; second antennal joint not enlarged; small, apparently robust species with densely hairy body, legs and wings; widespread, mostly in warm or temperate regions. Moth-flies. . . . **PSYCHÓDIDÆ**



Figs. 482–486. **Psychodidæ**

482. **Bruchomyia,** wing (Alexander) Psychodidæ.
483. **Sycorax,** wing (Eaton) Psychodidæ.
484. **Pericoma,** wing. Psychodidæ.
485. **Psychoda** (Cole) Psychodidæ.
486. **Phlebotomus,** wing (Alexander) Psychodidæ.

a. Radial sector with four branches (Figs. 482, 486). . . . . b
Radial sector with three branches, Sc short and apically erect. (**Trichomỳia, Sycòrax** (Fig. 483)). . . . . **TRICHOMYIÌNÆ**

b. Distal section of Cu_1 elongate, extending generally parallel to M_4, cell M_4 about equal to cell M_3 along the wing-margin, Sc reduced. (**Psychòda** (Fig. 485), **Maruìna, Perícoma** (Fig. 484), **Telmatóscopus, Termitadélphus**) . . **PSYCHODÌNÆ**
Distal section of Cu_1 short, bent toward the axilla, cell M_4 at wing-margin at least as wide as cell Cu, Sc long, Sc_2 and usually Sc_1 preserved c

c. Radial sector pectinately four-branched; mouthparts of female elongate, formed for sucking blood. Sand-flies. (**Phlebótomus** (Fig. 486)) . . . . . **PHLEBOTOMÌNÆ**
Radial sector dichotomously four-branched; mouthparts not formed for sucking blood. (**Bruchomỳia** (Fig. 482), **Nemopálpus,** neotrop.). (*NEMOPALPÌNÆ*).
BRUCHOMYIÌNÆ

Wings longer and narrow (Fig. 490), not held sloping against the sides of the body, wing-margin and veins scaly, Sc ending in costa beyond middle of wing, radius four-branched; antennæ of male usually feathered with long hairs; second antennal joint enlarged: slender species, usually with long, moderately hairy or scaly legs. In all regions, many species.. **CULÍCIDÆ**

a. Proboscis short, not fitted for piercing; wings hairy, scaled only at margin; mesosternum without ridge; sternopleura divided by transverse suture; lateral sclerite of metasternum much reduced, not triangular (Fig. 488). (**Corèthra** (=*Móchlonyx*), **Chaóborus** (=*Sayomyia*), **Eucorèthra** (=*Pelorêmpis*). (*CHAOBÓRIDÆ* or *CHAOBORÌNÆ*) ..... **CORETHRÌNÆ**

Proboscis much longer than head, firm, of female adapted for piercing; wings always fully scaled; mesosternum ridged; sternopleura not divided by transverse suture (except Uranotæniini, Fig. 487); lateral sclerite of metasternum forming a triangular piece between the bases of middle and hind coxæ.....b

b. Palpi of female more than one-third as long as proboscis; abdomen sometimes without scales; scutellum crescent-shaped, with marginal bristles evenly distributed: larva without respiratory siphon, resting horizontally at surface of water; eggs provided with lateral floats. (**Anópheles** (Malaria mosquitoes)). **ANOPHELÌNÆ**

Palpi of female less than one-third as long as proboscis; abdomen always scaled: larva with well developed respiratory siphon; eggs without lateral floats.....c

c. Scutellum evenly rounded; clypeus much broader than long; calypteres not ciliated; bright-scaled, day-flying, not blood-sucking. (**Megarhìnus**) ..... **MEGARHINÌNÆ**

Scutellum trilobed, with marginal bristles only on the lobes....d

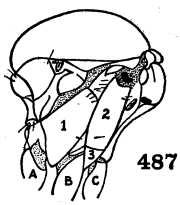
d. Base of hind coxa in line with upper margin of lateral metasternal sclerite which is a small triangular piece located between bases of middle and hind coxæ: day-fliers. (**Sabèthes, Goeldia, Joblotia, Limàtus, Menólepis, Wyeomỳia**). **SABETHÌNÆ**

Base of hind coxa distinctly below upper margin of lateral metasternal sclerite; body scales usually sparse and rarely with metallic colors: disease-bearing or obnoxious mosquitoes.....e

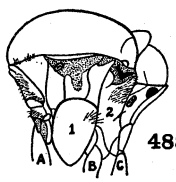
e. Anal vein extending well beyond fork of cubitus; wings villose; upper calypter usually ciliated. (**Cùlex** (*C. quinquefasciàtus*, Filaria mosquito), **Aèdes** (*A. ægypti* (*cálopus*) (=*Stegomyia fasciàta*), Yellow-fever and Dengue-fever mosquito), **Lùtzia, Ochlerótatus, Orthopodomỳia, Psoróphora, Tæniorhỳnchus** (=*Mansonia*), **Theobáldia** (=*Culisèta*)). **CULICÌNÆ**

Anal vein ending opposite or before fork of cubitus; wings not villose; calypteres not ciliate. (**Uranotænia** (Fig. 487)). **URANOTÆNIÌNÆ**

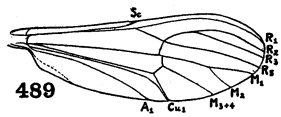
15. Radius with four nearly parallel curving branches (Fig. 489), the second vein (R_{3+4}) strongly arched, R_5 ending beyond apex of wing; basal cells reaching distinctly beyond middle of wing, coextensive; ocelli absent; joints of flagellum of antennæ indistinctly separated. Few species, widespread, but mostly holarctic. (**Díxa** (Fig. 489); **Microdíxa,** Eur.; **Neodíxa,** N. Zeal.) ..... **DÍXIDÆ**



487



488



489

490

Figs. 487–490. **Culicidæ, Dixidæ**

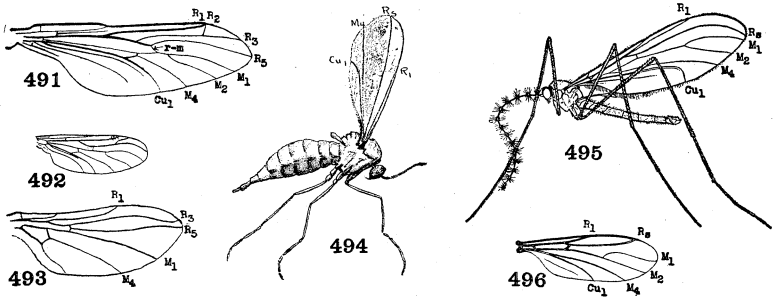
487. **Uranotænia,** side view of thorax (Dyar and Shannon) Culicidæ. 1, sternopleura; 2, mesepimeron; 3, merite of middle coxa; A, front coxa; B, middle coxa; C, hind coxa.
488. **Eucorethra,** side view of thorax (Dyar and Shannon) Culicidæ. Explanation of parts same as for Fig. 487.
489. **Dixa,** wing. Dixidæ.
490. **Culex,** wing. Culicidæ.

Radius with three to five branches (Fig. 492), the second vein ending before apex of wing; basal cells usually not extending beyond middle of wing, the second basal cell always shorter than first; ocelli well developed; antennæ 8- to 18-jointed, the joints distinctly separated. Rare. (**Hesperìnus** (Fig. 492); **Cramptonomỳia,** western nearc.)..... **HESPERÍNIDÆ**

16. Antennæ composed apparently of two thick basal joints and a terminal nine- or ten-jointed arista; wings with seven longitudinal veins (Fig. 493), media unbranched, both basal cells closed; both sexes holoptic, ocelli absent. Small, rare, woodland species, occurring in Europe, North America and the Canary Islands. (**Thaumàlea** (=*Orphnéphila*) (Fig. 493), **Androprosòpa**). (*ORPHNEPHÍLIDÆ*).. **THAUMALÈIDÆ**

Antennæ long, composed of 10 to 36 cylindrical or bead-like joints; wings with greatly reduced venation (Figs. 494–496). (*ITONÍDIDÆ*) ..... **CECIDOMYÌIDÆ**

a. Wings broad, with three or at most six longitudinal veins, sometimes media and cubitus branches stalked, crossveins apparently wanting; abdomen not swollen; eyes round or reniform, sometimes with confluent projections above antennæ: delicate, often minute species. Gall gnats; widespread, principally holarctic ..... b



Figs. 491–496. **Pachyneuridæ, Hesperinidæ, Thaumaleidæ, Cecidomyiidæ**

491. **Axymyia,** wing (Edwards) Pachyneuridæ.
492. **Hesperinus,** wing (Johannsen) Hesperinidæ.
493. **Thaumalea,** wing (Williston) Thaumaleidæ.
494. **Mayetiola.** Cecidomyiidæ.
495. **Hormosomyia** (Cole) Cecidomyiidæ.
496. **Lestremia,** wing (Kieffer) Cecidomyiidæ.

Wings much atrophied (Fig. 670) crumpled, with two longitudinal and two crossveins; first five segments of abdomen enormously swollen, the apical four segments small and slender, forming a post-abdomen; eyes confluent above, separated below antennæ: adults found exclusively in nests of termites. (**Termitomástus** (Fig. 670), South America). (See couplet 147).
TERMITOMASTÌNÆ

b. Wing-membrane peculiarly pubescent, the hairs (macrotrichia) directed toward base of wing; tarsi five-jointed.....c

Wing-membrane with simple microscopic pubescence; metatarsus longer than following joint, or the tarsi with less than five joints; ocelli absent; media wanting or represented by a fold.

(**Heteropèza, Brachyneùra, Lasiópteryx, Miástor, Oligárces**) ..... **HETEROPEZÌNÆ**

c. Media (M_{1+2}) forked or simple, radial sector present but sometimes crowded close to costa; ocelli present; metatarsus longer than following joint. (**Lestrèmia** (Fig. 496), **Campylomỳza, Hormosomỳia** (Fig. 495), **Micromỳia, Monárdia, Prionéllus, Strobliélla**) ..... **LESTREMIÌNÆ**

Media with anterior branch (M_{1+2}) wanting, M_{3+4} absent or represented by a fold; ocelli absent; metatarsus much shorter than following joint; antennal joints with whorls of looped threads, or sometimes with horseshoe-like appendages. (**Cecidomỳia** (=*Itónida*), **Asphondỳlia, Asteromỳia, Colpòdia, Contarínia** (*C. jóhnsoni*, Grape blossom-midge; *C. pyrîvora*, Pear midge), **Dasyneùra** (*D. rhodóphaga*, Rose midge; *D. trifolii*, Clover leaf midge), **Diarthronomỳia** (*D. hypogœa*, Chrysanthemum gall-midge), **Diplòsis, Lasióptera, Phytóphaga** (*P.* (*Mayetîola*) *destrúctor*, Hessian fly, Fig. 494), **Rhabdóphaga**) ..... **CECIDOMYIÌNÆ**

17. Discal cell present in middle of wing contiguous to end of basal cells (Fig. 500), media four-branched, eight veins reaching wing-margin; ocelli present; dichoptic; antennæ 12- to 16-jointed; pulvilli wanting, but empodium pulvilliform. Widespread, not many species. (**Anìsopus** (=*Rhyphus*, =*Phryne*) (Figs. 465e, 500), **Lobogáster, Olbiogáster**). (*PHRYNÈIDÆ, RHÝPHIDÆ*) ..... **ANISOPÓDIDÆ**

Wings without a discal cell formed between branches of the usually petiolate media 18

18. Ocelli present, sometimes the lateral ocelli next to the eyes and the middle one vestigial or absent 19

Ocelli absent or at most vestigial; coxæ not lengthened 30

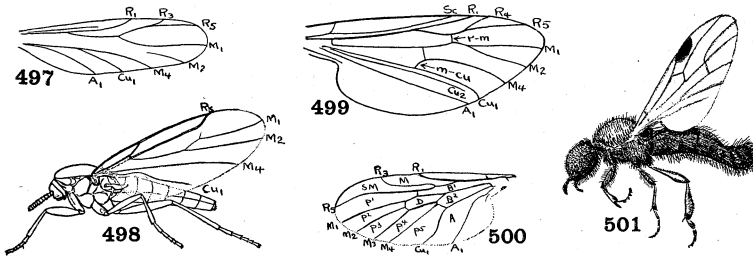
19. Second basal cell present (Fig. 501), usually longer than the first basal and attaining middle of wing (shorter than first in *Plecia* (Fig. 499) which has third vein furcate), anterior veins strong; pulvilli present; antennæ usually shorter than thorax, rather stout, without constrictions between joints; male holoptic, eyes large and divided into upper and lower parts; palpi four-jointed. Widespread, mostly holarctic. March flies. .... **BIBIÓNIDÆ**

a. Third vein furcate. (**Plècia** (Fig. 499), **Penthètria**). **PLECIÌNÆ**

Third vein simple. (**Bíbio** (Fig. 501), **Bibiòdes, Dílophus**). **BIBIONÌNÆ**

Second basal cell imperfectly separated from first (*i.e.* base of media weak or undeveloped), or apically open, or very short, never longer than first basal cell; pulvilli absent or very minute 20

20. At least the four posterior tibiæ without apical spurs (Fig. 498); coxæ short, much less than half the length of femora; antennæ short and robust, 10- or 11-jointed, the middle joints shorter than broad; anterior veins strong, crowded close to costa, other veins weak and inconspicuous, m-cu crossvein absent; eyes contiguous or nearly so; palpi one-jointed. Minute species, mostly holarctic ..... **SCATÓPSIDÆ**



Figs. 497–501. **Scatopsidæ, Bibionidæ, Anisopodidæ**

497. **Canthyloscelis,** wing (Edwards) Scatopsidæ.
498. **Scatopse** (Cole) Scatopsidæ.
499. **Plecia,** wing. Bibionidæ.
500. **Anisopus,** wing. Anisopodidæ.
501. **Bibio,** male. Bibionidæ.

a. Third vein forked, *i.e.* R_3 arising from R_5, costa reaching much beyond R_5. (**Corynóscelis, Synneùron,** holarc.; **Canthylóscelis** (Fig. 497), Austr.) ..... **CORYNOSCELÌNÆ**

Third vein (R_5) simple; costa scarcely continued beyond third vein ..... b

b. Holoptic, face narrow; front tibiæ without apical spine; mesonotum not elevated in front. (**Scatópse** (Fig. 498), **Aldrovandiélla, Anapaùsis, Reichertélla, Rhegmoclèma, Swammerdaméllа**) ..... **SCATOPSÌNÆ**

Dichoptic, face rather broad; front tibiæ ending in a spine; mesonotum elevated in front. (**Aspístes, Árthria**). **ASPISTÌNÆ**

All tibiæ with apical spurs (compare Fig. 502); coxæ longer, usually about half the length of femora 21

21. Radial sector with three branches, *i.e.* second longitudinal vein forked, the second vein (R_{2+3}) arising from the third (R_5) at or before the anterior crossvein (r-m) (Fig. 491); antennæ 15-jointed, the joints longer than wide; male dichoptic; coxæ not lengthened. (**Pachyneùra,** palæarc.; **Axymỳia** (Fig. 491), nearc.) ..... **PACHYNEÙRIDÆ**

Radial sector with two branches 22

22. Second basal cell apically widely open, the posterior branch of the media when complete arising from the cubitus usually near the base, anal vein incomplete, not reaching margin of wing (see Fig. 504) 23

Second basal cell closed (see Fig. 506), the apparent crossvein (*i.e.* the angular origin of M_4) sometimes located close to base of wing (Fig. 507), or the media and cubitus coalescent where the crossvein usually is located, or when the basal section of M is wanting, the media appears to arise from Cu_1; anal vein reaching margin at least as a fold 25

23. Anterior branch (R_{2+3}) of radial sector abruptly extending to R_1, appearing like an extra crossvein closing the small rectangular or trapezoidal cell R_1 (Fig. 503); Sc usually reaching cell R_1; ocelli usually remote from eye-margin; microscopic hairs of wing-membrane typically irregularly scattered or the wings pubescent. Many genera; Europe, America, Australia. (**Sciófila** (Fig. 503), **Diómonus, Dziedzíckia, Monoclòna, Mycomỳia, Neoemphèria, Polylépta, Stenophrágma**). **SCIOPHÍLIDÆ**

Radial sector not branched, the cell R_1 open to the wing-margin; Sc usually vestigial; microscopic hairs of wing-membrane seriately arranged 24

24. Coxæ much elongated, fully half the length of femora; r-m crossvein usually distinctly angulated from the second section of radial sector (Fig. 505); cubitus usually formed and long petiolate, rarely simple; eyes oval or reniform but without bridging projections above antennæ; palpi 4- or 5-jointed; prothorax with bristles. The dominant family of Fungus-gnats. Widespread. (*FUNGIVÓRIDÆ*) ..... **MYCETOPHÍLIDÆ**

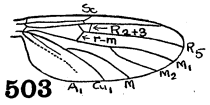
a. R_1 and R_s running separately to base of wing, traces of base of R_{2+3} present. (**Lygistorrhìna,** Austr.). **LYGISTORRHINÌNÆ**

R_s arising from R_1 well beyond base of wing, or base of R_s wanting; R_{2+3} not present ..... b

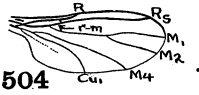
b. Antennæ inserted plainly above middle of head; pronotum without bristles; occiput flattened, orbital bristles seriate; media with only apica disconnected parts present. (**Manòta**, holarc.). **MANOTÌNÆ**

Antennæ inserted at middle of head; pronotal bristles developed; occiput convex, orbital bristles not seriate; base of media developed, at most the forward branch interrupted. (**Mycetóphila** (Fig. 502), **Acnèmia, Allòdia, Boletìna** (Fig. 505), **Córdyla, Docòsia, Dynatosòma, Exèchia, Gnoríste, Leìa** (= *Neoglaphyróptera*), **Phrònia, Phthínia, Rhymòsia, Trichónta, Zygomỳia.**) ..... **MYCETOPHILÌNÆ**

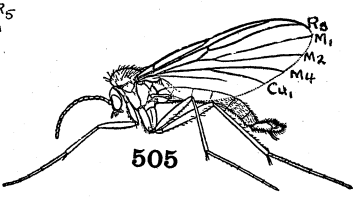
502



503



504



505

Figs. 502–505. **Mycetophilidæ, Sciophilidæ, Sciaridæ**

502. **Mycetophila** (Johannsen) Mycetophilidæ.
503. **Sciophila,** wing (Johannsen) Sciophilidæ.
504. **Sciara,** wing (Johannsen) Sciaridæ.
505. **Boletina,** male (Cole) Mycetophilidæ.

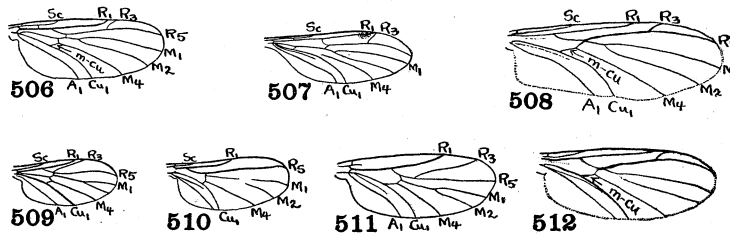
Coxæ not greatly elongated, somewhat less than half the length of the femora; r-m crossvein appearing like a continuation of the strong second section of the radial sector (Fig. 504), posterior veins weak, cubitus forked near base of wing; eyes more or less completely connected by a narrow projection above base of antennæ; palpi 3-, 2-, or 1-jointed. Cosmopolitan. (*LYCORÌIDÆ*) ..... **SCIÁRIDÆ**

a. Third vein forked. (**Crátyna**) ..... **CRATYNÌNÆ**
Third vein simple..... b
b. Cubitus and M_4 forking beyond origin of M_{1+2}. (**Megalósphys, Fungivórides, Phorodónta**) ..... **MEGALOSPHYÌNÆ**
Cubitus and M_4 forking before or opposite origin of M_{1+2}..... c
c. Medial cell (between M_1 and M_2) not wider than adjacent cells. (**Scìara** (=*Lycòria*) (Fig. 504), **Epídapus, Plastoscìara, Psiloscìara**) ..... **SCIARÌNÆ**

Medial cell much wider than adjacent cells; male antennæ with flagellar joints cylindrical and long-stalked. (**Zygoneùra**, Eur.) ..... **ZYGONEURÌNÆ**

25. Second basal cell minute, much shorter than first basal cell due to the proximal location of the apparent m-cu crossvein (Fig. 507), radius three-branched, the middle branch short and commonly ending in R_1 near its tip; Sc complete; basal and middle sections of media continuous. (**Bolitóphila** (Fig. 507), **Bolitophilélla**). **BOLITOPHÍLIDÆ**

Second basal cell nearly or quite as long as first, sometimes confluent with it 26



Figs. 506–512. **Mycetobiidæ, Bolitophilidæ, Diadocidiidæ, Ditomyiidæ, Ceroplatidæ, Macroceratidæ**

506. **Palæoplatyura,** wing (Johannsen) Mycetobiidæ.
507. **Bolitophila,** wing (Johannsen) Bolitophilidæ.
508. **Macrocera,** wing. Macroceratidæ.
509. **Mycetobia,** wing (Johannsen) Mycetobiidæ.
510. **Diadocidia,** wing (Johannsen) Diadocidiidæ.
511. **Ditomyia,** wing (Johannsen) Ditomyiidæ.
512. **Ceroplatus,** wing. Ceroplatidæ.

26. Radius three-branched; if the basal cells are coextensive and the crossveins transverse then the Sc meets the costa beyond the basal fourth of the wing 27

Radius two-branched (Fig. 510); Sc short, evanescent; basal cells coextensive and more or less fused, the two crossveins in the same straight line perpendicular to the wing-axis; mesonotum with rows of bristles. Holarctic. (**Diadocídia** (Fig. 510), **Arachnocámpa**) ..... **DIADOCIDÌIDÆ**

27. Anterior crossvein (r-m) present though short (Fig. 509); middle branch of radius (R_3) usually arising from the third vein (R_5) before the middle of that vein and usually much longer than half of R_5 28

Anterior crossvein (r-m) obliterated by the coalescence of the radial sector and the media for a short distance where the crossvein usually is; R_3 much shorter than half of R_5 (Fig. 508) 29

28. Subcosta short, evanescent, ending free; pronotum with bristles. (**Ditomỳia** (Fig. 511), **Sýmmerus**) ..... **DITOMYÌIDÆ**

Subcosta relatively long, reaching at least one-fourth the wing-length and usually ending in the costa; pronotum without bristles. (**Mycetòbia** (Fig. 509), **Palæoplatyùra** (Fig. 506), holarc.; **Mesòchria**, Seychelles) ..... **MYCETOBÌIDÆ**

29. Antennæ short, usually thick-set and often flattened; tibial bristles present though usually small, posterior tibiæ with unequal apical spurs; forks of cubitus evenly diverging from the beginning. Europe, N. America, N. Africa, Australia. (**Ceróplatus** (Fig. 512), **Asíndulum, Apêmon, Cerotèlion, Nervijúncta, Platyùra** (=*Zelmìra*). (*PLATYÙRIDÆ*).

CEROPLÁTIDÆ

Antennæ usually very slender, nearly as long as or even much longer than the whole body; tibiæ without bristles, posterior tibiæ with subequal apical spurs; forks of apparent cubitus (M_4 and Cu_1) parallel for a short distance and then diverging. (**Macrócera** (Fig. 508), widespr.; **Chiasmoneùra**, indo-mal.).

MACROCERÁTIDÆ

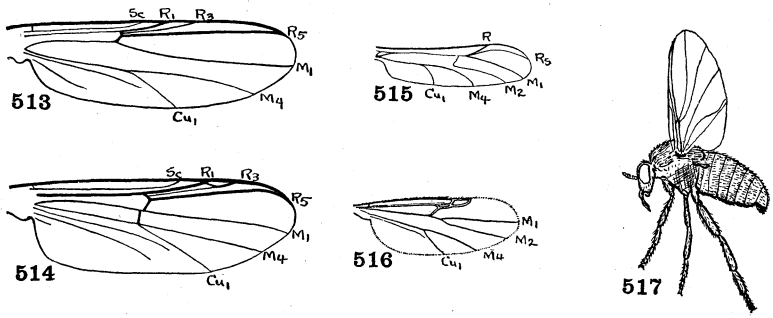
30. Cubital vein commonly forked near middle of wing (Fig. 513), radial branches not greatly thicker than the other veins; antennæ of male often with very long plumes and of female bead-like; eyes separated, sometimes males are holoptic; first abdominal segment without fringed flap 31

Cubitus forked at base, not petiolate, second basal cell open; anterior veins thick, others very weak (Fig. 517); antennæ about as long as head, ten-jointed, the flagellar joints closely united (Fig. 465b); male holoptic; first abdominal tergite with a conspicuous fringed flap-like scale; male metatarsi usually dilated. Widespread, mostly holarctic and neotropical. Black-flies, Buffalo-gnats. (*MELUSÍNIDÆ*) ..... **SIMULÌIDÆ**

a. Radial sector forked, the two branches close together; second joint of hind tarsus without dorsal incision, the first joint apically

truncate. (**Prosimùlium, Hélodon**, holarc.; **Cnèphia, Parasimùlium**, nearc.; **Tænioptérna**, palæarc.).
PROSIMULIÌNÆ

Radial sector not forked ..... b
b. Hind metatarsi apically truncate, front metatarsi not broadened. c
Hind metatarsi roundly projecting below at apex ..... d
c. Second joint of hind tarsi without dorsal incision. (**Hellíchia, Ástega**, palæarc.) ..... **HELLICHIÌNÆ**
Second joint of hind tarsi with a deep incision on dorsal side toward base. (**Ectémnia**, nearc.; **Pternáspatha**, neotrop.).
ECTEMNIÌNÆ



Figs. 513–517. **Chironomidæ, Ceratopogonidæ, Simuliidæ**

513. **Chironomus,** wing (Kieffer) Chironomidæ.
514. **Anatopynia,** wing (Kieffer) Chironomidæ.
515. **Stenoxenus,** wing (Kieffer) Chironomidæ.
516. **Hartomyia,** wing (Cole) Ceratopogonidæ.
517. **Simulium** (Lugger) Simuliidæ.

d. Second joint of hind tarsi without dorsal incision; front metatarsi normal. (**Stegoptérna**, palæarc.; **Gigántodax**, neotrop.; **Mallochélla**, holarc.) ..... **STEGOPTERNÌNÆ**
Second joint of hind tarsi with a dorsal sulcus ..... e
e. Front metatarsi normal. (**Nevermánnia**, holarc.; **Frièsia, Wilhélmia**, widespr.; **Cnètha, Schoenbaueria**, palæarc.).
NEVERMANNIÌNÆ
Front metatarsi of both sexes flattened and broadened. (**Simùlium** (Fig. 517), **Odágmia**, widespr.; **Bcóphthora**, holarc.; **Býssodon**, nearc.; **Edwardséllum**, ethiop.) . . **SIMULIÌNÆ**

31. Anterior branch of media not forked; mouthparts not chitinized, not fitted for piercing; front legs lengthened, commonly raised

up and vibrated when at rest; postnotum generally with median longitudinal furrow or keel. (*TENDIPÉDIDÆ*).
CHIRONÓMIDÆ

a. Crossvein between M_1 and cubitus present, *i.e.* second basal cell complete (Fig. 514) ..... b
Crossvein between media and cubitus absent, no second basal cell (Fig. 513) c

b. R_{2+3} either present and forked, *i.e.* connected with R_1 by a crossvein, or else absent altogether. (**Tánypus** (=*Pelòpia*, = *Protênthes*), **Anatopỳnia** (Fig. 514), **Pentaneùra** (=*Ablabesmyia*), **Procl**à**dius**). (*PELOPIÌNÆ*)..... **TANYPODÌNÆ**
R_{2+3} present and simple, not connected with R_1 and always distinct. (**Diámesa**) ..... **DIAMESÌNÆ**

c. Metatarsus shorter than tibia, front tibiæ with spur; male styles folded inward..... d
Metatarsus nearly always longer than tibia, front tibiæ rarely with spur; male styles directed rigidly backward. (**Chirónomus** (Fig. 513) (=*Téndipes*), **Tanytársus**). (*TENDIPEDÌNÆ*) ..... **CHIRONOMÌNÆ**

d. Pronotum scarcely divided, anepisternal suture well developed (*i.e.* an oblique slash-like cleft extending from base of wings nearly to front coxæ, as in fig. 487); male antennæ normally plumose. (**Orthocl**à**dius, Corynoneùra, Cricótopus, Metriocnêmis, Spaniótoma** (=*Camptocl*à*dius*)).
ORTHOCLADIÌNÆ
Pronotal lobes widely separated; anepisternal suture obsolete; male antennæ not plumose. Seashore species. (**Clùnio, Telmatogèton**) ..... **CLUNIONÌNÆ**

Media forked (Fig. 516); mouthparts chitinized, fitted for piercing; postnotum gently rounded, without median furrow; front legs not lengthened. Punkies, No-see-ums, Sand-flies. Mainly holarctic. (*HELÈIDÆ*) ..... **CERATOPOGÓNIDÆ**

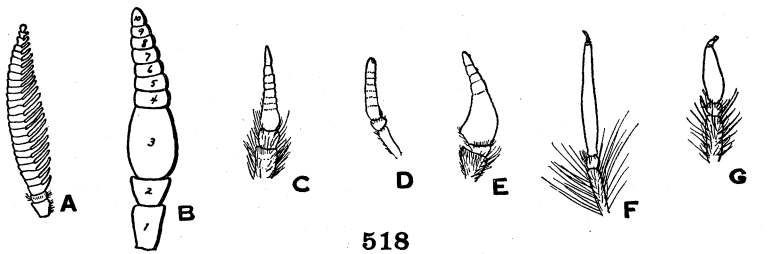
a. R and M fusing to beyond middle of wing. (**Stenóxenus** (Fig. 515), nearc.). (*STENOXÉNIDÆ*) ..... **STENOXENÌNÆ**
R and M separate. (**Ceratopògon, Culicòides, Bêzzia, Forcipomỳia, Hartomỳia** (Fig. 516), **Johannsenomỳia, Palpomỳia**). (Incl. *JOHANNSENOMYÌIDÆ*).
CERATOPOGONÌNÆ

Suborder Brachycera, Section Orthorrhapha

32. Last tarsal joint furnished with three nearly equal pads under the tarsal claws, *i.e.* empodium developed pulvilliform (Fig. 534);

head and thorax with no strong bristles; anal cell closed near margin, or even narrowly open; third vein almost always forked, *i.e.* R_4 and R_5 separate.....33

Empodium wanting or replaced by a bristly hair, therefore only two tarsal pads (pulvilli) (Fig. 557) very rarely the pulvilli also absent; bristles often well developed; third antennal joint never truly annulated.....42



518

Fig. 518. **Brachycerous Antennæ (Orthorrhapha)**

A, **Rhachicerus** (Vollenhoven) Xylomyiidæ; B, **Subulonia** (Enderlein) Xylomyiidæ; C, **Cœnomyia** (Verrall) Cœnomyiidæ; D, **Xylophagus** (Verrall) Xylophagidæ; E, **Tabanus** (Verrall) Tabanidæ; F, **Bombylius** (Verrall) Bombyliidæ; G, **Thereva** (Verrall) Therevidæ.

33. Third antennal joint complex, annulated into three to eight apparent segments (Fig. 518 b–e, or the antennæ more than three-jointed, rarely (some Stratiomyiidæ) the third complex-joint bearing an elongate arista (Fig. 520).....34

Antennæ three-jointed, the third joint compact, not composed of rings (Fig. 518 f, g), usually bearing an elongate arista or style, rarely the two basal joints fused.....40

34. Prefurca (first section of R_s) short, *i.e.* R_s arising opposite first fork of M which forms the base of the discal cell (Fig. 521); tibial spurs wanting, at most middle tibiæ with a slight spur; proboscis short.....35

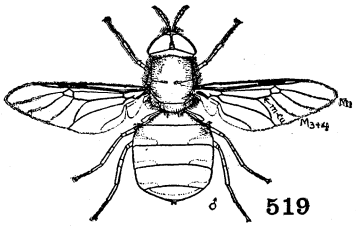
Prefurca longer, *i.e.* R_s arises distinctly before base of discal cell (Fig. 526); at least middle tibiæ with distinct spurs; costa continuing around hind margin of wing as the ambient vein.....37

35. Second vein (R_{2+3}) arising at or beyond anterior crossvein (r-m), discal cell small, usually pentagonal and located closer to the costa than usual; submarginal cell or cells very small and narrow

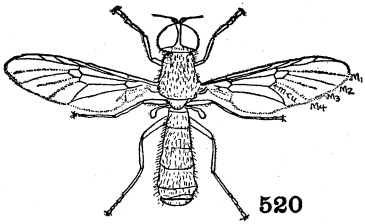
and located entirely before wing-tip, anterior veins usually crowded near costa, the other veins faint; four or five posterior cells present, all open; costa ending before wing-tip, no vein on hind margin of wing; scutellum often armed with marginal spines. Soldier flies. A large, widespread family with many tropical genera ..... **STRATIOMYÌIDÆ**

a. Abdomen with seven visible segments; middle tibiæ sometimes spurred; third antennal joint normally with eight annulations and without a style.....b
Abdomen with five or six visible segments; tibiæ not spurred; third antennal joint with not more than six annulations.....d

b. Scutellum with four or more spines.....c
Scutellum not spined, rarely with marginal row of small teeth. (**Metopònia,** austr.; **Allognósta,** holarc.; **Berismỳia, Hylòrus,** neotrop.) ..... **METOPONIÌNÆ**



519



520

Figs. 519, 520. **Stratiomyiidæ**

519. **Odontomyia,** male (Cole) Stratiomyiidæ.
520. **Geosargus,** male (Verrall) Stratiomyiidæ.

c. Media three-branched; palpi often reduced. (**Bèris, Hoplacántha,** widespr.; **Béridops, Heteracánthia,** neotrop.; **Eumécacis,** austr.) ..... **BERIDÌNÆ**
Media four-branched; palpi three-jointed. (**Actìna,** widespr.; **Apospásma, Huttonélla, Neoexaìreta,** mostly austr.). **ACTINÌNÆ**

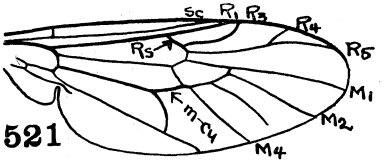
d. Media three-branched (Fig. 523), *i.e.* discal cell emitting two veins from its apex in addition to the vein forming its under side....e
Media four-branched (Fig. 524), *i.e.* discal cell emitting three veins from its apex or the third just below.....g

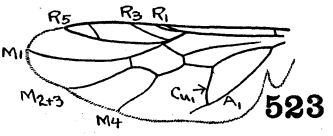
e. Anterior branch of cubital fork (M_{3+4}) joined to the discal cell by an apparent crossvein, *i.e.* discal cell emitting only two veins; apical antennal segment bristle-like, as long as remainder of antenna. (**Prosopochrỳsa,** Java) .. **PROSOPOCHRYSÌNÆ**

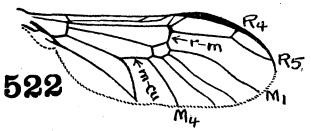
M_{3+4} forming the lower side of the discal cell for a greater or less distance, the discal cell emitting therefore three veins in all. .f

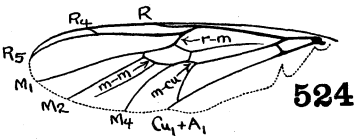
f. Antennæ with last, terminal or subterminal, segment (tenth) bristle-like and tipped with an extra hair, segments three to nine usually short and forming an oval or spherical complex third antennal joint. (**Pachygáster**, holarc.; **Cynipimórpha** (Fig. 523), **Zabráchia**, nearc.; **Panàcris**, **Psephiócera**, neotrop.; **Evàsa**, malay.; **Plátyna**, ethiop.).

PACHYGASTRÌNÆ









Figs. 521–524. **Stratiomyiidæ**

521. **Archistratiomys**, wing (Enderlein) Stratiomyiidæ.
522. **Analcocerus**, wing (Williston) Stratiomyiidæ.
523. **Cynipimorpha**, wing (Williston) Stratiomyiidæ.
524. **Chrysochlora**, wing. Stratiomyiidæ.

Antennæ with tenth segment not bristle-like, usually flattened, long, strap-shaped and fringed on edges, sometimes all ten antennal segments are similar, suggesting the Nematocera. (**Lophóteles**, **Artemìta**, **Psegmómma**, neotrop.; **Isomerócera**, **Ptilócera**, **Tínda**, ethiop., indomal.).

LOPHOTELÌNÆ

g. All four medial branches arising from discal cell (Fig. 524). . . . . h
M_4 apparently connected with discal cell by a crossvein (Fig. 520) . . . . . k

h. Last antennal piece (tenth segment) ribbon-like; segments six to eight with groove in front; scutellum without spines. (**Hermètia**, **Acrodésmia**, **Amphilécta**, mainly neotrop.; **Eudmèta**, malay.) . . . . . **HERMETIÌNÆ**

Last antennal part styliform or undifferentiated, not ribbon-like, segments six to eight without furrow. i

i. Scutellum with marginal spines ..... j
Scutellum without spines. (**Chrysochlòra** (Fig. 524), **Ábavus, Anacanthélla, Porpócera, Rùba**) .. **CHRYSOCHLORÌNÆ**

j. Scutellum with four to twelve spines. (**Antíssa, Parantíssa,** neotrop.; **Tetracanthina,** Java) ..... **ANTISSÌNÆ**
Scutellum with two spines. (**Clitellària** (=*Ephíppium*), **Euparỳphus, Nemótelus, Oxýcera,** holarc.; **Negritomỳia,** ethiop., malay.; **Euryneùra, Nothomỳia**) ..... **CLITELLARIÌNÆ**

k. Antennæ with elongate terminal or dorsal arista l
Antennæ without a distinct arista ..... m

l. Scutellum with two spines, or with vestiges of two spines. (**Rhaphiócera, Hoplístes, Lysòzum,** neotrop.).
RHAPHIOCERATÌNÆ
Scutellum without spines; metanotum prominently convex and with upturned hairs. (**Geosárgus** (=*Sárgus*) (Fig. 520), **Chrysochròma, Microchrỳsa, Ptécticus,** widespr.; **Gongròzus,** malay.). (*SARGÌNÆ*) ..... **GEOSARGÌNÆ**

m. Antennæ ending in an elongate and broadly flattened ribbon-like segment; scutellum with two spines. (**Analcócerus** (Fig. 522), neotrop.) ..... **ANALCOCERÌNÆ**
Antennæ with last segment of third joint usually short, never ribbon-like ..... n

n. Scutellum with two spines. (**Stratiomỳia** (=*Stratìomys*), **Odontomỳia** (=*Eulàlia*) (Fig. 519), widespr. mostly in temperate zone; **Cyphomỳia,** widespr., mostly tropical; **Myxosárgus, Rhingiópsis,** neotrop.; **Hírtea, Hoplodónta**).
STRATIOMYIÌNÆ
Scutellum unarmed. (**Lasiòpa,** widespr.; **Chordonòta,** neotrop.; **Udamacántha**) ..... **LASIOPÌNÆ**

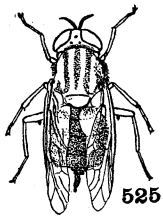
Second vein arising before anterior crossvein (r-m), veins not crowded anteriorly; mostly neotropical species 36

36. Third vein simple, ending before wing-tip; all posterior cells open; third antennal joint usually three-segmented; abdomen slender, comprising seven segments; species under one inch in length. (**Chiromỳza, Clavimỳia** (Fig. 528), **Mesomỳza, Nonàcris, Xenomórpha,** neotrop.; **Archimỳza,** austr.).
CHIROMÝZIDÆ
Third vein forked, its branches (R_4 and R_5) widely divergent and enclosing the tip of the wing (Fig. 525), fourth posterior cell (M_3) closed; abdomen broadly rounded; gigantic species, not common. (**Pantophthálmus, Acanthomèra, Rhaphiorrhýnchus,** neotrop.). (*ACANTHOMÉRIDÆ*).
PANTOPHTHÁLMIDÆ

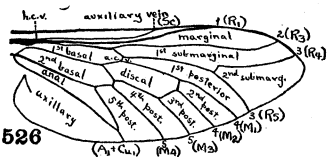
37. Calypteres conspicuous, but not concealing halteres, their margin fringed; head widely hemispherical (Fig. 527); third antennal joint composed of four to eight annuli; branches of third vein (R_4 and R_5) widely diverging and enclosing tip of wing; females usually blood-sucking. A large family of conspicuous flies, occurring in all regions, most species tropical. Horse-flies, Gad-flies, Deer-flies ..... **TABÁNIDÆ**

a. Hind tibiæ without apical spurs ..... b
Hind tibiæ with two apical spurs which sometimes are minute. . h

b. Third antennal joint divided into four, rarely three, segments. (**Hæmatópota**, widespr.; **Heptátoma**, Eur.).
HÆMATOPOTÌNÆ
Third antennal joint divided into five segments, antennæ therefore apparently seven-jointed, rarely indistinctly ten-jointed. . c



525



526

527

Figs. 525–527. **Pantophthalmidæ, Tabanidæ**

525. **Pantophthalmus,** photograph of specimen in O. S. Westcott collection. Pantophthalmidæ.
526. **Tabanus**, wing (Williston) Tabanidæ.
527. **Tabanus,** photographed specimen. Tabanidæ.

c. Anal cell open, or rarely closed to a point; ocelli absent. (**Chásmia,** Malay.) ..... **CHASMIÌNÆ**
Anal cell closed and petiolate ..... d

d. Palpi with last joint broad, flat and shining black. (**Lepisélaga,** neotrop.) ..... **LEPISELAGÌNÆ**
Palpi with last joint normal ..... e

e. First antennal joint longer than wide, usually much longer; ocelli absent; first posterior cell open; relatively slender species. (**Diachlòrus, Acanthócera,** neotrop.) ..... **DIACHLORÌNÆ**
First antennal joint about as long as wide ..... f

f. Antennæ with basal segment of third joint not excavated above, without angle or tooth, but instead with a few short black spines; small, delicate species. (**Stenotabànus,** neotrop.).
STENOTABANÌNÆ

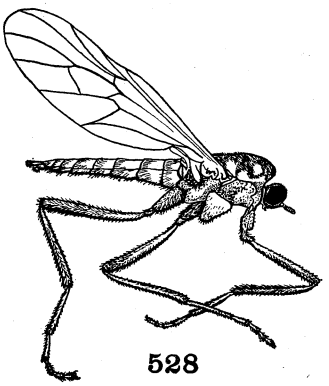
Antennæ with third joint always distinctly angulated above toward base or with a finger-like projection.....g

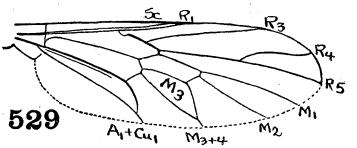
g. First posterior cell open; ocelli sometimes present. (**Tabànus** (Figs. 518e, 526, 527), **Atylòtus**, **Therioplèctes**, widespr.; **Dichelócera**, neotrop.) ..... **TABANÌNÆ**

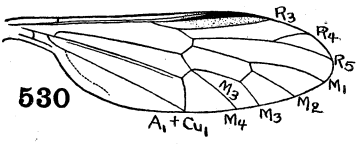
First posterior cell closed; ocelli absent. (**Bellárdia**, Asia; **Psalídia**, neotrop.) ..... **BELLARDIÌNÆ**

h. Third antennal joint consisting of five segments, rarely four, or the segments fused to a single joint.....i

Third antennal joint consisting of eight, rarely seven, segments, the antennæ therefore ten- or nine-jointed.....j







Figs. 528–530. **Chiromyzidæ, Xylomyiidæ, Xylophagidæ**

528. **Clavimyia** (Enderlein) Chiromyzidæ.
529. **Xylomyia**, wing. Xylomyiidæ.
530. **Xylophagus**, wing. Xylophagidæ.

i. First posterior cell open. (**Sílvius**, widespr.; **Chrỳsops** (Deerflies), cosmop.) ..... **SILVIÌNÆ**

First posterior cell closed. (**Scárphia, Metaphàra**, S. Afr.). **SCARPHIÌNÆ**

j. Anal and first posterior cells open; female with long ovipositor; thorax high. (**Cœnùra**, Chile; **Pelecorhýnchus**, Austr.). (*PELECORHYNCHÌNÆ*) ..... **CŒNURÌNÆ**

Anal cell closed.....k

k. First posterior cell open, rarely closed at margin. (**Mélpia**, neotrop.; **Corizoneùra** (=*Bùplex*), widespr.; **Apatoléstes** (=*Gòniops*), nearc.; **Ósca**) ..... **MELPIÌNÆ**

First posterior cell closed. (**Pangònia**, palæarc.; **Phàra**, ethiop.; **Esenbéckia, Fidèna, Sciòne**, neotrop.; **Lilæa**, austral.).
PANGONIÌNÆ

Calypteres small or vestigial; head not hemispherical, the occiput convex; abdomen oblong; second submarginal cell (R_4) not wide. 38

38. Fourth posterior cell (M_3) almost or quite closed (Fig. 529); dichoptic . . . . . **XYLOMYÌIDÆ**

a. Third joint of antennæ divided into eight annulations. (**Xylomŷia** (Fig. 529), Eurasia, Afr., Am.; **Nematocerópsis**, Manchuria; **Prísta**, malay,; **Sólva**, palæarc., malay.; **Subulònia**, nearc.) . . . . . **XYLOMYIÌNÆ**

Flagellum of antenna divided into 20 to 36 usually pectinate divisions (Fig. 518a). (**Rhachícerus**, holarc., malay.). (*RHACHICÉRIDÆ*) . . . . . **RHACHICERÌNÆ**

Fourth posterior cell (M_3) open (Fig. 530). 39

39. Face flat or produced, the facial orbits and cheeks not sutured; hind margin of wing thin before anal angle; male dichoptic. Very slender flies resembling ichneumon-flies. (**Xylóphagus** (=*Erínna*) (Fig. 530), Eur., Am., Austr.; **Archimŷia**). (*ERÍNNIDÆ*) . . . . . **XYLOPHÁGIDÆ**

Facial orbits and cheeks separated from the central part; hind margin of wing veined throughout; male holoptic; scutellum of *Cœnomyia* spined. Mostly robust, yellowish or blackish flies; widespread, but rare . . . . . **CŒNOMYÌIDÆ**

a. Proboscis short . . . . . b

Proboscis as long as head and thorax, obliquely porrect; body robust. (**Arthróteles**, ethiop.) . . . . . **ARTHROTELÌNÆ**

b. All tibiæ with apical spurs c

Front tibiæ without spurs. (**Arthróceras, Arthròpeas, Glùtops**). **ARTHROCERATÌNÆ**

c. Abdomen broader than thorax; scutellum spined or not. (**Cœnomŷia** (Fig. 518c), **Anacantháspis**, holarc.).
CŒNOMYIÌNÆ

Abdomen elongate, narrower than thorax; scutellum armed with spines. (**Stratioléptis**, Siberia, Japan).
STRATIOLEPTÌNÆ

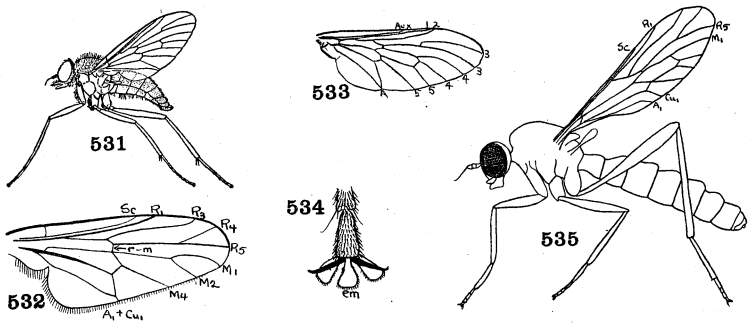
40. Costa continuing around wing-margin, venation normal (Fig. 531), anterior crossvein (r-m) distinct, five posterior cells (*Hilarimorpha* with four); at least posterior tibiæ with spurs; calyp-

teres vestigial; mostly holarctic, inhabiting woodlands. Snipe-flies. (*LÉPTIDÆ*) ..... **RHAGIÓNIDÆ**

a. Empodium undeveloped; discal cell open, fourth vein (media) forked and long-petiolate; tibiæ without spurs. (**Hilarimórpha** (Fig. 532), holarc.) ..... **HILARIMORPHÌNÆ**

Empodium pulvilliform (Fig. 534); discal cell present. . . . . b

b. Face flattened and projecting, nasiform; the antennæ inserted above middle of eyes; alula undeveloped, calypteres reduced; front tibiæ with strong apical spur. (**Vermíleo** (Fig. 535), **Lampromỳia**) ..... **VERMILEONÌNÆ**



Figs. 531–535. **Rhagionidæ**

531. **Rhagio,** male (Cole) Rhagionidæ.
532. **Hilarimorpha,** wing. Rhagionidæ.
533. **Chrysopila,** wing. Rhagionidæ.
534. **Rhagio,** end of tarsus, showing broad empodium. Rhagionidæ.
535. **Vermileo** (Wheeler) Rhagionidæ.

Face socketed and not projecting, separated by a groove from the rather wide cheeks, antennæ inserted below middle of eyes; alula present, calypteres well developed. c

c. Front tibiæ with one or two spurs, hind tibiæ with two spurs. (**Bicálcar,** palæarc.; **Bolbomỳia, Diálysis, Triptótricha,** nearc.) ..... **BICALCARÌNÆ**

Front tibiæ without spurs. . . . . d

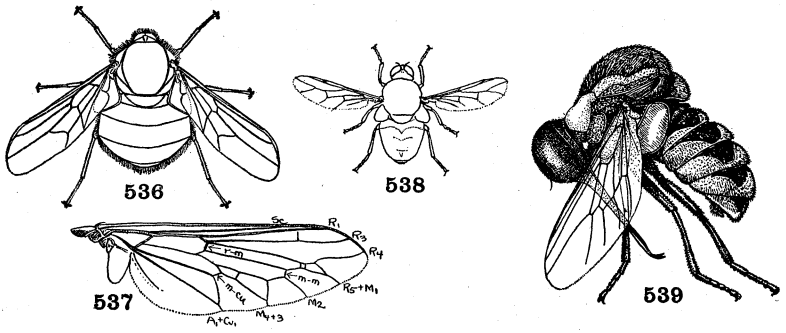
d. Hind tibiæ with two spurs; eyes not bisected. (**Rhàgio** (=*Léptis*) (Fig. 531), **Athèrix, Átrichops**). (*LEPTÌNÆ*). **RHAGIONÌNÆ**

Hind tibiæ with one spur which is sometimes reduced; eyes bisected, the lower facets smaller than the upper; second vein

short, curving upward at end close to first (R_1) vein. (**Chrysopìlus** (Fig. 533), **Omphalóphora, Ptiolìna, Spània, Symphoromỳia**) ..... **CHRYSOPILÌNÆ**

Costa more or less thinned beyond tip of wing, venation usually eccentric (Figs. 537, 551), anterior crossvein (r-m) usually absent or located near base of discal cell; tibiæ with short or no spurs; proboscis sometimes excessively long..... 41

41. Head as wide as the depressed thorax; calypteres vestigial; posterior veins parallel with hind margin (Fig. 551), sometimes



Figs. 536–539. **Acroceratidæ**

536. **Pterodontia,** female (Cole) Acroceratidæ.
537. **Ocnæa,** wing. Acroceratidæ.
538. **Acrocera** (Verrall) Acroceratidæ.
539. **Thyllis** (Cole) Acroceratidæ.

forming a secondary network of small cells, first basal cell very long, its forward border continued obliquely across the wing as a "diagonal vein." Rare species, inhabiting arid regions, principally Asia Minor, S. Africa, Chile and Australia.
NEMESTRÍNIDÆ

a. Proboscis elongate, slender and hard, the labella usually narrow, palpi short. (**Nemestrìnus, Fallénia, Megistorhýnchus, Neorhynchocéphalus, Rhynchocéphalus** (Fig. 551).
NEMESTRINÌNÆ

Proboscis short and broad, the labella fleshy, palpi long and upturned; ovipositor telescopic; alula broad. (**Hirmoneùra, Hyrmophlæba, Symmíctus,**) ..... **HIRMONEURÌNÆ**

Head placed low, very small as compared with the greatly humpbacked body, abdomen rounded, often inflated (Fig. 536); calypteres inflated, hiding the halteres; costa discontinued at wing-tip, posterior veins not parallel with hind margin of wing and not forming accessory cells; eyes of both sexes broadly contiguous. Spider parasites, rare species; widespread, but poorly represented in Indo-australia and tropical Africa. (*CÝRTIDÆ, HENÓPIDÆ, ONCÓDIDÆ*).

ACROCERÁTIDÆ

a. Third antennal joint small, with terminal style or hair-like rays; proboscis short.....b

Third antennal joint large, more or less compressed, without terminal style; proboscis often very long, sometimes vestigial. (**Pánops, Astoméllа, Eulónchus, Ocnæa** (Fig. 537), **Làsia, Pialeòidea**) ..... **PANOPÌNÆ**

b. Prothoracic lobes separated; abdomen usually inflated. (**Acrócera** (Fig. 538), **Cýrtus, Nòthra, Oncódes, Opsèbius, Pterodóntia** (Fig. 536)). (*CYRTÌNÆ, ONCODÌNÆ*).

ACROCERATÌNÆ

Lobes of prothorax very large and broadly fused in the middle to form a shield in front of the mesonotum; abdomen not inflated. Mainly neotropical, some ethiopian. (**Philpota, Hélle, Megálybus, Thýllis** (Fig. 539) .....**PHILPOTÌNÆ**

42. Anal cell distinctly longer than second basal cell, either open, or acutely closed in or near margin of wing, basal cells usually relatively large (see Fig. 545);[1] head bristles rarely evident 43

Anal cell shorter, rarely acute, closed some distance from wing-margin, usually by a turning back of Cu_1, sometimes the anal cell completely absent; "small crossvein" (see couplet 45) never formed, *i.e.* never five posterior cells; some bristles commonly developed on head.....50

[1] The following forms having short acute anal cell slightly longer than the second basal cell will cause confusion at this point of the key. The strength of the head bristles is then the best guide.

Opetia, Platypezidæ, couplet 58, Fig. 581: head bristles weak, no discal cell, the third vein not forked.

Sciadoceratidæ, couplet 52, Fig. 584: head bristles strong, subcosta ending in R1.

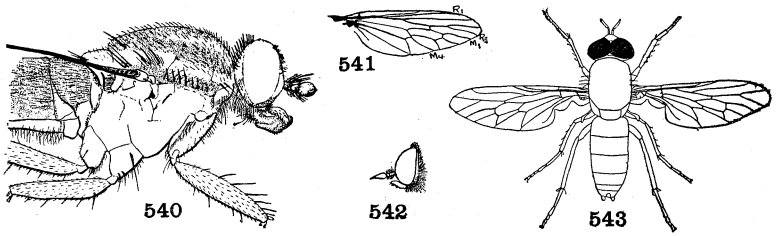
Empididæ, Brachystomatinæ, couplet 48, Fig. 559; and Hybotinæ, couplet 57, Fig. 563: head bristles weak, anal and basal cells rather long. Remaining Empididæ, couplet 53, have the anal cell small and either perpendicularly or obtusely closed.

Lonchopteridæ, couplet 54, Fig. 572: head bristles strong, wings lancet-shaped, no discal cell. The female has a false anal cell.

Trypetidæ, couplet 126, Fig. 656, and the Ortalid series, couplets 94 to 97: anal crossvein (Cu1) angulately broken, the anal cell therefore with a pointed apical lobe.

Tachiniscidæ, couplet 99, Fig. 633: body bristly.

43. Radial sector three-branched, *i.e.* third longitudinal vein (R_{4+5}) forked (see Fig. 543) 44
Radial sector two-branched, *i.e.* third longitudinal vein simple (R_4 absent). (If the second vein is short and terminates in the first vein (Fig. 546), see Bombyliidæ, Mythicomyiinæ, couplet 48,j) 55
44. Vertex plane or convex, the eyes not bulging, eyes of male often meeting; legs not robust 45
Vertex sunken, the eyes bulging above and never contiguous; wing-veins numerous; often large species with strong legs... 49



Figs. 540–543. **Apioceratidæ, Therevidæ**

540. **Ripidosyrma,** head and thorax (Melander) Apioceratidæ.
541. **Thereva,** wing. Therevidæ.
542. **Psilocephala,** profile of head (Cole) Therevidæ.
543. **Psilocephala,** male (Cole) Therevidæ.

45. Media four-branched, "small crossvein" present, *i.e.* the obtuse apex of the second basal cell touches two posterior cells in addition to the discal cell (Fig. 541), five posterior cells present, the fourth commonly closed; thorax with some bristles; abdomen long and tapering 46
Media three- or two-branched, four or three posterior cells present, if rarely five posterior cells present the extra one is due to an extra vein bisecting the third, the fourth posterior cell not closed, "small crossvein" absent, *i.e.* the acute apex of the second basal cell touches but one posterior cell in addition to the discal cell (see Fig. 545); abdomen usually oval or oblong; thorax without true bristles 47
46. Apical veins curving forward, the third vein (R_5) and nearly always also the fourth (M_1) ending before apex of wing; at least the scutellum bristly; antennæ with a very short style; eyes

separated; palpi broadened at tip. A small family; occurring in arid places; South Africa, America, Australia, Borneo. (**Apiócera, Apomìdas, Rhaphiomỳdas, Ripidosỳrma** (Fig. 540)). **APIOCERÁTIDÆ**

Fourth vein ending beyond apex of wing (Fig. 541); body usually furry rather than bristly, sometimes nearly bare; palpi not broadened apically. Widespread, principally holarctic. (**Théreva** (Fig. 541), **Anaborrhỳnchus, Epomỳia, Dialineùra, Phỳcus, Psilocéphala** (Figs. 542, 543), **Tabùda, Xestomỳia**). **THERÉVIDÆ**

47. Costa not continuing beyond apex of wing, fourth vein (M_1) ending at or before wing-tip, three posterior cells (Fig. 552); proboscis hidden; antennæ without a style; body bare. Holarctic, neotropical and oriental; about thirty species; some are found on windows. (**Scenópinus** (=*Omphràle*) (Fig. 552), **Pseudatrìchia**). (*OMPHRÁLIDÆ*) ..... **SCENOPÍNIDÆ**

Costa continuing around entire wing, fourth vein (M_1) ending beyond wing-tip, usually four posterior cells. (If the discal cell is open and the fourth vein is forked and long-petiolate (Fig. 532), see Hilarimorphinæ, couplet 40, a) 48

48. Antennæ usually ending in a small style, style-like process, or circlet of bristly hairs; tibiæ usually with spicules; proboscis usually long, thin and porrect; body usually furry and stout, rarely (Systropodinæ) extremely slender, bare and wasp-like; anal vein complete, anal cell (Cu) usually reaching margin, often open, alula usually distinct. Mostly occurring in sunny dry localities; alert, quick-flying species; many genera and species ..... **BOMBYLÌIDÆ**

a. Second vein (R_3) arising almost perpendicularly from R_s very close to the anterior crossvein (r-m) and forming a knee at its origin, only the third vein (R_{4+5}) continuous with the prefurca (Fig. 545); eyes with an indentation in the middle of the hind margin ..... b

Second and third veins forking acutely or in an arch and at a greater distance before the anterior crossvein than the length of that crossvein (see Fig. 548) c

b. Calypteres margined with fringe of hairs; antennal style with a pencil of hairs at its tip; metapleuræ bare. (**Ánthrax** (Fig. 545), **Argyramœba, Chionamœba, Coquilléttia, Spongostỳlum**). **ANTHRACÌNÆ**

Calypteres margined with scales; style without apical crown of hairs; metapleuræ hairy. (**Exoprosòpa, Dipálta, Hemi-**

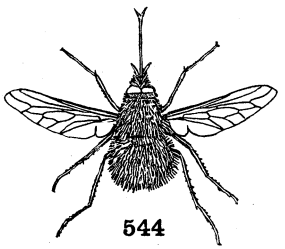
pénthes, Hyperalònia, Lepidánthrax, Stónyx, Thyridánthrax, Villa (= *Hyalánthrax*)) .... **EXOPROSOPÌNÆ**

c. Antennæ widely separated; abdomen elongate, cylindrical; hind margin of eyes not indented. (**Cytherèa, Callístoma, Gyrocráspedum, Pantárbes, Sericosòma**) ..... **CYTHEREÌNÆ**

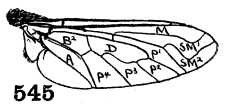
Antennæ approximated, if the antennæ are widely separated the abdomen is not slender.....d

d. Eyes with an indentation in the middle of the hind margin at which arises an impressed bisecting line in both sexes.....e

Eyes without posterior indentation and the bisecting line, at most with a rounded indentation.....g



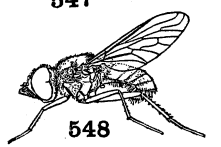
544



545

546

547



548

Figs. 544–548. **Bombyliidæ**

544. **Bombylius** (Verrall) Bombyliidæ.
545. **Anthrax,** wing. Bombyliidæ.
546. **Mythicomyia,** wing (Williston) Bombyliidæ.
547. **Geron,** wing (Williston) Bombyliidæ.
548. **Epacmus,** male (Cole) Bombyliidæ.

e. Face produced roof-like over the long and narrow mouth-opening, proboscis short; second vein arising in a curve. (**Tomomỳza, Antònia, Plesiócera**) ..... **TOMOMYZÌNÆ**

Face convex, not projecting; second vein arising acutely.....f

f. Head no broader than thorax; abdomen at least as broad as thorax, flattened; anterior crossvein much beyond middle of discal cell. (**Lomàtia, Anisotàmia, Canària, Comptòsia, Oncodócera**). **LOMATIÌNÆ**

Head broader, but the hind edge narrower than the thorax; body more cylindrical than depressed; anterior crossvein near middle of discal cell. (**Aphœbántus, Desmatoneùra, Epácmus** (Fig. 548), **Eucéssia, Petroróssia**)..... **APHŒBANTÌNÆ**

g. Face vertical, much longer than the front; clypeus separated from cheeks by a deep groove; second vein arising in a curve. (**Mariobézzia.**) ..... **MARIOBEZZIÌNÆ**

Face at most as long as front; clypeus not separated from cheeks by a deep groove; second vein arising at an acute angle.....h

h. Abdomen very long and slender, pedunculate; metasternum very strongly developed; occiput concave; eyes united in both sexes or nearly so; body bare; wings narrowed at base, without alula and calypteres. (**Sýstropus, Dolichomỳia**) . **SYSTROPÌNÆ**

Abdomen not remarkably slender; wings with alula and calypter.i

i. Third vein simple, therefore only one submarginal cell; small bare flies with humped thorax.....j

Third vein forked, two or three submarginal cells, second vein long, never ending in the first vein.....k

j. Second vein very short, ending in the first vein, or entirely absent. (**Mythicomỳia** (Fig. 546), **Empidideìcus, Glabéllula** (= *Pachynères*)). (*GLABELLULÌNÆ*) . **MYTHICOMYIÌNÆ**

Second vein normal, ending independently in costa. (**Cyrtòsia, Cyrtomórpha, Platypỳgus**) ..... **CYRTOSIÌNÆ**

k. Body more or less hunched, narrow, or at least not broad, thorax prominent, abdomen cylindrical or sometimes flattened; sometimes bare, or scaly, or with bristles; wings usually relatively short.....l

Body not narrow nor hunched, the abdomen rather flattened and usually hairy and without bristles.....m

l. Prothorax in shape of an anterior ring beset with strong curved bristles. (**Toxóphora, Heniconeùra, Lepidóphora**). **TOXOPHORÌNÆ**

Prothorax smaller and not beset with curved bristles. (**Cyllènia, Amíctus, Éclimus, Epíbates, Hénica, Thevenetimỳia**). **CYLLENIÌNÆ**

m. First antennal joint thickened and long-hairy; wings short, with four open posterior cells. (**Conóphorus, Aldríchia, Codiònus, Platamòdes**) ..... **CONOPHORÌNÆ**

First antennal joint not thickened; wings not short.....n

n. Face protruding as a very short muzzle, proboscis short, porrect, with fleshy tip; eyes of male bisected; discal cell broadened at end, much broader than second posterior cell; nearly bare species. (**Heterótropus** (= *Malthacótricha*), **Cænòtus, Proràtes**) ..... **HETEROTROPÌNÆ**

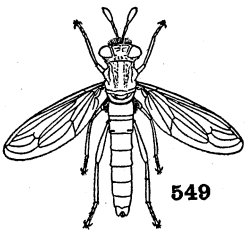
Face, when developed, convex or somewhat conically projecting, but not beak-like, proboscis long, with small labella; rarely wholly bare.....o

o. Second vein and fork of third vein in line with wing-axis; body not broad but rather humped, vestiture fine and not abundant; leg bristles weak or absent. (**Phthíria, Apólysis, Crocídium, Gèron** (Fig. 547), **Rhabdopsélaphus, Semiràmis**). **PHTHIRIÌNÆ**

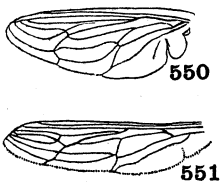
Second vein and fork of third vein curving forward, ending distinctly before tip of wing; body usually broad..... p

p. Vestiture short or undeveloped; no bristles on legs; head small. (**Ũsia, Corsomỳza, Legnotomỳia, Psiathalássius**). **USIĨNÆ**

Vestiture usually pronounced; tibiæ with three rows of evident bristles; lower occiput usually broadened. (**Bombýlius** (Fig. 544), **Heterostỳlum, Lordòtus, Sparnapòlius, Systœchus, Triplàsius**) ..... **BOMBYLIĨNÆ**



549



550

551

552

Figs. 549–552. **Mydaidæ, Nemestrinidæ, Scenopinidæ**

549. **Leptomydas,** male (Cole) Mydaidæ.
550. **Mydas,** wing. Mydaidæ.
551. **Rhynchocephalus,** wing (Williston) Nemestrinidæ.
552. **Scenopinus** (Verrall) Scenopinidæ.

Antennal style longer than the third joint; tibiæ without spicules; proboscis short, sharp and incurved; body slender, nearly bare; anal cell closed within the wing, the anal vein not reaching margin. Delicate, shade-loving flies. (See couplet 53, g, Brachystomatinæ) ..... **EMPÍDIDÆ**, part

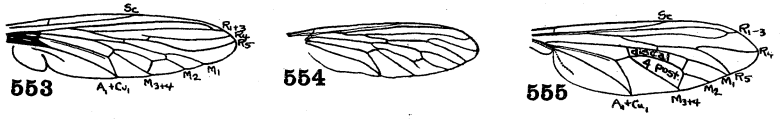
49. Body without bristles; fourth vein (M_1) curving forward to end at or before wing-tip, neuration complex (Fig. 550), prefurca (*i.e.* basal section of R_s) very short; antennæ with a clubbed style; proboscis with fleshy expanded tip, palpi vestigial. About 130 species; widespread, but not common; often flies of large size. (**Mỳdas** (Fig. 550), widespr.; **Leptomỳdas** (Fig. 549) nearc.; **Cephalócera**, ethiop.; **Miltìnus, Triclònus**, austr.). (*MYDÁSIDÆ*) ..... **MYDÀIDÆ**

Body usually with bristles, face bearded; fourth vein not curving forward, neuration not abnormal, prefurca long (Fig. 553); proboscis adapted for piercing, not fleshy, palpi usually prominent. A large family of nearly 4000 species, widespread, es-

pecially in warm localities; adults predatory on flying insects. Robber-flies ..... **ASÍLIDÆ**

a. Palpi one-jointed; antennæ with slender terminal arista; mesopleural bristles wanting; abdomen with eight segments.....b
Palpi two-jointed; antennæ with or without a thickened terminal style, very rarely with a terminal arista.....c

b. Marginal cell open; very slender species with few hairs and bristles; claws long, pulvilli absent; ovipositor without whorl of spines. (**Leptogáster, Euscelídia, Psílonyx**) .. **LEPTOGASTRÌNÆ**
Marginal cell closed and petiolate; less slender, or robust species, bristly rather than hairy; pulvilli present; ovipositor often with a crown of spines. (**Asìlus, Cerdístus, Dýsmachus, Ērax** (Fig. 553), **Mallóphora, Philodìcus, Ommàtius, Prómachus, Proctacánthus, Tolmèrus**) ..... **ASILÌNÆ**



Figs. 553–555. **Asilidæ**

553. **Erax,** wing (Hine) Asilidæ.
554. **Stichopogon,** wing. Asilidæ
555. **Atomosia,** wing. Asilidæ.

c. Marginal cell open, or rarely closed at extreme tip; mesopleural bristles wanting. (*DASYPOGONÌNÆ*)[1] ..... d
Marginal cell closed; mesopleural bristles present; male abdomen with seven (rarely six) segments; species often stout and very hairy. (*LAPHRIÌNÆ*)[1] ..... f

d. Abdomen of male with six segments. (**Laphýstia, Pérasis, Psilocùrus, Trichárdis, Trìclis**) ..... **PYRTANIÌNÆ**
Abdomen of male with seven, of female with eight segments....e

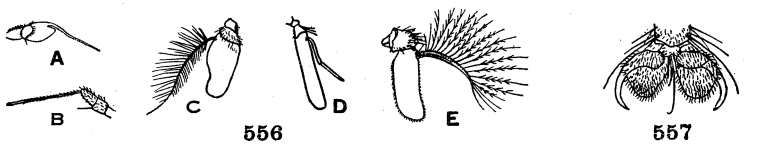
e. Front tibiæ without a claw-like apical projection. (**Anisopògon, Cyrtopògon, Dióctria, Habropògon, Heteropògon, Holopògon, Lasiopògon, Microstỳlum, Myiélaphus, Pycnopògon, Rhádinus, Stenopògon, Stichopògon** (Fig. 554)). **EREMOCNEMÌNÆ**
Front tibiæ with a claw-like apical projection. (**Cenopògon, Cophùra, Dasypògon, Deromỳia, Isopògon, Nícocles,**

[1] The divisions of the Dasypogoninæ and Laphriinæ have less rank than the other two subfamilies of the Asilidæ, but are given because of the dominance of this family. The divisions of the Dasypogoninæ have no corresponding type genera.

Saropògon, Selidopògon, Tarácticus). (*DASYPOGONÌNÆ*, s. str.) ..... **ACANTHOCNEMÌNÆ**

f. Small, usually dark colored; third antennal joint with a subapical thorn on upper side; side callouses of metanotum hairy or with blunt bristles; crossveins closing discal and fourth posterior cells usually in line with each other (Fig. 555); genitalia relatively small and ventrally placed. (**Atomòsia** (Fig. 555), **Amathomŷia, Loewinélla**) ..... **ATOMOSIÌNÆ**

Moderate to large, rather heavily pubescent species; third antennal joint without subapical thorn; side pieces of metanotum never bristly; crossveins closing discal and fourth posterior cells not in the same line; genitalia free and usually large. (**Làphria, Andrenosòma, Ctenòta, Dasýllis, Dásythrix, Lámpria, Lámyra, Nùsa, Pogonosòma**) ..... **LAPHRIÌNÆ**, s. str.



556 557

Figs. 556, 557. **Cyclorrhaphous Antennæ** and **Tarsus**

556. *Antennæ*: A, **Dolichopus,** Dolichopodidæ; B, **Drapetis** (Williston) Empididæ; C, **Volucella** (Williston) Syrphidæ; D, **Gonia** (Williston) Tachinidæ; E, **Glossina** (Hegh) Glossinidæ.

557. **Musca,** end of tarsus, showing hair-like empodium (Kellogg) Muscidæ.

50. No functional frontal suture or lunule above antennæ, front uniformly chitinized, without an anterior median differentiated stripe; no alula 51

Frontal suture well developed as a horseshoe-shaped groove over the antennæ continuing down so as to separate the center of the face from the sides, frontal lunule present as a crescentic sclerite between the antennæ and the frontal suture (Fig. 594),[1] middle part of front nearly always differentiated from the orbits; calypteres and alula usually pronounced; arista almost

[1] The frontal suture is forced open by the protrusion of the ptilinum, an eversible sac, for prying off the lid of the puparium at the time of emergence of the adult. Newly emerged flies of this group sometimes show the ptilinum; in older flies the ptilinum is withdrawn and the frontal suture closes to form the characteristic seam over the antennæ. The lid of the puparium opens by a circular cleft (see Fig. 763), hence the significance of the group-name Cyclorrhapha, meaning circular seam. In the coördinate group Orthorrhapha (including couplets 32 to 49) the pupa case opens by a dorsal straight longitudinal seam (see Fig. 707) and accordingly the frontal suture and ptilinum are not developed.

always dorsal; costa not extended to hind margin of wing; first two dorsal segments of abdomen more or less fused. *MUSCÒIDEA*) 59

51. Venation not of the types represented by Figs. 570 and 571, a closed cell (discal or discal and second basal) usually formed between the branches of the media, wings neither with radial branches concentrated near costa and medial veins extending obliquely across field of wing (as in Fig. 570), nor of lanceolate shape with long second vein and ambient costa (as in Fig. 571); antennæ evidently two- or three-jointed, the apical joint not spherical; male sometimes holoptic 52

Venation peculiar, of the type represented by Fig. 570 or Fig. 571; no discal cell; eyes of both sexes widely separated..... 54

52. Alular edge of wing without hairy bristles; posterior crossvein (m–m) usually present and then always located much beyond the anterior crossvein (r–m); anal cell acute (Fig. 563), rectangular (Fig. 561), rounded (Fig. 565) or obtuse (Fig. 560), when the anal cell is acute, the basal cells are relatively long and the subcosta is either vestigial or terminates in the costa; hind tarsi with first joint longer than second..... 53

Alular edge of wing with feathery bristles; basal cells and discal cell very small, r-m and m-m crossveins in same transverse line, anal cell short and acute, the anal vein reaching margin, medial branches disjoined basally, Sc ending in R_1; postocular cilia present; hind metatarsus shorter than next joint. (**Sciadócera**, (Fig. 584), neotrop., austr.) ..... **SCIADOCERÁTIDÆ**

53. Anterior crossvein (r-m) located beyond basal fourth of wing, discal cell usually separate from second basal, third vein often forked, often four posterior cells, *i.e.* M_2 separate from M_3, Sc vestigial or ending in costa; calypteres minute; eyes usually with a small incision at the antennæ; seriate postocular cilia wanting; antennal style usually terminal; proboscis usually rigid; male genitalia not inflexed; dull colored species, almost never metallic. A large family of over 2000 species, widespread, but principally holarctic and neotropical..... **EMPÍDIDÆ**

a. Anal and discal cells complete, or if either is incomplete the front coxæ are very long and the front legs are raptorial, or else the anal angle of the wing is rectangular..... b

Discal cell united with second basal (Fig. 561), anal cell and anal vein wanting or incomplete, three posterior cells, Sc vestigial or wanting, third vein always simple. (**Tachydrômia, Drápetis**

(Fig. 556b), **Coloboneùra, Micrémpis, Platypálpus** (Fig. 561), **Stílpon, Tachypèza, Tachyémpis**). **TACHYDROMIÌNÆ**

b. Anal angle of wing not projecting, costa weakly but visibly continuing around hind margin of wing, anal crossvein (Cu_1) acute, perpendicular, or rounded, rarely obtusely closing anal cell; front coxæ longer than posterior pairs; proboscis short; eyes broadly separated on the front; mesopleuræ oblique c

Anal angle more or less distinct, if the wings taper uniformly toward base, the mesopleuræ are vertical or the hind margin of the wing is thin; front coxæ not elongate; male often holoptic . . e

c. Front legs raptorial, located well forward, front coxæ subequal to femora in length; radial sector arising closer to anterior crossvein than to humeral crossvein. (**Hemerodròmia, Chelífera** (Fig. 564), **Chelípoda, Colàbris, Drymodròmia, Monodròmia**) . . . . . **HEMERODROMIÌNÆ**

Legs slender, the front pair not distant from the others, the coxæ not long and the femora not thick; radial sector arising nearer base of wing . . . . . d

d. Second antennal joint connected with third by a finger-like projection on inner side; no anal cell: restricted to southern hemisphere. (**Ceratómerus, Icásma**) . . . . . **CERATOMERÌNÆ**

Second antennal joint normal; anal cell present: mostly found about swiftly running brooks and waterfalls. (**Clinócera** (=*Atalánta*), **Boreodròmia, Dolichocéphala, Heleodròmia, Oreothàlia** (Fig. 562), **Synamphótera, Trichopèza, Wiedemánnia**). (*ATALANTÌNÆ*) . . . . . **CLINOCERATÌNÆ**

e. Anal crossvein forming a distinct angle with basal part of anal vein; proboscis rarely longer than head; thorax often highly arched . . . f

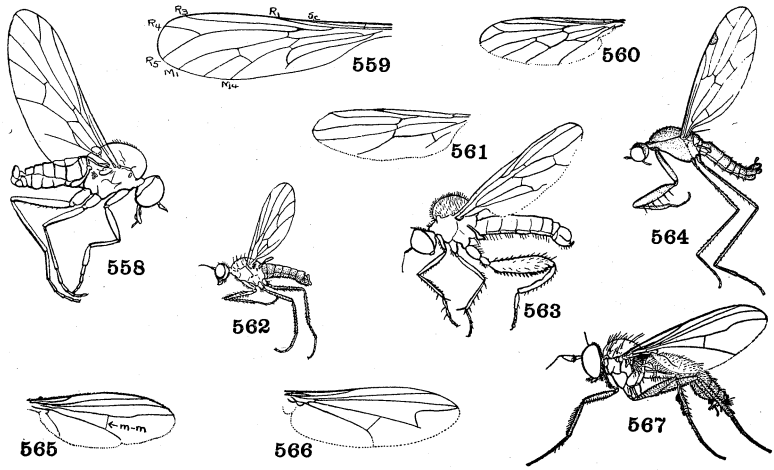
Anal crossvein recurved and confluent with underside of anal cell, the anal vein usually an independent fold; proboscis often long, rarely porrect; antennæ usually three-jointed. (**Émpis** (Fig. 560), **Glòma, Hesperémpis, Hílara, Hilarémpis** (Fig. 558), **Hormopèza, Iteáphila, Micróphorus, Rhamphomỳia**). **EMPIDÌNÆ**

f. Anal cell as long as second basal, or longer, its outer angle acute; Sc distinct . . . . . g

Anal cell shorter than or about as long as second basal cell, its outer angle obtuse or right; Sc weak; proboscis short. (**Ocydròmia, Anthàlia, Bicellària, Euthyneùra, Hoplocýrtoma, Leptopèza, Œdàlea, Trichìna**) . . . . . **OCYDROMIÌNÆ**

g. Discal cell emitting three veins, costa visibly continuing on hind margin; proboscis short and incurved; antennæ three-jointed; thorax not highly arched. (**Brachýstoma** (Fig. 559), **Anomalémpis, Homalocnèmis**). (Including *HOMALOCNEMÌNÆ*). **BRACHYSTOMATÌNÆ**

Discal cell emitting two veins; proboscis rigid, porrect; antennæ two-jointed; thorax greatly arched. (**Hỳbos** (= *Noèza*), **Euhỳbos** (Fig. 563), **Meghỳperus, Lactistomỳia, Sýndyas, Synèches**). (*HYBÓTIDÆ*) ..... **HYBOTÌNÆ**



Figs. 558–567. **Empididæ, Dolichopodidæ**

558. **Hilarempis,** male. Empididæ.
559. **Brachystoma,** wing. Empididæ.
560. **Empis,** wing. Empididæ.
561. **Platypalpus,** wing. Empididæ.
562. **Oreothalia,** male. Empididæ.
563. **Euhybos,** male (Melander) Empididæ.
564. **Chelifera,** male (Melander) Empididæ.
565. **Dolichopus,** wing. Dolichopodidæ.
566. **Psilopodinus,** wing (Aldrich) Dolichopodidæ.
567. **Argyra,** male (Cole) Dolichopodidæ.

Anterior crossvein located within basal fifth of wing (Fig. 566), discal cell always confluent with second basal, third vein never forked, three posterior cells, *i.e.* M_1 and M_2 fused, Sc when complete ending in R_1; calypteres rather large and fringed; a row of postocular cilia present; proboscis almost always soft; male genitalia more or less inflexed under abdomen; color usually metallic green. A large family of over 2000 species, widespread, principally holarctic and neotropical.. **DOLICHOPÓDIDÆ**

a. Fourth vein typically broken, the front fork widely diverging and angulately approaching the third vein (Fig. 566); head short and broad, occiput concave, vertex sunken, ocellar triangle prominent; hypopygium free, its appendages visible; slender species with short and broad thorax, long narrow abdomen and long slender legs. (**Scìopus, Chrysosòma, Leptorèthrum, Mesórhaga, Psilopodìnus** (Fig. 566), **Tenùopus**). (*AGONOSOMATÌNÆ, LEPTOPODÌNÆ, PSILOPODÌNÆ, SCIAPODÌNÆ*) ..... **CHRYSOSOMATÌNÆ**

Fourth vein not angulately fractured though sometimes bowed; vertex not sunken; thorax longer than broad..... b

b. First antennal joint bare, or if exceptionally hairy then the occiput is concave and fitting against the thorax, or the palpi are broad, or the hypopygium is not free..... c

First antennal joint pubescent; occiput convex; face of male usually narrow and with only a weak indication of a transverse impression; palpi small; alar callus present; hind crossvein distant from margin; middle tibiæ with an apical set of five bristles; hypopygium large, rather free, with evident and often large lamellæ; robust and bristly species. (**Dolíchopus** (Fig. 556a, 565), **Hercóstomus, Orthochile, Paraclius, Pelastoneùrus, Tachýtrechus**) ..... **DOLICHOPODÌNÆ**

c. Proboscis stout, with an incurved hook; coxæ spined; front femora basally with two divergent spine-like bristles; maritime species. (**Aphrosỳlus, Teneríffa**) ..... **APHROSYLÌNÆ**

Proboscis not furnished with a hook-like piercing organ; coxæ and front femora not so spined..... d

d. Face usually broad, with evident transverse impression..... e

Face usually narrow, with an incomplete transverse impression, which is sometimes entirely wanting, at least in male..... h

e. Arista dorsal; postvertical bristles evident; palpi usually very broad, applied against proboscis; occiput usually convex; hypopygium small, not free, with small to large appendages.... f

Arista apical or subapical; postverticals minute or wanting; occiput concave; thorax with a prescutellar bare, flattened area; hypopygium long, without long evident appendages; alar callus not distinct. (**Medètera, Oligochætus, Thrýpticus; Saccopherónta,** ethiop.) ..... **MEDETERÌNÆ**

f. Hind crossvein nearly parallel with hind margin of wing, fourth vein bent forward and ending before wing-tip; upper occiput concave; no acrostichal bristles; hypopygium sunk into sixth segment. (**Plagioneùrus,** America). **PLAGIONEURÌNÆ**

Hind crossvein nearly transverse, located close to hind margin of wing, the distal segment of fifth vein short..... g

g. Acrostichal bristles absent. (**Thinóphilus, Eucóryphus, Peòdes, Schænóphilus,** ethiop.) ..... **THINOPHILÌNÆ**

Acrostichals present. (**Hydróphorus, Liáncalus, Orthocerà-tium, Scéllus**) ..... **HYDROPHORÌNÆ**

h. Third antennal joint usually long and narrow, with apical arista, second joint transverse; occiput convex; middle tibiæ with apical ring of bristles; hypopygium long and free. (**Rhàphium, Eutársus, Machærium, Syntórmon, Sýstenus, Xiphán-drium**) ..... **RHAPHIÌNÆ**

Third antennal joint triangular or spherical, short, rarely somewhat lengthened with dorsal arista..... i

i. Hypopygium large and free, appendages more or less conspicuous; thorax short, scarcely longer than broad, with prescutellar area; abdomen long; legs slender and without set of apical bristles on middle tibiæ. (**Neurigòna, Oncopỳgius**)... **NEURIGONÌNÆ**

Hypopygium usually small, rarely free, often hidden, the appendages never large though visible from beneath..... j

j. Abdomen and legs elongate; antennæ located very high; ocellar triangle prominent; no pulvilli; hind margin of first abdominal segment raised. (**Stolidosòma,** neotrop.). **STOLIDOSOMATÌNÆ**

Abdomen short and robust; thorax longer than broad; middle tibiæ tipped with set of bristles..... k

k. Occiput rather concave; arista dorsal or subapical; hypopygium cap-shaped or hemispherical, usually with four or more strong bristles and only rarely with distinct appendages; body bristly, usually apex of abdomen furnished with bristles. (**Diáphorus, Árgyra** (Fig. 567), **Asýndetus, Chrysòtus, Leucóstola**). **DIAPHORÌNÆ**

Occiput convex; third antennal joint short-triangular, pubescent, with dorsal arista; face of male narrow; hypopygium small, rarely free and with appendages; usually small, weakly bristly species, the apex of abdomen without bristles..... l

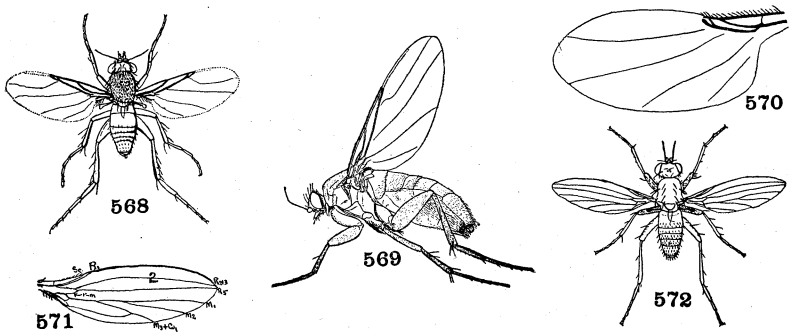
l. Acrostichals wanting. (**Xanthochlòrus, Chrysotìmus, Lamprochròmus; Micromórphus,** ethiop.). **XANTHOCHLORÌNÆ**

Acrostichals present, in one or two more or less evident rows. (**Campsicnèmus, Sympýcnus, Syntormoneùra**). **CAMPSICNEMÌNÆ**

Suborder Brachycera, Section Cyclorrhapha

54. Radial veins stout, running into the costa near middle of wing, medial veins weak and extending obliquely across wing, no crossveins and therefore no basal cells (Fig. 570); antennæ placed

low, apparently single-jointed because the minute basal joints are set in a cavity of the third joint, provided with a long, apical or subdorsal, three-jointed arista; palpi projecting, not jointed; hind legs long, their femora compressed; first and second abdominal segments separate; small, humpbacked, quick-running flies of characteristic form. Widespread, many species, mostly holarctic; including most myrmecophilous genera of flies, some of which are specialized and degenerate forms. (See couplet 155). HYPÓCERA ..... **PHÓRIDÆ**



Figs. 568–572. **Phoridæ, Lonchopteridæ**

568. **Paraspiniphora** (Verrall) Phoridæ.
569. **Chætoneurophora** (Cole) Phoridæ.
570. **Megaselia,** wing. Phoridæ.
571. **Lonchoptera,** wing of female. Lonchopteridæ.
572. **Lonchoptera,** male (Verrall) Lonchopteridæ.

a. Propleuræ lateral in position, visible from the sides, prothoracic spiracle not visible from above. ..... b
Propleuræ small, anterior in position, the humeri formed by the mesonotum, prothoracic spiracle visible from above; female usually wingless; ant-guests. (**Platýphora** (=*Ænigmàtias*), **Ænigmatístes, Psyllomỳia**). (*ÆNÍGMATÌINÆ*). **PLATYPHORÌNÆ**

b. Tibiæ usually with one or several long preapical bristles; lower frontal bristles when present curving obliquely upward; mesopleuræ usually undivided; both sexes winged. (**Phòra** (=*Trineùra*), **Chætoneuróphora** (Fig. 569), **Conícera, Diploneùra, Hypócera, Paraspiníphora** (Fig. 568).. **PHORÌNÆ**
Tibiæ without any long preapical bristles, bare or ciliate on the

edge; two or four supra-antennal proclinate bristles; female often wingless or with aborted wings. (**Metopìna, Apocéphalus, Chonocéphalus, Gymnóphora, Ecitomỳia, Megasèlia** (=*Aphiochæta*) (Fig. 570), **Pulicíphora** (=*Stethópathus*), **Rhyncophoromỳia, Syneùra**). (*PULICIPHÓRIDÆ, STETHOPÁTHIDÆ*) ..... **METOPINÌNÆ**

Wings rather pointed at tip, lanceolate (Fig. 571,) costa encompassing entire wing, basal cells very small, second vein (R_3) ending almost at wing-tip, anterior crossvein not obvious, no discal cell, the three branches of media arising from a common stalk from the apex of the second basal cell, Cu_1 of female curving forward and ending in M_4 at middle of wing-length, thus forming an apparent anal cell (Fig. 571), of male short and reaching hind margin (Fig. 572), veins largely setulose above; oral margin bristly; third antennal joint rounded, with a long subterminal bristle; thorax with bristles but no hairs. Principally palæarctic, few species, females rare. (**Lonchóptera** (Figs. 571, 572) (=*Musidòra*)). (*MUSIDÓRIDÆ*).

LONCHOPTÉRIDÆ

55. Proboscis small, very rarely elongated; front never as broad as the width of the eye, no functioning lunule suture above antennæ, eyes of male usually meeting; face without subantennal grooves 56

Proboscis distinctly longer than head, slender, stiff and often folding (Fig. 578); head wider than thorax, front broad in both sexes; face with a groove or grooves under the porrect antennæ, buccal cavity large; no body bristles; abdomen clavate, deflexed at tip; first posterior cell pointed, anterior crossvein near middle of discal cell. Widespread, about 500 species; parasitic on wasps, bees and Orthoptera. (See couplet 80).

CONÓPIDÆ

a. Vertex and tibiæ without bristles; anal cell rather long and pointed; ovipositor not excessively long ..... b

Vertex with bristles, tibiæ spurred; anal cell small; ovipositor very long; proboscis long and geniculate; third antennal joint with subdorsal arista. (**Stylogáster**, mainly neotrop.).

STYLOGASTRÌNÆ

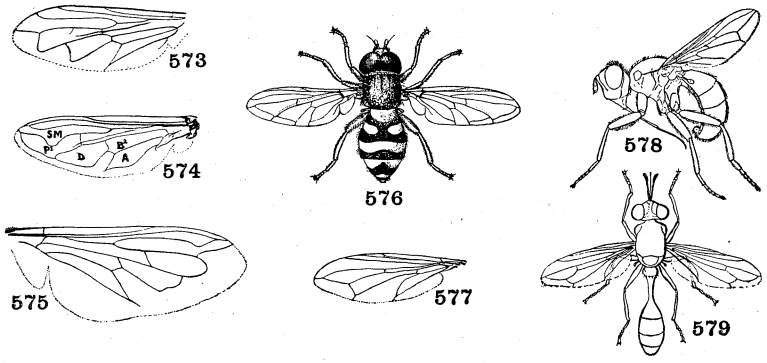
b. Third antennal joint with dorsal two-jointed arista; proboscis usually hinged at middle, the distal part folding back; ocelli present c

Third antennal joint with short apical style; ocelli usually vesti-

gial; proboscis directed forward, not geniculate at middle; abdomen constricted toward base. (**Cònops** (Fig. 577), **Physocéphala** (Fig. 579), **Tropidomŷia**) ..... **CONOPÌNÆ**

c. Anal cell equal to second basal cell; ovipositor large and folding forward under abdomen. (**Dalmánnia** (Fig. 578)). **DALMANNIÌNÆ**

Anal cell much longer than second basal; ovipositor not extending forward under abdomen. (**Myòpa, Sìcus, Thecomŷia** (=*Oncomyia*), **Zòdion**) ..... **MYOPÌNÆ**



Figs. 573–579. **Syrphidæ, Conopidæ**

573. **Microdon,** wing (Williston) Syrphidæ.
574. **Eristalis,** wing. Syrphidæ.
575. **Copestylum,** wing. Syrphidæ.
576. **Syrphus,** male (Metcalf) Syrphidæ.
577. **Conops,** wing. Conopidæ.
578. **Dalmannia,** male (Cole) Conopidæ.
579. **Physocephala** (Lugger) Conopidæ.

56. First posterior cell (R_5) open, though sometimes narrowed, no extra vein crossing the anterior crossvein (r-m). (If the anal cell is narrowly open at the margin see Bombyliidæ, Cyrtosiinæ, couplet 48, j) 57

First posterior cell (R_5) closed (Fig. 574), usually an extra vein between the third (R_5) and fourth (M_1) veins and crossing the anterior crossvein (r-m); costa continuing around margin or stopping at wing-tip; anal cell closed just before wing-margin, therefore short-petiolate, the vein closing discal cell parallel with margin; head and body usually without bristles; arista dorsal,

very rarely terminal; male usually holoptic; ocelli always present. Characteristically showy flower-flies with yellow markings; quick fliers and good hoverers; cosmopolitan, about 3000 species ..... **SŸRPHIDÆ**

a. Antennæ elongate, porrect ..... b
Antennæ moderate in length, drooping, if elongate and porrect not placed on a produced front ..... e

b. First posterior cell without stump of a vein from the third vein .. c
First posterior cell with a stump of a vein from the third vein which almost divides the cell into two ..... d

c. Antennæ inserted on a strong frontal process; a single red abdominal band. (**Psàrus**) ..... **PSARÌNÆ**
Antennæ inserted on the flattened front; abdomen marked with several reddish bands. (**Chrysotóxum**) .. **CHRYSOTOXÌNÆ**

d. Arista dorsal; face rounded and pilose; scutellum usually armed and emarginate; sometimes antennæ of male split into two or four parts; larvæ and pupæ developing in ant nests. (**Mìcrodon** (Fig. 573), **Mixogáster, Rhopalosŷrphus**). (Including *MASARŸGIDÆ*, neotrop., with antennæ of male split into lobes) ..... **MICRODONTÌNÆ**
Style terminal, antennæ on frontal processes; face not with abundant pile. (**Ceriòides** (=*Cèria*, = *Sphyxímórpha*)) ... **CERIOIDÌNÆ**

e. Anterior crossvein located before middle of discal cell, nearly always rectangular ..... f
Anterior crossvein near or beyond middle of discal cell, usually oblique ..... n

f. Wholly black or metallic tinted species, if abdomen is spotted with yellow, the facial profile is parallel with eye-margin and face and eyes are pubescent; front of mesonotum pubescent ..... g
Pale color marks present on head, thorax and abdomen i

g. Antennæ with terminal bristle. (**Callícera**) . **CALLICERATÌNÆ**
Antennæ with dorsal arista ..... h

h. Third antennal joint very large, orbicular, thick; abdomen concave below, genitalia entirely hidden from dorsal view. (**Nausigáster**) ..... **NAUSIGASTRÌNÆ**
Third antennal joint smaller; abdomen not strongly concave below, the genitalia usually largely visible from above. (**Chilòsia, Chrysogáster, Cnèmodon, Heríngia, Orthoneùra, Pipìza, Psilòta**) ..... **CHILOSIÌNÆ**

i. Lower part of face strongly projecting ..... j
Lower part of face not strongly projecting l

j. Face distinctly projecting conically downward; third antennal joint stout, with thickened three-jointed arista. (**Pelecócera, Chamæsŷrphus**) ..... **PELECOCERATÌNÆ**

Face not projecting downward, but strongly produced forward; third antennal joint not stout and not with thickened arista. . k

k. Alula very small; abdomen clavate; hind femora thickened. (**Sphegìna, Neoáscia**) ..... **SPHEGÌNÆ**

Alula normal; abdomen short, not constricted at base. (**Brachyòpa, Rhíngia**) ..... **BRACHYOPÌNÆ**

l. Humeral calli and the region between them destitute of pile; marginal cell open, vein closing first posterior cell usually parallel with margin; arista bare or pubescent..... m

Humeral calli and the interhumeral region more or less pilose; marginal cell closed, vein closing first posterior cell distally recurrent; arista heavily plumose; hind coxæ with hair behind. (**Volucélla** (Fig. 556c), **Copestỳlum** (Fig. 575), **Temnócera**). **VOLUCELLÌNÆ**

m. Abdomen elongate, basally narrow. (**Báccha, Dòros, Spathiogáster**) ..... **BACCHÌNÆ**

Abdomen oval, not narrow at base nor clavate. (**Sýrphus** (Fig. 576), **Dídea, Eriozòna, Leucozòna, Melanóstoma, Páragus, Platychìrus, Pyrophæna, Sphærophòria, Xanthogámma**) ..... **SYRPHÌNÆ**

n. Third vein bending deeply into first posterior cell (Fig. 574); femora with conspicuous patch of black spinules near base. (**Erístalis** (Fig. 574), **Arctosýrphus, Helóphilus, Mallòta, Megáspis, Mèrodon** (=*Lampètia*) (*M. equêstris*, Narcissus bulb-fly)) ..... **ERISTALÌNÆ**

Third vein not bending deeply into first posterior cell..... o

o. Arista plumose. (**Arctóphila, Conosýrphus, Pararctóphila, Sericomỳia** (=*Cínxia*)). (*CINXIÌNÆ, SERICOMYIÌNÆ*). **ARCTOPHILÌNÆ**

Arista bare or pubescent..... p

p. Apical crossvein recurrent, usually with a stump of a vein at the angle. (**Eumèrus**) ..... **EUMERÌNÆ**

Apical crossvein oblique, at most very slightly recurrent at apex. q

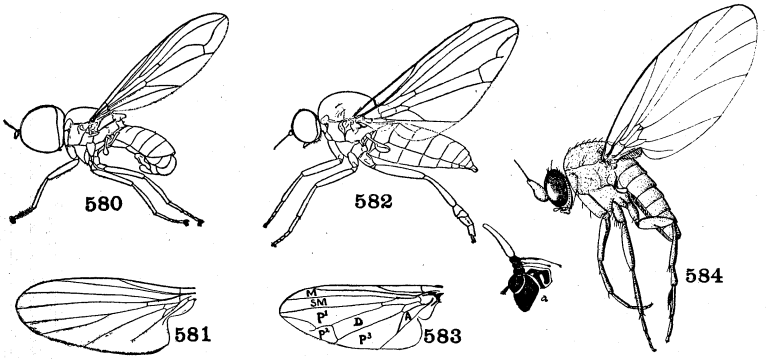
q. Marginal cell closed and petiolate. (**Milèsia**) .... **MILESIÌNÆ**

Marginal cell open. (**Xylòta** (=*Zêlima*), **Brachypálpus, Calliprόbola, Cynorrhìna, Criorrhìna** (=*Penthesílea*), **Myiolépta, Sphecomỳia, Spilomỳia, Syrítta, Temnóstoma, Tropídia**) ..... **XYLOTÌNÆ**

57. Proboscis firm, styliform, porrect or short; male genitalia terminal, more or less asymmetrical; subcosta evanescent, not reaching costa, anal angle of wing more or less rectangular, no alula, costa interrupted at fourth vein; arista usually thread-like and terminal (Fig. 563). (Subfamily Hybotinæ, see couplet 53, g). **EMPÍDIDÆ**, part

Proboscis very small and soft; male genitalia forming a hypopygium inflexed under the abdomen; subcosta complete, ending in costa 58

58. Antennæ with terminal arista; face small and broad; anal angle of wing more or less full, basal cells small, second basal much shorter than discal cell; hind tibiæ and tarsi dilated, especially in male; head and thorax with bristles; female sometimes bright-colored. About 100 species, principally holarctic, some nearctic, indoaustralian and ethiopian. (**Platypèza** (=*Clýthia*) (Fig.



Figs. 580–584. **Pipunculidæ, Platypezidæ, Sciadoceratidæ**

580. **Pipunculus,** male (Cole) Pipunculidæ.
581. **Opetia,** wing (Verrall) Platypezidæ.
582. **Calotarsa,** female; *a*, hind tibia and tarsus of male (Cole) Platypezidæ.
583. **Platypeza,** wing. Platypezidæ.
584. **Sciadocera** (Tonnoir) Sciadoceratidæ.

583), **Agathomỳia, Calotársa** (Fig. 582), **Microsània, Opètia** (Fig. 581)). (*CLYTHÌIDÆ*) ..... **PLATYPÉZIDÆ**

Antennæ with dorsal arista; face narrow; legs not dilated; head and body without true bristles; head very large, usually spherical, consisting almost wholly of the eyes; anal angle of wings not developed, second basal cell subequal to discal cell in length; anal cell closed near margin; ovipositor large, with bulbous base and long sword-like point, inflexed under abdomen. About 300 species, principally holarctic and australian, some nearctic and ethiopian. (**Pipùnculus** (=*Dórylas*) (Fig. 580), **Chálarus, Nephróceros, Verrállia**). (*DORYLÀIDÆ*). **PIPUNCÙLIDÆ**

Schizophora

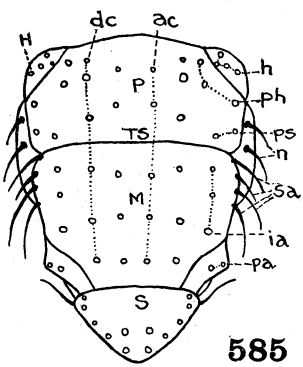
59. Coxæ close together, the legs attached ventrally; head movably separated from thorax; adults not ectoparasites upon mammals, birds or bees; rarely viviparous, in which case the new-born young are very immature. (EUMYÌIDÆ, MUSCÒIDEA, MYIODARIA) 60

Coxæ broadly separated from each other, the legs appearing attached toward the sides of the thorax and therefore sprawling (Fig. 663); head often small and closely united with body, the eyes more or less reduced, often wholly wanting, ocelli wanting or vestigial; adults usually much flattened, of a leathery or horny structure, often wingless, living parasitically upon warm-blooded vertebrates or upon the honey bee; viviparous, the new-born larvæ well developed, ready for pupation, Braulidæ oviparous in bee-hives. (PUPÍPARA, EPROBOSCÍDEA, OMALÓPTERA, NYMPHÍPARA) 138

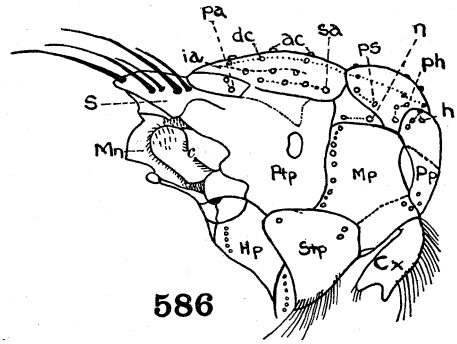
60. Second antennal joint with a longitudinal seam along upper outer edge which extends quite to the base; anterior orbits not differentiated above from the lateral vertex plates, bearing a row of convergent lower frontal bristles which are more distant from eye-margin than the upper frontal bristles are (Fig. 594); usually at least lower calypter large; posthumeral and intra-alar bristles usually both present; thorax with a complete transverse suture before wings (Fig. 585); front of male usually narrow or the eyes meeting; subcosta always distinct and ending in costa, first vein (R_1) never short (Fig. 598); abdominal spiracles at least of segments two to five located in side margins of tergites, very rarely in the membrane. (CALYPTRATÆ, MUSCARIDÆ, MYODARIA SUPERIÒRA, THECOSTÓMATA) 61

Second antennal joint without such a seam (except *Loxocera*, couplet 124); anterior orbits usually separated above from lateral vertex plates, or the latter alone developed and bearing fronto-orbital bristles (if exceptionally the fronto-orbital bristles are located on the orbits the lower ones are closer to the eye-margin than the upper ones are); lower calypter vestigial or undeveloped; posthumeral bristles absent; thorax without a complete transverse suture in front of wings, posterior callosity usually absent; a visible membrane connecting the dorsal and ventral sclerites of the abdomen, in which the spiracles are nearly always located (if spiracles are in tergites, *e.g.* Chlorop-

idæ and Ephydridæ, the subcosta is imperfect); front of both sexes of nearly equal width, or if wider in female the greater width is due to a widening of the middle stripe; fourth vein (M_1) nearly straight, never angulate or with an appendage; often very small species. (ACALYPTRATÆ, BORBORÒIDEA, HAPLOSTÓMATA, MYODARIA INFERIÒRA).....71



585



586

Figs. 585, 586. **Calliphoridæ**

585. **Calliphora,** thorax, dorsal view (Walton) Calliphoridæ.

586. **Calliphora,** thorax, lateral view (Walton) Calliphoridæ.

Sclerites: Cx, front coxa; H, humerus; Hp, hypopleura; M, posterior portion of mesonotum (metazona); Mp, mesopleura; Mn, metanotum; P, anterior portion of mesonotum (prozona); Pp, propleura; Ptp, pteropleura; S, scutellum; Stp, Sternopleura.

Bristles: ac, acrostichals; dc, dorsocentrals; h, humerals; ia, intra-alars; n, notopleurals; pa, post-alars; ph, posthumerals; ps, presutural; sa, supra-alars.

c, calypteres; TS, transverse suture separating prozona from metazona.

61. Mouthparts functional; usually with sternopleural bristles at least, often very bristly species.....62

Mouth-opening small, the mouthparts vestigial or wanting; vibrissæ and bristles undeveloped, no sternopleural bristles; front broad in both sexes; antennæ set in the facial groove or grooves; lower calypter with margin only slightly pubescent. **ŒSTRIDÆ**

a. Head apparently closed below, the small mouth-opening filled by the proboscis with which it is connected by a membrane, mouth-

parts atrophied or even wanting, the proboscis never angled at base; arista always bare. . . . . b

Head with a deep groove beneath, mouthparts present, proboscis angled at base, withdrawn in the oral groove, palpi not visible; arista bare or plumose. (*CUTERÉBRIDÆ*) . . . . . d

b. Middle part of face narrow; hypopleuræ with fan of strong hairs. (**Œstrus** (Fig. 590), cosmop., in nasal cavities of sheep, antelope, etc.; **Cephalomŷia,** S. Eur., N. Afr.; **Pharyngomŷia,** Eur., in pharynx of elk; **Rhinœstrus,** Eurasia, Afr., in nasal cavities of horse and hippopotamus) . . . . . **ŒSTRÌNÆ**

Middle part of face broad. c

c. Middle part of face deeply sunken; hypopleuræ without hairs. Elephant stomach bots. (**Cobbóldia** (Fig. 591), **Rodhainomŷia,** ethiop.) . . . . . **COBBOLDIÌNÆ**

Middle part of face forming a slightly convex plate; hypopleuræ with bundle of hairs. Warbles, widespread, occurring under skin of host. (**Hypodérma,** in ruminants; **Œdemágena,** in reindeer; **Œstromŷia,** in rodents) . . . . **HYPODERATMÌNÆ**

d. No facial carina; antennal pit large and deep; antennæ elongate, the third joint three times as long as second. . . . . e

Facial carina present; antennal pit small and shallow; antennæ short. Rodent parasites, mostly American. (**Cutérebra** (Fig. 589), **Bogèria, Rogenhòfera**) . . . . . **CUTEREBRÌNÆ**

e. Epistoma rather broad, projecting obliquely forward and downward between sides of face; arista thickly long-plumose to tip. (**Pseudogamètes,** neotrop.) . . . . . **PSEUDOGAMETÌNÆ**

Epistoma very narrow, projecting straight downward between the sides of face; arista with hairs on upper side only. (**Dermatòbia,** neotrop., under skin of mammals, including man). **DERMATOBIÌNÆ**

62. Hypopleuræ and pteropleuræ with one or more vertical rows of bristles or hairs (Fig. 586); fourth vein (M_1) curving or bending forward, narrowing or closing first posterior (apical) cell, often with a spur (M_2) at the bend (Fig. 598); when three sternopleural bristles present usually but one behind. (TACHINÒIDEA) 63

Hypopleuræ without a vertical series of strong bristles below spiracle, if rarely the hypopleural bristles are present there is no row of bristles on pteropleura (in *Stomoxys,* which has a porrect rigid proboscis (Fig. 602), both hypopleural and pteropleural hairs are present); when three sternopleural bristles present usually two behind; ventral membrane usually distinct; postscutellum not developed convexly. 68

63. Postscutellum little developed, not convexly prominent (Fig. 586), if more or less prominent the metathoracic spiracular covering is not in two parts but covers the entire lower portion, leaving a small opening in middle above; middle segments of abdomen rarely with rather strong hairs; second ventral segment of abdomen more or less overlapping edges of the dorsal segments 64

Postscutellum strongly developed in the form of a transverse rounded ridge often projecting as far as apex of scutellum; dorsal segments of abdomen with strong bristles in addition to finer hairs, their edges overlapping all the ventral segments 66

64. Hindmost posthumeral bristle located lateral to the presutural bristle (Fig. 585) (sometimes absent in *Engyzops*); propleura and prosternum hairy (bare in *Pollenia* (Fig. 600) which has matted metallic hairs on mesonotum); generally two notopleural bristles, rarely three; arista generally long-plumose; body usually metallic blue or green; fifth ventral segment of male with a split hind margin, sometimes prominently developed; eyes of male touching or approximated, of female separated. Cosmopolitan ..... **CALLIPHÓRIDÆ**

a. Cheeks narrow, about one-fifth eye-height; arista plumose to end; curve of fourth vein broadly rounded, basal vein sometimes setose; metathoracic spiracle with its front and back ends equally rounded; postscutellum usually well developed. (**Mesembrinélla**, neotrop.) ..... **MESEMBRINELLÌNÆ**

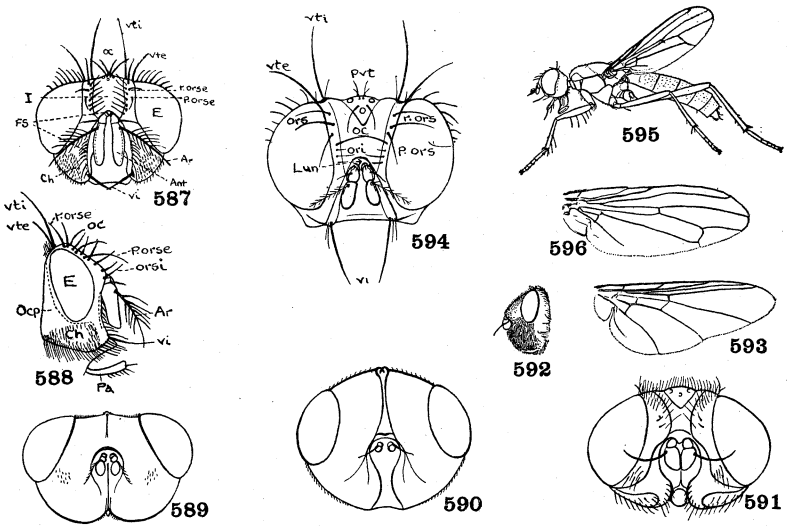
Cheeks subquadrate, about half the eye-height; curve of fourth vein usually angulate; postscutellum not strongly developed..b

b. Basal section of radius with distinct setulæ or hairs on posterior upper side c

Basal vein not setulose on posterior upper side.....d

c. Lower calypter subtruncate at apex, concave on outer margin, haired on part of upper surface; the small rounded callosity below base of wing often with erect hairs. (**Phórmia, Chrysomỳia, Cochliomỳia** (*C.* (*Compsomyia*) *macellària*, Screw-worm), **Protocallíphora** (maggots on nestling birds), **Protophórmia**). (*CHRYSOMYIÌNÆ*) ..... **PHORMIÌNÆ**

Lower calypter rather narrowly rounded at apex, nearly straight on outer margin, bare above; subalar callosity bare or without distinct hairs. (**Rhínia, Metállea, Rhyncomỳia, Stomatorhìna**) ..... **RHINIÌNÆ**



Figs. 587–596. **Calliphoridæ, Œstridæ, Gastrophilidæ, Cordyluridæ**

587. **Calliphora,** head from front (Walton) Calliphoridæ: Ant, antenna; Ar, arista; Ch, cheek; E, eye; FS, frontal suture; I, interfrontalia; Ocp, occiput; Pa, palpus; oc, ocellar bristles; orsi, inner row of upper orbital bristles; p. orse, proclinate bristle in outer row of upper orbitals; r. orse, reclinate bristles in outer row of upper orbitals; vi, vibrissæ; vte, exterior vertical bristle; vti, inner vertical bristle.

588. **Calliphora,** profile of head (Walton) Calliphoridæ. Lettering as for Fig. 587.

589. **Cuterebra,** head from front. Œstridæ.

590. **Œstrus,** head from front. Œstridæ.

591. **Cobboldia,** head from front (Rodhain and Bequaert) Œstridæ.

592. **Gastrophilus,** head from side (Cole) Gastrophilidæ.

593. **Gastrophilus,** wing (Cole) Gastrophilidæ.

594. **Cordylura,** head from front. Cordyluridæ: Lun, frontal lunule; ori, lower set of fronto-orbital bristles; ors, upper set of fronto-orbitals; p.ors, proclinate bristle of upper set; pvt, postverticals; r.ors, reclinate fronto-orbital bristles of upper set; vi, vibrissæ; vte, outer vertical bristle; vti, inner vertical bristle.

595. **Parallelomma,** female (Cole) Cordyluridæ.

596. **Scatophaga,** wing. Cordyluridæ.

d. Prosternum and propleura hairy; hairs of parafacial stripe not reaching lower margin of eyes. Blow-flies, Blue-bottle flies. (**Callíphora** (Figs. 585–588), **Cynomỳia, Lucília, Onèsia**). **CALLIPHORÌNÆ**

Prosternum and center of propleura bare; parafacial hairs extending to lower margin of eyes. (**Pollènia** (*P. rùdis*, Clusterfly (Fig. 600); **Anthracomỳia**, austr.) ..... **POLLENIÌNÆ**

Hindmost posthumeral bristle placed higher than or level with the presutural bristle; propleura and prosternum bare, thorax not with matted hairs, often four notopleural bristles; arista bare or hairy on basal half; eyes not contiguous, front of male narrow, or as wide as in female.....65

65. Calypteres large and round, reaching scutellum; fifth ventral segment of male abdomen with a straight hind margin, or entirely absent; arista generally plumose only on basal half, sometimes bare; eyes bare. Flesh-flies ..... **SARCOPHÁGIDÆ**

a. Head quadrangular in profile; arista usually plumose, rarely only pubescent; third and fourth sternites more or less evident, though not completely covering the margins of the tergites; theca of penis rarely with spine; front of male usually more or less narrow and without orbital bristles; more than two sternopleural bristles present (see Fig. 586, stp.). Larvæ of most species feeding on carrion, some parasitic on grasshoppers. (**Sarcóphaga, Àgria, Brachỳcoma, Helicòbia, Blæsóxipha, Ravínia, Sarcóphila, Sarcotáchina, Tephromỳia, Wohlfártia**) ..... **SARCOPHAGÌNÆ**

Head not quadrangular in profile; third and fourth sternites less evident, covering margins of tergites; theca of penis usually with spine; arista bare or with very short pubescence; two sternopleural bristles present; front often with orbital bristles.b

b. Middle tibiæ near the middle with a single extensor bristle; cheeks rather narrow, eyes large, front of both sexes of nearly equal breadth; arista sometimes with weak pubescence; third and fourth sternites completely covered. Larvæ feeding on supplies stored in nests of various bees and wasps. (**Miltográmma, Apódacra, Craticùlina, Hilarélla, Metòpia, Opsídia, Pediasiomỳia, Pachyophthálma, Senotaínia**). (*METOPIÌNÆ*) ..... **MILTOGRAMMATÌNÆ**

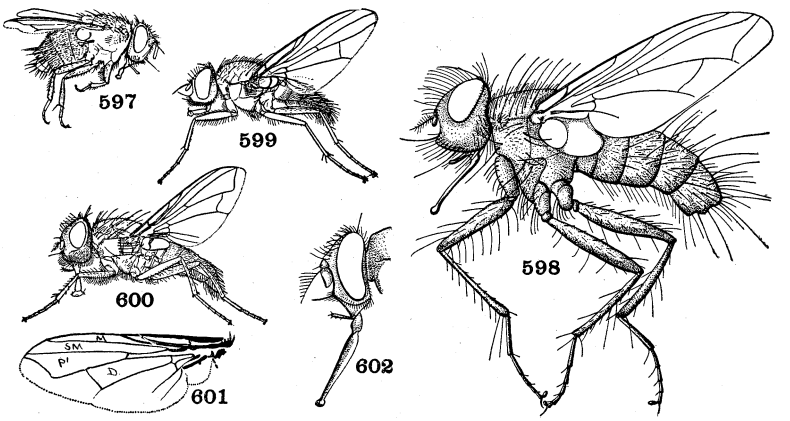
Middle tibiæ with at least two bristles near the middle; eyes small, cheeks broad, face broader than vertex, front of female broader than of male; arista bare.....c

c. Antennæ very short; genitalia large; sternites two to five large, open; eyes very small. (**Paramacronỳchia, Nemoræa**, Eur.). **PARAMACRONYCHIÌNÆ**

Antennæ normal; genitalia small; sternites two to five more or less covered ..... d

d. Tergites three and four with discal macrochætæ, body bristly; eyes pubescent; theca fused with penis, forceps long. (**Rhaphiochæta, Brachymèra,** Eur.) ..... **RHAPHIOCHÆTÌNÆ**

Tergites three and four without discal machrochætæ, body with short bristles; eyes bare; theca free, penis without membrane. (**Amòbia**) ..... **AMOBIÌNÆ**



Figs. 597–602. **Tachinidæ, Dexiidæ, Anthomyiidæ, Muscidæ, Calliphoridæ**

597. **Belvosia.** Tachinidæ.
598. **Ptilodexia.** Dexiidæ.
599. **Limnophora** (Cole) Anthomyiidæ.
600. **Pollenia** (Cole) Calliphoridæ.
601. **Musca,** wing. Muscidæ.
602. **Stomoxys,** head. Muscidæ.

Calypteres narrow, with the inner edge generally bending away from scutellum; fifth ventral segment of male split to the middle; arista pubescent; eyes sometimes hairy. Larvæ parasitic on sowbugs, snails, beetles, etc. (**Rhinóphora, Macquártia, Melanóphora, Phỳto**) ..... **RHINOPHÓRIDÆ**

66. Ventral membrane more or less evident between the reduced sternites and the margins of the tergites, if not the abdomen is elongate cylindrical (*Cylindromyia* = *Ocyptera*), or the

female abdomen is tipped by an under-folded claw (*Phania*); abdomen destitute of stout bristles; facial plate more or less convexly produced nose-like below the vibrissal angles and fused with the lowest part (epistome). Larvæ parasitic on bugs and beetles. (**Phàsia, Alóphora, Cystogáster, Clytiomŷia, Gymnosòma, Leucóstoma, Phorántha, Trichópoda**). (Including *GYMNOSOMÁTIDÆ* with four, not five, abdominal segments) ..... **PHASÌIDÆ**

Ventral membrane not visible; abdomen bearing some stout bristles; facial plate flattened, at most slightly produced. . . . 67

67. Antennæ inserted usually at or below middle of eyes, the arista usually hairy; no presutural intra-alar bristle; ventral segments of abdomen concealed below the meeting edges of the tergites; legs often relatively long. Larvæ parasitic in beetles. (**Déxia, Myiócera, Ptilodéxia** (Fig. 598), **Rhynchodéxia, Thelaìra, Therèsia**) ..... **DEXÌIDÆ**

Antennæ inserted above middle of eyes, the arista usually bare, rarely short-pubescent (Fig. 556d); intra-alar bristles usually extending in front of suture, if not the ventral segments broadly visible, or the fifth ventral of male is vestigial; at least two posthumeral and three posterior intra-alar bristles. Tachina flies. Larvæ mostly endoparasitic in caterpillars and other insects. (**Táchina** (=*Larvœvora*), **Áphria, Árchytas, Belvòsia** (Fig. 597), **Ernéstia, Exorísta, Frontìna, Gònia** (Fig. 556d), **Masícera, Phorócera, Peletèria, Siphòna, Stúrmia, Winthemia, Zenílllia**). (Including EXORÍSTIDÆ, MASICÉRIDÆ, HISTRICÌIDÆ, etc.). (*LARVÆVÓRIDÆ*). **TACHÍNIDÆ**[1]

68. Fourth vein (M_1) often bending forward to narrow the apical cell at the margin (Fig. 601); if the apical cell is not narrowed then the eyes are not widely separated, or cruciate bristles are present on the front, and the lower calypter is longer than the upper, and the abdomen proper contains only five segments; if the eyes are widely separated (the females and some males) the oval,

[1] This dominant group has been divided by several taxonomists into about sixty so-called families, which do not have the rank of the dipterous subfamilies presented in the previous portions of the key. Because the limits of these groups have not been agreed on by the students of the muscoid flies and because there is no satisfactory published key no attempt is here made to present subdivisions of the Tachinidæ. Even the distinctions between the conventional families Dexiidæ and Tachinidæ have broken down of recent years with the discovery of annectant genera. Perhaps the best solution is to consider but two subfamilies, Dexiinæ and Tachininæ, with a unique army of legions, cohorts and tribes of genera comprising the latter. (See page 9).

more or less bristly abdomen is distinctive; scutellar suture complete. (MUSCÒIDEA) 69

Apical cell not narrowed at margin (Fig. 596); no cruciate frontal bristles; eyes broadly separated in both sexes; lower calypter not longer than the upper; scutellar suture interrupted in the middle; abdomen more or less elongate, with six segments before the genitalia (the first two fused together, as usual). (*SCATOMÝZIDÆ, SCATOPHÁGIDÆ, SCOPEÙMIDÆ*).

CORDYLÙRIDÆ

a. Front femora and tibiæ beneath at most with a single row of bristles. b

Front legs raptorial, their femora beneath with a double row of bristles, front tibiæ with one or two rows; first vein bare above. (**Noréllia, Plethochæta, Pycnoglóssa**) ..... **NORELLIÌNÆ**

b. First vein usually setose above; propleural bristle present. (**Cordylùra** (Fig. 594), **Acicéphala, Hexamitócera, Megophthálma, Orthochæta, Parallelómma** (Fig. 595)).

CORDYLURÌNÆ

First vein bare above; propleural bristle absent. (**Scatóphaga** (=*Scopeùma*) (Fig. 596), **Acanthocnèma, Hydromỳza, Microprosòpa, Pogonòta, Spathióphora, Tricopálpus**). (*SCOPEUMÌNÆ*) ..... **SCATOPHAGÌNÆ**

69. Either the hypopleural or pteropleural bristles or hairs present (Fig. 586); basal bristles of abdomen reduced; fourth vein bending or curving forward (straight in *Eginia*); arista feathered to tip . . 70

Neither the hypopleural nor pteropleural hairs or bristles present; abdomen usually bristly; fourth vein curving backward (if curving forward the arista is not feathered to the tip); arista sometimes bare (Fig. 599) ..... **ANTHOMYÌIDÆ**

a. Anal vein complete, faint apically but reaching margin ..... b

Anal vein not distinctly traceable to margin c

b. Eyes of male close together on the narrowed front; calypteres large. (**Anthomỳia, Chortóphila, Ègle, Hammomỳia, Hylemỳia** (*H. antíqua*, Onion maggot, *H. brássicæ*, Cabbage maggot, *H. cilicrùra*, Seedcorn maggot, *H. coarctàta*, Wheat bulb fly), **Hydrophòria, Opsolàsia, Pegomỳia** (*P. hyoscyami*, Beet-fly, *P. rubívora*, Raspberry cane maggot), **Phórbia, Pycnoglóssa**). (*HYLEMYIÌNÆ, PEGOMYIÌNÆ*).

ANTHOMYIÌNÆ

Eyes of both sexes widely separated by the broad front; calypteres small. (**Fucéllia, Chiròsia, Mycóphaga, Myopìna**).

FUCELLIÌNÆ

c. Lower sternopleural bristle wanting, or if present, closer to one of the upper sternopleurals than to the other. . . . . d
Lower sternopleural equidistant from the two upper; front in both sexes one-third the width of the head, each orbit with one long backward-directed bristle on upper half; thorax with but one pair of presutural dorsocentral bristles; lower stigmatal bristle directed downward; eyes of both sexes usually widely separated. (**Cœnòsia, Chelísia, Atherígona, Limnospìla, Lispocéphala, Schœnomỳza**) . . . . . **CŒNOSIÎNÆ**

d. Pteropleura with a central group of hairs; palpi dilated apically, usually conspicuously dilated; front of both sexes equal to eye-width, the interfrontalia without cruciate bristles; parafacials with some hairs on their entire length. (**Líspa**). . . **LISPÎNÆ**
Pteropleura usually without such group of hairs, but if haired, the front of the male is narrower than that of the female; palpi not conspicuously dilated; parafacials bare below base of antennæ . . . . . e

e. Hind tibiæ of male with a strong dorsal bristle just beyond middle. f
Hind tibiæ of male without such a strong dorsal bristle. . . . . g

f. Anal vein very short, stopping abruptly, the seventh vein (axillary or A2) more or less distinctly curved forward around the apex of the first anal; female with wholly convex front, the broad orbits (and in males with wide front also) bearing two fronto-orbital bristles on upper half directed outward over eyes, or the upper one directed slightly backward; middle tibiæ of male more or less densely pubescent and often swollen on inner side. (**Fánnia, Cœlomỳia, Piezùra**) . . . . **FANNIÎNÆ**
Axillary vein not curving around end of anal vein; front of female more or less projecting forward, orbits not with two upper fronto-orbitals curving outward over eyes in either sex; middle tibiæ of male not pubescent or swollen. (**Phaònia** (=*Arícia*), **Allœostỳlus, Diályta, Hèra, Hydrotæa, Ophỳra, Pogonomỳia**). (*ARICIÌNÆ*, including *HYDROTÆÌNÆ*) . . **PHAONIÌNÆ**

g. Thorax with an uneven number of dark stripes, or unmarked; scutellum with only the larger basal and subapical bristles; face and oral margin usually produced; third and fourth veins parallel or slightly convergent, rarely divergent; usually sparsely short-setose. (**Limnóphora** (Fig. 599), **Hebecnèma**). **LIMNOPHORÌNÆ**
Thorax with an even number of dark stripes, or rarely unmarked; scutellum usually with stout discal, prebasal and preapical bristles in addition to the basals and subapicals; face usually vertical, rarely produced; third and fourth veins usually divergent or parallel; usually strongly setose. (**Mydæa** (including **Spilogáster**), **Helìna**) . . . . . **MYDÆÌNÆ**

70. Proboscis needle-like, porrect, at rest completely ensheathed by the long slender palpi; arista strongly plumose with feathered hairs (Fig. 556e); prosternum membranous; middle coxæ separated by the forward-projecting metasternum; abdominal spiracles located in the membrane between tergites and sternites. Tsetse flies. (**Glossìna,** ethiop.) (Fig. 556e).

GLOSSÍNIDÆ

Proboscis, if elongate and porrect, not ensheathed by the palpi; hairs of arista not feathered; prosternal plate developed; abdominal spiracles located in second to fifth tergites.

MÚSCIDÆ

a. Proboscis of both sexes elongate, rigid, fitted for piercing and sucking blood, the labella not enlarged; arista with long hairs on upper side, bare or pubescent below; lower calypter rounded posteriorly, its inner basal margin well separated from the lateral basal angles of scutellum. (**Stomóxys** (*S. cálcitrans,* Stable fly (Fig. 602)), **Hæmatòbia, Lyperòsia** (*L. írritans,* Horn fly); **Haphóspatha,** Eur., Afr.; **Hæmatobósca,** China).

STOMOXYDÌNÆ

Proboscis not heavily chitinized, the labella fleshy, fitted for lapping. . . . . .b

b. Apical cell widely open, the fourth vein gently curving back; hypopleural bristles present above hind coxæ; pteropleural bristles absent beneath root of wing. (**Egínia,** palæarc.).

EGINIÌNÆ

Apical cell narrowed; hypopleural bristles nearly always absent, pteropleural bristles or hairs often present; lower calypter with posterior curvature more or less transverse, the inner basal angle very close to and often touching or underlying the basal lateral angle of scutellum. (**Músca** (*M. doméstica,* Housefly (Figs. 557, 601), **Cordylòbia** (*C. anthropóphaga,* Tumbu-fly, ethiop.), **Dasýphora, Graphomỳia, Mesembrìna, Moréllia, Muscìna, Myiospìla, Pyréllia, Synthesiomỳia**).

MUSCÌNÆ

Acalyptratæ

71. Mouth-opening small, the mouthparts vestigial; antennæ sunken in the facial grooves which form a rounded pocket, arista bare; vibrissæ and bristles absent, no sternopleural or pteropleural bristles; scutellar suture broadly interrupted at middle; ovipositor sturdy and inflexed under abdomen; costa ending at third vein (R_5) which terminates much before tip of wing, the

apical cell widely open (Fig. 593). Horse botflies, cosmopolitan. (**Gastrôphilus** (Figs. 592, 593)) .... **GASTROPHÍLIDÆ** [1]

Mouth-opening normal, the mouthparts functioning; third and fourth veins usually parallel or converging, very rarely markedly diverging; larvæ not internal parasites of horses, etc. 72

72. Costa entire, no indication of a break near the end of the subcosta nor near the humeral crossvein; Sc nearly always distinctly separated from R_1 and ending in the costa an appreciable distance before R_1 which usually terminates near or beyond middle of wing (see Fig. 608) 73

Costa fractured just before end of subcosta (best seen by transmitted light), or if Sc is imperfect the costa is visibly broken or constricted before end of first vein (R_1) (Fig. 603), or at least with an indication of such fracture; sometimes with an additional break near the humeral crossvein (Fig. 658).....99

73. Subcosta complete, ending in the costa, usually free from R_1, rarely closely approximated to it, rarely wanting; anal cell present 74

Subcosta incomplete, developed only at base and continuing as an evanescent fold, not attaining the costa; anal cell faint or absent; postvertical bristles divergent.....98

74. Vibrissæ present at the vibrissal angle of the head, in distinction to peristomial or buccal bristles or hairs.....75

Definite vibrissæ absent.....78

75. Palpi well developed.....76

Palpi very small, vestigial; anterior orbital bristles never developed; head spherical, cheeks narrow; arista bare or nearly so; posterior spiracle usually with at least one bristle; abdomen somewhat elongate and usually narrowed at base; black scavenger flies. Cosmopolitan ..... **SÉPSIDÆ**

a. Postvertical bristles wanting; head broadened, with projecting eyes. (**Eurychoromŷia**).....**EURYCHOROMYIÌNÆ**

Postverticals present and diverging; if absent, the head is not broadened ..... b

b. First and second basal cells united. (**Pandòra** (Fig. 608), widespr.; **Saltélliseps**, ethiop., asiat.) ..... **PANDORÌNÆ**

Basal cells separate.....c

[1] The enigmatical family CTENOSTYLIDÆ, erected by Bigot for *Ctenostylum* from the Amazon River differs in having the arista long-plumose above, mesothorax with a short recurved bristle at each posterior angle and the marginal cell divided into six or seven small cells by thickened crossveins between the costa and the second vein. Bigot located the family near the Conopidæ from which it differs in the widely open apical cell and atrophied mouthparts. Apparently the only specimens known were collected previous to 1850.

c. Thorax verrucose, subshining, pubescence fine, forming a sheen; dorsal abdominal segments devoid of bristles and setæ. (**Toxópoda, Paratoxópoda,** mainly ethiop.) ..... **TOXOPODÌNÆ**

Thorax not verrucose, at least mesopleuræ shining, hairs short, not forming a sheen; abdomen often with bristles.....d

d. Postocular and mesopleural bristles wanting. (**Themìra** (Fig. 607), **Enícita,** holarc.; **Protothemìra,** palæarc.). **THEMIRÌNÆ**

At least mesopleural bristle present.....e

e. Front femora of male more or less excised before end and provided with varying sets of bristles, thorns or prongs; orbital bristle weak or wanting. (**Sépsis** (Fig. 609), cosmop.; **Lasioséрpsis,** Eur., ethiop.)..... **SEPSÌNÆ**

Front femora not excised toward end, with or without rows of bristles but without spinigerous tubercles.....f

f. A strong orbital bristle present on each side; abdomen of both sexes without bristles; postocular bristle strong. (**Meròplius,** widespr.) ..... **MEROPLIÌNÆ**

Orbital bristle weak or wanting, or if present, the postocular bristle is weak or wanting. (**Nemópoda, Sepsidomórpha,** holarc.). **NEMOPODÌNÆ**

76. Thorax convex; cheeks, pleuræ and legs not remarkably bristly; postvertical bristles divergent.....77

Mesonotum and scutellum more or less flattened; head, body and legs coarsely bristly (Fig. 613). Seashore species. (See couplet 87) ..... **CŒLÓPIDÆ**

77. Second antennal joint usually with an angulate projection from the exterior edge (Fig. 635); interfrontal cross-bristles often present; tibiæ usually with preapical bristles; anal vein abbreviated, not reaching margin. (See couplets 107 and 129). **CLUSÌIDÆ**

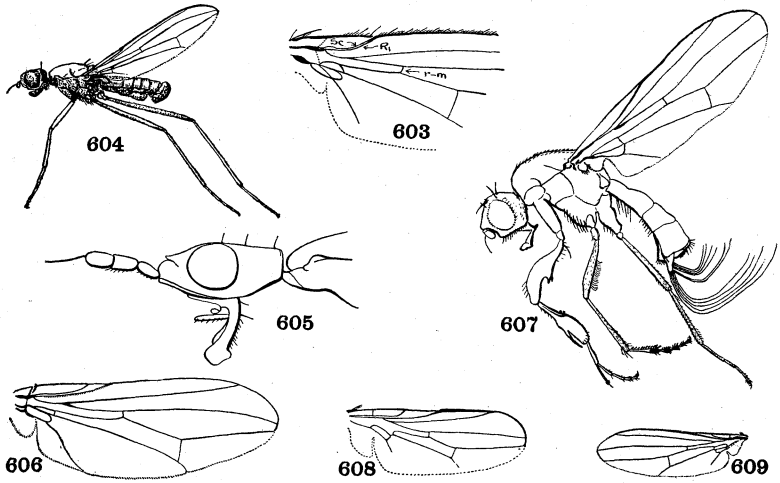
Second antennal joint without angular projection; no interfrontal cross-bristles; tibiæ without preapical bristles; anal vein continuing as a fold almost to margin. (See couplet 109). (**Actenóptera,** (=*Gymnomỳza*), palæarc.). **NEOTTIOPHÍLIDÆ,** part

78. First posterior cell (R_5) closed or much narrowed at apex due to the convergence of both third and fourth veins (wide in Nothybidæ, couplet 81, which have remarkably long prosternum); abdomen elongate; legs long, or very long and slender.....79

First posterior cell widely open, if narrowed, the abdomen is short and the legs are not unusually long and slender.....83

79. Eyes large, the cheeks and posterior orbits narrow; upper occiput concave 80

Eyes moderately large, front not narrow, cheeks and posterior orbits not distinctly narrow, face often greatly retreating, occiput usually large; ocellar and humeral bristles absent.....82



Figs. 603–609. **Micropezidæ, Neriidæ, Tanypezidæ, Sepsidæ**

603. **Trichoscelis,** basal portion of wing. Trichoscelidæ.
604. **Calobata,** male (Cole) Micropezidæ.
605. **Nerius,** profile of head. Neriidæ.
606. **Tanypeza,** wing. Tanypezidæ.
607. **Themira,** male. Sepsidæ.
608. **Pandora,** wing. Sepsidæ.
609. **Sepsis,** wing (Cole) Sepsidæ.

80. Proboscis very long and geniculate; ovipositor elongate; arista terminal. (See couplet 50). (**Stylogáster,** America, Afr.). **CONÓPIDÆ,** part

Proboscis and ovipositor not elongate; arista dorsal; hind metatarsi with basal group of bristles.....81

81. Ocellar and humeral bristles present, though sometimes small; prothorax small; first vein (R_1) setulose; front of male narrow. (**Tanypèza** (Fig. 606), **Polphopèza, Scipopèza,** mainly neotrop.) ..... **TANYPÉZIDÆ**

Ocellar and humeral bristles absent; thorax elongate, the prosternum prominent, the front legs attached behind middle of thorax; hind femora without bristles on posterior edge; first vein bare; front of both sexes wide. (**Nothỳbus**, malay.).
NOTHÝBIDÆ

82. Arista dorsal, located toward base of the third antennal joint; front legs shorter than posterior pairs from which they are widely separated, the front coxæ short; propleuræ scarcely produced in front; second antennal joint without projection; palpi usually small. Mostly tropical ..... **MICROPÉZIDÆ**

a. Middle and hind tibiæ uniformly pubescent but without bristles; hind metatarsi with some setæ at base; subcosta evident. (**Calóbata** (= *Trepidària*) (Fig. 604), **Calobatélla**, **Paracalóbata**) ..... **CALOBATÌNÆ**

Middle and hind tibiæ with a row of short extensor bristles; hind metatarsi without group of setæ at base; subcosta closely approximated to first vein.....b

b. Posterior basal cell present. (**Tanýpoda**, **Cardiocéphala**, **Eurýbata**, **Grallipèza**, **Ptílosphen**, **Scipòpus**)...**TANYPODÌNÆ**

Posterior basal cell united with discal cell. (**Micropèza** (= *Tylos*), **Cliopèza**, **Neriocéphalus**) ..... **MICROPEZÌNÆ**

Arista apical or subapical (Fig. 605); front legs longer than posterior pairs, the front coxæ lengthened, thus placing the front legs close to the middle pair; propleuræ strongly developed beneath in front of front coxæ; second antennal joint with a finger-like process on inside edge; palpi long. Mostly tropical. (**Nèrius** (Fig. 605), **Macrótoma**, **Telostỳlus**) ..... **NERÌIDÆ**

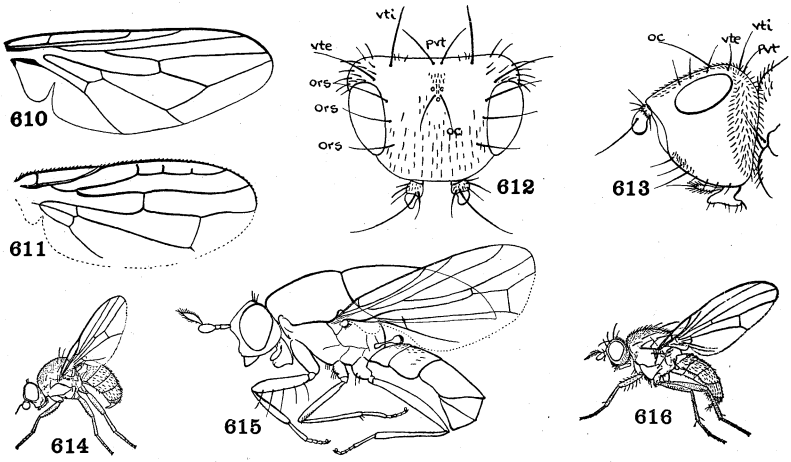
83. Eyes prominently bulging, the vertex sunken; scutellum often large and grooved; femora and usually hind tibiæ greatly enlarged; anal cell rather large; prelabrum well developed.....84

Eyes less prominent, vertex not sunken; first posterior cell widely open, if rarely narrowed the femora are not thick.....85

84. First vein ending far beyond subcosta, first posterior cell usually narrowed apically due to the angulation of the fourth vein at apex of discal cell; posterior spiracle with a group of bristles; palpi broad. Principally neotropical. (**Rhopalomèra**, **Apophorhýnchus**, **Krœberia**, **Willistoniélla** (Fig. 610)).
RHOPALOMÉRIDÆ

First vein ending close to subcosta, first posterior cell widely open; posterior spiracle without group of bristles; palpi narrow. (See couplet 119). (**Rhinótora** (Fig. 611), neotrop., ethiop.).
RHINOTÓRIDÆ

85. Some or all tibiæ with preapical bristle on extensor side; ovipositor short, retractile.....86
Tibiæ without extensor preapical bristle; in case preapical bristles are present either the ovipositor is long and chitinized, or the first vein is setulose, or the anal crossvein (Cu_1) is broken...90



Figs. 610–616. **Rhopalomeridæ, Rhinotoridæ, Cœlopidæ, Ochthiphilidæ, Celyphidæ, Lauxaniidæ**

610. **Willistoniella,** wing. Rhopalomeridæ.
611. **Rhinotora,** wing. Rhinotoridæ.
612. **Orygma,** head from above. For lettering see Fig. 594. Cœlopidæ.
613. **Orygma,** head in profile. Cœlopidæ.
614. **Leucopis** (Cole) Ochthiphilidæ.
615. **Celyphus.** Celyphidæ.
616. **Minettia** (Cole) Lauxaniidæ.

86. Scutellum never broadly covering the wings and abdomen.....87
Scutellum enormously enlarged and convexly inflated, covering the abdomen and the wings when at rest (Fig. 615); nearly bristleless flies with shortened thorax, antennæ porrect, arista subapical, prelabrum large; abdominal sternites very small; alula large, discal and second basal cells confluent. Indo-australian and African. (**Cely̆phus** (Fig. 615), **Acely̆phus, Parcely̆phus, Spaniocely̆phus**) ..... **CELY̆PHIDÆ**

87. Thorax convex; cheeks, pleuræ and legs not remarkably bristly; last tarsal joint not flattened.....88
Mesonotum and scutellum flattened; head, body and legs coarsely bristly; last tarsal joint flat and enlarged. Seashore species. (*PHYCODRÓMIDÆ*) ..... **CŒLŌPIDÆ**

a. Postvertical bristles convergent or parallel; metathoracic spiracle without bristles; propleural bristle absent. (**Cœlòpa, Malacomỳza** (= *Phycodròmia*)) ..... **CŒLOPÌNÆ**
Postverticals divergent; metathoracic spiracle with group of bristles; propleural present. (See couplet 76).(**Orỳgma** (Figs. 612, 613)) ..... **ORYGMÌNÆ**

88. Postvertical bristles convergent or crossing; second antennal joint with dorsal bristle; one or two sternopleural bristles and one mesopleural present; lower edge of front femora bearing bristles; anal and second basal cells small, anal vein abruptly shortened (Fig. 616); two or one fronto-orbital bristles, the lower often directed inward. Many genera, mostly tropical. (**Lauxània, Caliòpe, Camptoprosopélla, Homoneùra, Minéttia** (Fig. 616), **Pelomỳza, Sapromỳza, Sapromyzosòma, Steganópsis, Trigonometòpus.**). (Including *TRIGONOMETÓPIDÆ*, with front horizontal). (*SAPROMÝZIDÆ*).. **LAUXANÌIDÆ**
Postverticals parallel or divergent, rarely wanting; second antennal joint rarely with dorsal bristle; mesopleural and usually sternopleural bristles wanting; front femora not bristly beneath; anal vein reaching margin, at least as a fold.....89
89. Prelabrum pronounced, not retractable with the infolding of the proboscis; first vein ending beyond middle of wing; femoral bristles undeveloped. A rather small family; principally holarctic ..... **DRYOMÝZIDÆ**

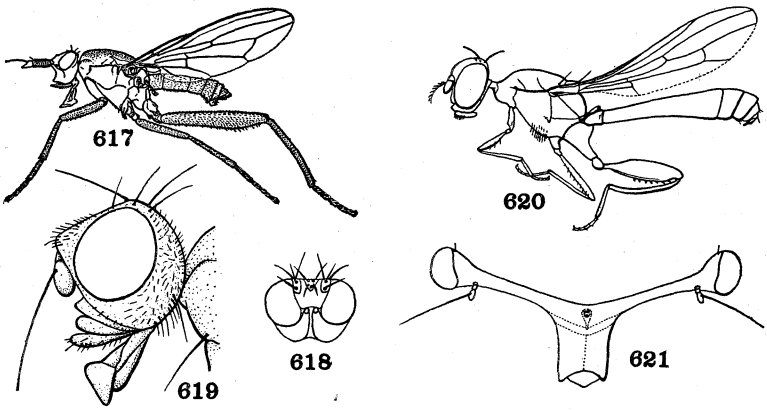
a. Cheeks evenly pubescent; third antennal joint spherical, antennæ separated; oral margin not protruding, palpi without apical bristle; anterior dorsocentral bristles present. (**Helcomỳza, Heterochìla**) ..... **HELCOMYZÌNÆ**
Cheeks with a bare groove; third antennal joint compressed, longer than broad, antennæ not separated; oral margin protruding, palpi with apical bristle; anterior dorsocentral bristle absent; middle femora with posterior row of bristles. (**Dryomỳza, Neuróctena** (Fig. 619)).....**DRYOMYZÌNÆ**

Prelabrum vestigial, rarely chitinized, not touching oral margin when the proboscis is extended; first vein ending at middle of

wing; femora setulose, their bristles developed, a characteristic bristle usually present near middle of anterior face of middle femora (Fig. 617). Many genera and species; widespread, largely holarctic. (*SCIOMÝZIDÆ*) ..... **TETANOCERÁTIDÆ**

a. Abdomen of female with seven segments, ovipositor not retractile; arista subapical; front femora not bristly. (**Tetanùra**). **TETANURÌNÆ**

No ovipositor; apical segments of female abdomen, beyond fifth, retractile; arista basal; front femora with bristles..... b



Figs. 617–621. **Tetanoceratidæ, Dryomyzidæ, Megamerinidæ, Diopsidæ**

617. **Sepedon** (Cole) Tetanoceratidæ.
618. **Sciomyza,** head from front (Hendel) Tetanoceratidæ.
619. **Neuroctena,** head from side. Dryomyzidæ.
620. **Syringogaster**. Megamerinidæ.
621. **Diopsis,** head from front. Diopsidæ.

b. Propleural bristle present; front usually without differentiated median polished stripe. (**Sciomỳza** (Fig. 618), **Mélina, Pherbéllia** (=*Ditœnia*), **Pterómicra**)..... **SCIOMYZÌNÆ**

Propleural bristle wanting; front usually with a distinct polished median stripe, rarely subshining. (**Tetanócera, Antichæta, Díctya, Élgiva, Hedroneùra, Hoplodíctya, Euthýcera, Límnia, Pœcilógrapha, Renócera, Sépedon** (Fig. 617)). **TETANOCERATÌNÆ**

90. Head produced on each side into a lateral process bearing the eye at the tip and the antennæ widely distant from each other on

the eye-stalk (Fig. 621), frontal lunule flattened; subcosta weak and parallel with first vein, third vein arising from second near middle of wing, discal cell confluent with second basal; front femora more or less thickened; scutellum bituberculate. A small family, mainly tropical. (**Diópsis** (Fig. 621), **Sphyracéphala**). **DIÓPSIDÆ**

Head not produced so that the eyes are stalked and the antennæ are distantly separated; third vein arising from second toward base of wing; scutellum not bituberculate. 91

91. Anal crossvein (Cu_1) not angulate, the anal cell not acutely produced (Fig. 608), first vein bare; ovipositor retractile, not prominent. (If legs and thorax are unusually elongate, see Nothybidæ, couplet 81) 92

Anal crossvein usually angulate so that the anal cell is acutely produced (Fig. 624), or at least the anal cell apically angled, first vein usually setulose above; ovipositor chitinized and more or less projecting, usually flattened; post-vertical bristles diverging or parallel; palpi developed. (If indomalayan, elongate flies with slender legs and prominent prothorax, see Phytalmidæ, couplet 100). (ORTALÍDIDÆ, *s. lat.*) 94

92. Hind femora long, thickened and spinose beneath; basal cells lengthened, anal vein usually reaching margin; abdomen elongate, slender at base, clavate; postvertical bristles wanting. A small family; Europe, N. America, Oceanica. (**Megamerìna,** (=*Lìssa*), **Syringogáster** (Fig. 620), **Syrittomỳia**). **MEGAMERÍNIDÆ**

Hind femora rarely thickened, not biseriately spinose beneath; basal cells short, anal vein abbreviated; postverticals present, though sometimes small. 93

93. Postvertical bristles diverging; palpi vestigial; front legs of male often more or less deformed and bristly; at least abdomen more or less shining. (See couplet 75) . . . . . **SÉPSIDÆ**

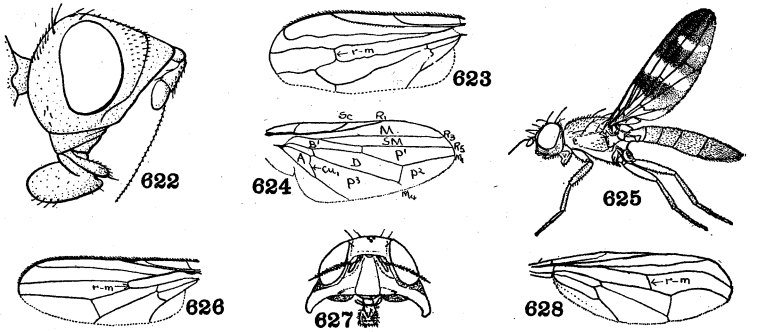
Postverticals converging, sometimes wanting; palpi developed; femora not spinose; usually densely gray-pruinose species, the oval abdomen usually pictured with paired brown spots. Europe N. America, Asia. (**Ochthíphila** (=*Chamæmyia*), **Acrometòpia, Leucòpis,** (Fig. 614), **Leucopomỳia, Pseudodínia**). (*CHAMÆMYÌIDÆ*) . . . . . **OCHTHIPHÍLIDÆ**

94. First and third veins usually bare; first posterior cell sometimes apically narrowed or rarely closed; body often metallic; head large, hemispherical, front broad, eyes not bulging, proboscis

stout. (**Ulídia, Chætópsis** (Fig. 625), **Chrysomỳza, Euxésta** (Fig. 624), **Mosíllus** (=*Myodìna*, =*Seóptera*), **Tímia**).

ULIDÌIDÆ

First vein usually setulose or hairy, when bare either the first posterior cell is not narrowed, or the eyes protrude, or the costal cell is very large.....95



Figs. 622–628. **Pyrgotidæ, Pterocallidæ, Ulidiidæ, Richardiidæ, Phytalmiidæ**

622. **Pyrgota,** profile of head. Pyrogotidæ.
623. **Pterocalla,** wing (Williston) Pterocallidæ.
624. **Euxesta,** wing. Ulidiidæ.
625. **Chætopsis** (Cole) Ulidiidæ.
625. **Cœlometopia,** wing (Williston) Richardiidæ.
627. **Phytalmodes,** head from front (Bezzi) Phytalmiidæ.
628. **Phytalmodes,** wing (Bezzi) Phytalmiidæ.

95. Ocelli present; ovipositor flattened 96
Ocelli usually absent; ovipositor not flattened; front projecting, face retreating, mouth-opening small, clypeus small, proboscis not heavy; second antennal joint elongate; no propleural bristle, prothoracic stigma with a row of hairs; third vein bare. (**Pyrgòta** (Fig. 622), **Adapsília, Bromóphila, Campylócera**).

PYRGŌTIDÆ

96. Third antennal joint round or short-ovate; first vein ending much beyond subcosta; eyes rather protuberant; face vertical, excavated in middle, without antennal grooves, prelabrum small; mesonotum bristly in back only; propleural bristle weak or wanting, sternopleural bristle present; non-metallic flies.

(**Pterocálla** (Fig. 623), **Callopístria, Dasymetòpa, Myénnis, Pseudotephrìtis, Stylophthalmỳia**) .. **PTEROCÁLLIDÆ**

Third antennal joint with sharpened apex; antennal grooves distinct; subcostal cell not large.....97

97. Propleural and usually sternopleural bristles absent, three supra-alar bristles; mouth-opening very large, clypeus large, proboscis heavy, palpi broad. A large group, mainly tropical. (Including *CEPHALÌIDÆ*) ..... **PLATYSTOMÁTIDÆ**

a. Upper occiput usually convex; abdomen stalked, elongate; basal cells of wing diminutive; sternopleurals usually present; ant-like species. (**Myrmecomỳia, Delphínia, Myrmecothèa, Tritóxa**) ..... **MYRMECOMYIÌNÆ**

Upper occiput never convex; abdomen not ant-like, if elongate no sternopleurals present; basal cells not small.....b

b. Epistome convexly projecting above oral margin. (**Tráphera, Lùle, Pìara, Xíria**) ..... **TRAPHERÌNÆ**

Epistome not convexly projecting.....c

c. Abdomen slender, much longer than wide, usually compressed; third antennal joint much longer than wide, arista not long-plumose, the distal part bare; at most one weak fronto-orbital bristle. (**Stenopterìna, Antineùra, Duomỳia, Elassogáster, Lamprophthálma, Xenáspis**) ..... **STENOPTERÌNÆ**

Abdomen usually elliptical or short-oval, if slender either the arista is feathered to apex, or antennæ shorter, or two fronto-orbitals present .....d

d. Abdomen spindle-shaped, broadest at middle, or beyond middle. (**Rivéllia, Cleitàmia, Ídana, Laglaisia**) ..... **RIVELLIÌNÆ**

Abdomen broadly oval, widest before middle, or very small and narrowly joined to thorax. (**Platýstoma, Achìas, Euprosòpia, Lamprogáster, Loxoneùra, Naùpoda, Peltacanthìna, Scholástes**) .....**PLATYSTOMATÌNÆ**

Propleural and sternopleural bristles present, four supra-alar bristles, anterior dorsocentral bristle present; mouthparts less developed, cheeks broad. (**Ōrtalis, Anacámpta, Hérina, Dorýcera, Melièria** (=*Ceróxys*), **Tétanops, Tephronòta**). (Including *DORYCÉRIDÆ*) ..... **ORTALÍDIDÆ**

98. Discal cell complete, anterior crossvein near middle of wing, costa extending only to third vein (R_5), second vein (R_3) long, ending near tip of wing; vibrissæ absent. Europe, America, Ceylon. (**Periscelis, Cỳamops, Marbènia, Neoscùtops, Podócera, Sphyroperíscelis** (Fig. 629), **Scùtops**) .. **PERISCÉLIDÆ**

Discal cell entirely wanting, anterior crossvein located near base

of wing, costa extending to fourth vein, second vein very short, ending close to first vein; vibrissæ present. (See couplet 125). (**Astìa** (=*Astèia*) (Fig. 645) **Liomỳza, Sigaloéssa** (=*Crepidohámma*), **Stenómicra**) ..... **ASTÌIDÆ**

99. Typically heavy-bodied flies (Fig. 633), with broad, five-segmented abdomen and with rows of bristles on thorax, abdomen and legs (*Anthophasia* with tergites fused and apical bristles alone present on abdomen); second antennal joint as long as third or longer, arista bare; vibrissæ present; third vein close to second and ending much before wing-tip, costa stopping before tip of wing, first and third veins bristly above at least at base, subcosta distinct, obliquely ascending at tip, anal cell prolonged into a sharp point. Bright-colored flies, 7–18 mm. in length, with banded wings, resembling stout tachinids. (**Tachinísca** (Fig. 633), Peru, Bolivia; **Anthophàsia** (=*Tachinœstrus*), **Tachiniscídia**, ethiop.) ..... **TACHINÍSCIDÆ**

Not large, heavy-bodied, or very bristly flies. 100

100. Legs long and slender, thorax large, prothorax neck-like, abdomen long and clavate, the basal segment as long as remainder of abdomen; first posterior cell not narrowed; one or no frontoorbital bristle, no postvertical, propleural, sternopleural or dorsocentral bristles, two scutellars; arista long-plumose; cheeks often produced as lateral processes. Indomalayan. (**Phytálmia** (=*Elaphomyia*), **Angítula, Angitulòides, Atopógnathus, Giraffomỳia, Phytalmòdes** (Fig. 627, 628), **Terastiomỳia**) ..... **PHYTALMÌIDÆ**

Legs not unduly long and slender, prothorax not neck-like, body not suggestive of the Neriidæ. 101

101. Costa broken only at end of subcosta (Fig. 639). 102

Costa broken near humeral crossvein in addition to the subcostal break (Fig. 658), rarely (*Acartophthalmus*, couplet 129), the costa broken only at humeral crossvein. 126

102. Subcosta complete, ending in costa, usually independent of first radial vein (Fig. 630); second basal and anal cells complete (except Aulacogastridæ, couplet 106 (Fig. 631), with second basal and anal cells confluent) 103

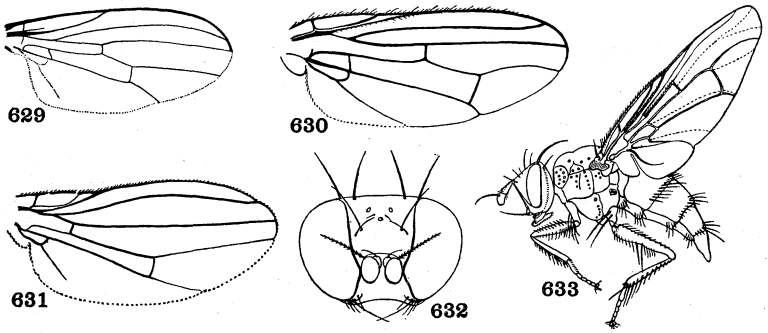
Subcosta incomplete or vestigial, the apical portion represented as a fold, not ending independently in the costa (Fig. 646). . 115

103. Vibrissæ present at the vibrissal angle (Fig. 635). 104

Vibrissæ absent, only peristomial hairs or setæ; no preapical tibial bristle 112

104. Cheek-plates continuing on the front, bearing inclinate lower fronto-orbital bristles (Fig. 594); tibiæ in addition to preapical and apical bristles usually with other bristles; metanotal suture continuous; anal crossvein straight or weakly curved, the tip of the anal cell angulate. (See couplet 68). . **CORDYLÙRIDÆ**

Cheek-plates not continuing on the front, lower fronto-orbitals therefore not present; mesonotal cross-suture interrupted in the middle. 105



Figs. 629–633. **Periscelidæ, Neottiophilidæ, Aulacogastridæ, Tachiniscidæ**

629. **Sphyroperiscelis,** wing. Periscelidæ.
630. **Neottiophilum,** wing. Neottiophilidæ.
631. **Aulacogaster,** wing. Aulacogastridæ.
632. **Aulacogaster,** head from front. Aulacogastridæ.
633. **Tachinisca** (Kertesz) Tachiniscidæ.

105. Postvertical (postocellar) bristles divergent (Fig. 634), parallel or wanting. 106

Postvertical (occipital) bristles convergent or cruciate (Fig. 637); foremost fronto-orbital bristle reclinate; costa often setose. . 110

106. Second basal and discal cells confluent, anterior crossvein located before middle of cell, costa thin but not broken near humeral crossvein; no postvertical bristles; a graded series of oral bristles in addition to the vibrissæ; tibiæ without preapical bristles. (**Aulacogáster** (Fig. 631, 632), holarc.).

AULACOGÁSTRIDÆ

Second basal and discal cells separated 107

107. Frontal orbits reaching the anterior edge of the front and bearing two to four fronto-orbital bristles (Fig. 636); second antennal joint nearly always with a triangular projection on the exterior side; preapical bristles usually present on tibiæ. (See couplet 77). (*HETERONEÙRIDÆ*) ..... **CLUSÌIDÆ**

a. Postvertical bristles distant from each other, eyes hairy, arista short; costa broken only at humeral crossvein, Sc diverging from R_1. (See couplet 129). (**Acartophthálmus** (Fig. 636), holarc.) ..... **ACARTOPHTHALMÌNÆ**

Postverticals (postocellars) close together, eyes bare, arista twice as long as antennæ or more; costa broken at Sc. Mostly tropical. (**Clùsia** (Fig. 635), **Clusiòdes** (= *Heteroneùra*), **Sobarocéphala** (Fig. 634)) ..... **CLUSIÌNÆ**

Frontal orbits shortened, fronto-orbital bristles absent, or one or two pairs present; second antennal joint without triangular projection on exterior side 108

108. Eyes round, occiput convex; no ovipositor 109

Eyes large, semicircular, occiput concave, front of male about one-fifth width of head; female with long ovipositor. (See couplet 114). (**Lonchæ̀a**) ..... **LONCHÆIDÆ**

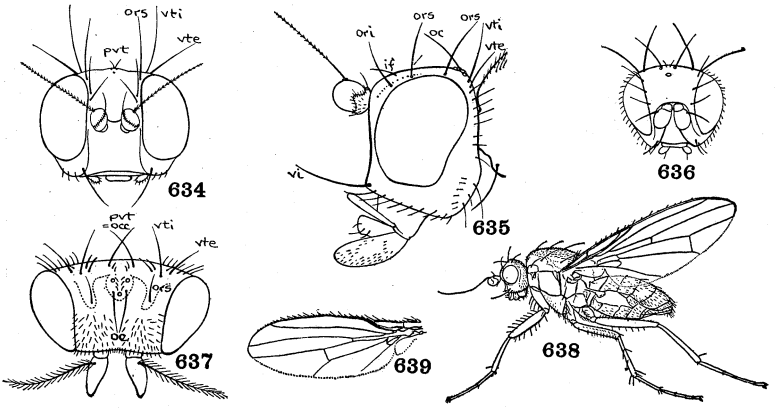
109. Costa spinose, first radial vein hairy above, anal vein reaching margin; four or five sternopleural bristles present; two fronto-orbital bristles; ocellar triangle large. (See couplet 77). (**Neottióphilum** (Fig. 630), Eur., larvæ parasites of nestling birds). **NEOTTIOPHÍLIDÆ**

Costa not spinose, first vein not hairy, anal vein abbreviated; two sternopleurals, one or no fronto-orbital. (**Pióphila**, cosmop. (*P. càsei*, Cheese skipper); **Mycetaùlus**, holarc.; **Prochylìza**, nearc.) ..... **PIOPHÍLIDÆ**

110. Orbital plates bearing the fronto-orbital bristles short (Fig. 637), one or two reclinate fronto-orbitals, set in from the eyes, the foremost near middle of front; subcosta strong and clearly independent of R_1, from which it diverges at apex, R_1 ending near two-fifths the wing-length (Fig. 638); preapical tibial bristles present. A rather large family, mainly holarctic. **HELOMÝZIDÆ**

a. No propleural bristle; anal vein not reaching margin; the strip bearing the upper fronto-orbital bristle reaching inward from the eye-margin (Fig. 637). (**Suíllia** (= *Helomyza*, auct.) (Fig. 637), **Allophỳla, Didymochæ̀ta, Pórsenus**). (*HELOMYZÌNÆ* auct.) ..... **SUILLIÌNÆ**

Propleural bristle present; anal vein nearly or quite reaching margin; the fronto-orbital strip extending only along the eye-margin. (**Helomỳza** (=*Blepharóptera*, =*Lèria*), **Amœ. balèria, Anoróstoma, Eccoptomèra, Œcòthea** (Fig. 638), **Scoliocéntra, Tephróchlamys**). (*LERIÌNÆ*) . . **HELOMYZÌNÆ**



Figs. 634–639. **Clusiidæ, Helomyzidæ, Trichoscelidæ**

634. **Sobarocephala,** head from front. Clusiidæ.
635. **Clusia,** head in profile view. Clusiidæ.
636. **Acartophthalmus,** head from front. Clusiidæ.
637. **Suillia,** head from above. Helomyzidæ.
638. **Œcothea** (Cole) Helomyzidæ.
639. **Trichoscelis,** wing. Trichoscelidæ.

Orbital plates longer, nearly attaining level of antennæ, the two or three fronto-orbital bristles close to eye-margin and the foremost in anterior portion of front; subcosta weak, parallel with R_1 with which it fuses at tip, R_1 shorter, ending at basal fourth to two-fifths of wing, anal vein not reaching margin (Fig. 639) 111

111. All tibiæ with preapical bristles; two fronto-orbital bristles; propleural bristle present, presutural dorsocentral bristles strong; costa spinulose. (**Trichóscelis** (=*Geomyza* Loew, = *Diástata* Malloch) (Fig. 639), **Psiloplàgia, Spilóchroa, Zagònia**). (*TRIXOSCÉLIDÆ, GEOMÝZIDÆ* auctt., part).

TRICHOSCÉLIDÆ

Tibiæ without preapical bristles; two or three fronto-orbitals; propleurals absent; palpi short; costa not spinulose; ground color yellow. Holarctic. (**Chyromỳia** (=*Chiromyia*, = *Peletóphila*), **Aphaniosòma**) ..... **CHYROMYÌIDÆ**

112. Second segment of abdomen typically with lateral bristles; first radial vein bare, slightly deflected near apex to form a small stigmal area beyond the subcostal break; femora often thickened and furnished with spines; wings pictured with a few spots or clouds, anal crossvein recurved, anal cell not acutely pointed; eyes sometimes stalked. Many genera and species, mostly tropical. (**Richárdia, Cœlometòpia** (Fig. 626), **Cóniceps, Epiplàtea, Odontomèra, Setéllia, Stenomàcra**).
RICHARDÌIDÆ

Second segment of abdomen without lateral bristles; first vein not forming a characteristic stigma; femora not thickened 113

113. Anal crossvein recurved, anal vein continued beyond anal cell (Fig. 641); one fronto-orbital bristle, postvertical bristles parallel or slightly diverging; head not triangular in profile; ovipositor with definite non-retractile base 114

Anal crossvein straight, anal vein vestigial (Fig. 646); three to five usually weak fronto-orbitals, postocellar bristles diverging; upper part of face swollen, separating the antennæ, cheeks wide, front wide, the ocellar triangle large; third antennal joint spherical; no ovipositor. (See couplet 120). (**Cánace** (Fig. 646), **Xanthocánace**) ..... **CANACÈIDÆ**

114. Head hemispherical in profile, eyes large and vertically semicircular, cheeks narrow, front narrow, in male one-fourth to one-fifth width of head; post-vertical bristles close together; third antennal joint more or less cylindrical; metallic black species. (See couplet 108). (**Lonchæa** (Fig. 641)).
LONCHÆIDÆ

Head globular, eyes round, front more than one-third width of head; third antennal joint orbicular; more or less pale-colored species, wings patterned. (**Pallóptera** (Fig. 640)).
PALLOPTÉRIDÆ

115. Anal cell complete or nearly so; arista pubescent 116

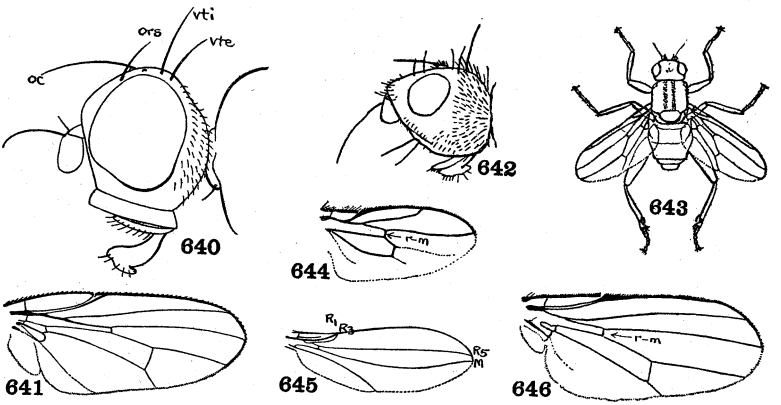
Anal cell entirely wanting; no preapical bristles. (If hind metatarsi are short and thickened see Leptoceratidæ, couplet 135) 125

116. Hind metatarsi shortened and incrassate (Fig. 643); no sternopleural bristle, vibrissæ strong, dorsocentral bristles weak.

Cosmopolitan, dung flies. (**Bórborus** (=*Cýpsela*), **Scatóphora** (=*Olìna*), **Sphærócera** (Fig. 643)). (*CYPSÉLIDÆ, SPHÆROCÉRIDÆ*) ..... **BORBÓRIDÆ**

Hind metatarsi not short and thick 117

117. Postvertical bristles converging, presutural dorsocentral bristle present, fronto-orbital bristles directed outward, interfrontal cross-bristles usually present, one sternopleural bristle. (If



Figs. 640–646. **Pallopteridæ, Lonchæidæ, Thyreophoridæ, Borboridæ, Leptoceratidæ, Astiidæ, Canaceidæ**

640. **Palloptera,** head from side. Pallopteridæ.
641. **Lonchæa,** wing. Lonchæidæ.
642. **Thyreophora,** head in profile view. Thyreophoridæ.
643. **Sphærocera,** dorsal aspect (Howard) Borboridæ.
644. **Leptocera,** wing (Spuler) Leptoceratidæ.
645. **Astia,** wing. Astiidæ.
646. **Canace,** wing. Canaceidæ.

preapical tibial bristles are present see Trichoscelidæ, couplet 111). Seashore species. (**Téthina** (=*Rhicnoêssa*), **Neopelomỳia, Pelomỳia**) ..... **TETHÍNIDÆ**

Postvertical bristles diverging or absent, if (Anthomyzidæ, couplet 123) converging then presutural dorsocentral bristles are not developed and the two prominent fronto-orbital bristles are reclinate 118

118. Preapical tibial bristles present; postocellar bristles diverging; two reclinate and one inclinate fronto-orbital bristle present;

vibrissæ present; one presutural and three postsutural dorsocentral bristles; terminal segments of female abdomen slender and retractile. (**Odínia**, **Neoalticomèrus**, **Tráginops**). **ODINÌIDÆ**

Preapical tibial bristles absent, or insect otherwise disagreeing from preceding description.....119

119. Eyes protuberant; scutellum usually tuberculate and medially grooved; front femora thickened; second basal and anal cells relatively large; at least base of anal vein firm; two reclinate fronto-orbital bristles, vibrissæ present, no postvertical bristles. Neotropical and ethiopian. (See couplet 84). (**Rhinótora** (Fig. 611)) ..... **RHINOTÓRIDÆ**

Eyes not bulging; scutellum not tuberculate; front femora not enlarged; basal cells usually small.....120

120. Subcosta uniformly firm though thin, separate from first radial vein almost to its tip, second basal and anal cells very small, anal crossvein straight, anal vein indicated by a weak fold (Fig. 646); no sternopleural bristle, postocellars diverging, three to five superior orbitals directed outward; ocellar triangle large, reaching edge of the front, antennæ well separated, the third joint orbicular. (See couplet 113). (If second basal cell is open, two fronto-orbitals present, the anterior proclinate and the posterior reclinate, no postverticals, but sternopleurals present, see Aulacogastridæ, couplet 106). (**Cánace** (Fig. 646), **Xanthocánace**) ..... **CANACÈIDÆ**

Subcosta apically much weakened.....121

121. Distinct vibrissæ present at the vibrissal angle of the face....122

Vibrissæ absent, though bristles may occur on the middle part of the cheeks; anal vein firm for some distance beyond anal cell, except when wings lack anal angle.....124

122. Second basal cell present; sternopleural bristles present.....123

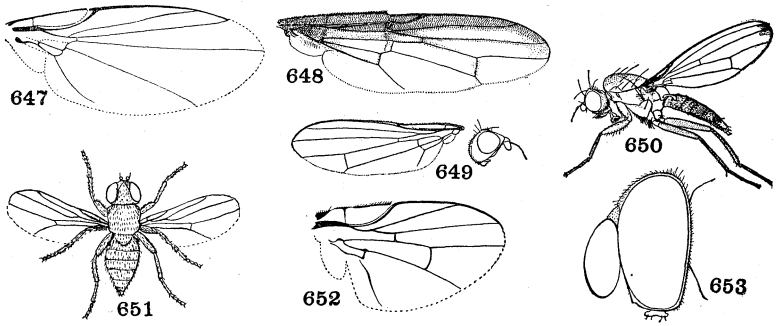
Second basal cell open, fourth vein vestigial beyond discal cell; postvertical bristles diverging or parallel; pleuræ without bristles except the propleural; hind metatarsi not short. (**Cypselosòma**, Formosa (aberrant genus)) . **BORBÓRIDÆ**, part

123. Postvertical (postocellar) bristles diverging; anterior fronto-orbital present and directed inward; seventh segment of female abdomen long and chitinized, not retractile; basal joint of arista shorter than broad. A large family, including many leaf-mining species; widespread. (**Agromỳza** (*A. parvicórnis*, Corn blotch leaf-miner; *A. pusílla*, Serpentine leaf-miner; *A.*

símplex, Asparagus miner), **Cerodónta, Domomỳza, Liriomỳza, Napomỳza** (*N. chrysánthemi,* Chrysanthemum leafminer), **Phytomỳza** (Fig. 647)) ..... **AGROMÝZIDÆ**

Postvertical (occipital) bristles converging, rarely absent; base of female genitalia retractile; basal joint of arista longer than broad. (**Anthomỳza, Anagnòta, Ischnomỳia, Mumetòpia, Paranthomỳza, Stiphrosòma**).

ANTHOMÝZIDÆ



Figs. 647–653. **Agromyzidæ, Psilidæ, Opomyzidæ, Chloropidæ, Cryptochætidæ**

647. **Phytomyza,** wing. Agromyzidæ.
648. **Chyliza,** wing (drawn by Cole) Psilidæ.
649. **Psila,** wing and profile of head (Cole) Psilidæ.
650. **Geomyza** (Cole) Opomyzidæ.
651. **Botanobia,** dorsal aspect (Lugger) Chloropidæ.
652. **Cryptochætum,** wing. Cryptochætidæ.
653. **Cryptochætum,** head from side. Cryptochætidæ.

124. One presutural and two or three postsutural dorsocentral bristles present; postvertical bristles minute or absent; one sternopleural bristle. (**Opomỳza, Anomalochæta, Geomỳza** (=*Balióptera,* not *Trichoscelis*) (Fig. 650). (*GEOMÝZIDÆ,* part).

OPOMÝZIDÆ

No presutural (very rarely one) and at most two postsutural dorsocentral bristles present; postvertical bristles diverging or absent; no sternopleural ..... **PSÍLIDÆ**

a. Anal cell closed by a straight crossvein; no or one notopleural bristle; third antennal joint elongate oval to very long..... b

Anal cell closed by a curved crossvein; head spherical, third antennal joint rounded; two notopleurals, two scutellars. (**Strongylophthalmỳia, Chamæpsìla** (*C. ròsæ*, Carrot rust fly) ..... **STRONGYLOPHTHALMYIÌNÆ**

b. Occiput concave; metapleural callus velvety; anal cell distinctly shorter than second basal. (**Chylìza** (Fig. 648) . **CHYLIZÌNÆ**

Occiput convex; metapleural callus bare; anal cell not shorter than second basal. (**Psìla** (Fig. 649), **Loxócera**) ..... **PSILÌNÆ**

125. Ocellar triangle large (Fig. 651); arista bare, pubescent, or heavily feathered; postvertical bristles convergent or absent; second vein (R_3) long, ending beyond middle of wing. A large, widespread family. (*OSCÍNIDÆ*) ..... **CHLORÓPIDÆ**

a. Costa reaching to tip of third vein, or a little beyond. (**Chlòrops** (=*Óscinis*), **Chloropísca, Eurìna, Ectecéphala, Meromỳza**). **CHLOROPÌNÆ**

Costa reaching to tip of fourth vein. (**Botanòbia** (=*Oscinosòma*, =*Óscinis*, auct.) (Fig. 651), **Elachíptera, Hippelàtes, Gaùrax, Notonaùlax**). (*OSCINOSOMÌNÆ*) ..... **BOTANOBIÌNÆ**

Ocellar triangle small; arista loosely feathered; postvertical (preocellar) bristles diverging; second vein very short, ending close to first vein. Few species. (See couplet 98). (**Astìa** (Fig. 645), **Sigaloéssa**) ..... **ASTÌIDÆ**

126. Subcosta free from first vein, ending steeply in the costal break much before the end of the first vein (Fig. 657), anal cell angular, often drawn out into an acute point, at least first vein setulose, wings usually banded or spotted; inclinate lower frontoorbital bristles present; no vibrissæ, but oral hairs developed; no preapical tibial bristles; seventh segment of female abdomen long and chitinized. A large family, including many species of fruit flies, many tropical. (*EURIBÌIDÆ, TEPHRÍTIDÆ, TRYPANÈIDÆ*) ..... **TRYPÉTIDÆ**

a. Chætotaxy incomplete, the following bristles lacking, ocellar, inner occipital, postvertical, humeral, presutural, dorsocentral and sternopleural; second basal cell usually widened; antennæ elongate; sixth tergite of female short..... b

Chætotaxy complete, preceding bristles usually present; second basal cell not widened; antennæ usually short..... c

b. Femora more or less spinose beneath; transverse suture of mesonotum complete; abdomen long, cylindrical. (**Adràma, Meracanthomỳia**, indoaustr.) ..... **ADRAMÌNÆ**

Femora not spinose beneath; transverse suture of mesonotum in-

terrupted in middle; abdomen ovate or clavate. (**Dàcus** (Fig. 656), palæarc. (*D. òleæ*, Olive fly); **Bactrócera**, indoaustr. (*B. cucúrbitæ*, Melon fly); **Chætodàcus, Pélmatops**, indomal.; **Leptóxyda**, ethiop.; **Toxotrýpana**, neotrop. (*T. curvicauda*, Papaya fly)) ..... **DACÌNÆ**

c. Sixth abdominal tergite shorter than fifth; occipital bristles of hind margin of eye slender and pointed; wings banded or marked with brown or hyaline. (**Trypèta, Acídia, Aciùra, Anâstrepha** (*A. lùdens*, Orange maggot), **Ceratìtis** (*C. capitàta*, Mediterranean fruit-fly or Medfly; *C. ròsæ*, Natal fruit-fly), **Epòchra** (*E. canadénsis*, Currant fruit-fly), **Euríbia** (= *Tephrìtis* Latr. 1805, not 1804, = *Urôphora*), **Neaspilòta, Platypàrea, Procecidóchares** and **Œdáspis, Rhagóletis** (*R. cingulàta*, Cherry maggot; *R. pomonélla*, Apple maggot), **Straussia, Trypànea** (= *Urélliа*, Loew), **Zonosèma**). (*CERATITÌNÆ*) ..... **TRYPETÌNÆ**

Sixth abdominal tergite of female at least as long as fifth; occipital bristles on hind margin of eye usually stout and blunt; wings or at least crossveins with numerous small spots. (**Tephrìtis** Latr. 1804, **Actinóptera,** (= *Urélliа*), **Ensìna, Euarésta, Eurósta** (Fig. 657) (*E. solidáginis*, Goldenrod gallmaker), **Eutrèta, Ictérica, Oréllia, Teréllia**) ..... **TEPHRITÌNÆ**

Subcosta ending closer to first vein, not steeply bent toward costa, or vestigial; lower fronto-orbital usually wanting..... 127

127. Subcosta complete, ending in costa independently of R_1, second basal and anal cells well formed; postvertical bristles diverging 128

Subcosta incomplete, vestigial, or ending in R_1, second basal and anal cells usually weak or absent..... 130

128. Vibrissæ absent; anal cell more or less acute, often drawn out into an acute lobe, second basal cell moderately large; female with chitinized ovipositor. Refer to couplet 94, Ortalid series.

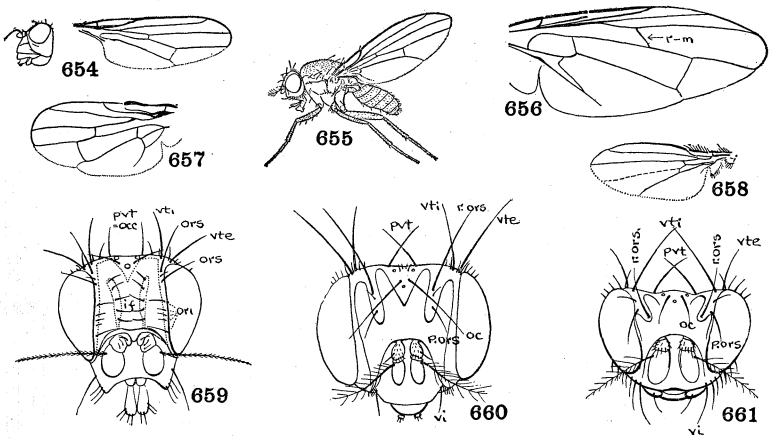
Vibrissæ present; anal cell not produced 129

129. Antennæ retractile into deep grooves, face retreating, eyes round and small (Fig. 642); scutellum very long, flattened, tipped with two setigerous tubercles; two vibrissæ. A small family; Eur., Afr., Austr. (**Thyreóphora** (Fig. 642), **Centrophlebomỳia, Dasyphlebomỳia, Piophilosôma**).

THYREOPHÓRIDÆ

Antennæ not retractile, the face flattened, vertical; subcostal break not evident. (**Acartophthálmus,** holarc. (See couplet 107)) ..... **CLUSÌIDÆ**, part

130. Arista lacking, antennæ inserted high on head, the apparent third joint long and leaf-like; no postvertical, orbital, vibrissal or other bristles, but body including mesopleuræ setulose; eyes large, vertical, cheeks linear; proboscis short; scutellum triangular, with sharp margin; calypteres without cilia. A small indoaustralian group, parasitic on scale insects, introduced into America. (**Cryptochætum** (=*Lestóphonus*) (Figs. 652, 653)). **CRYPTOCHÆTIDÆ**



Figs. 654–661. **Ephydridæ, Trypetidæ, Milichiidæ, Carnidæ, Drosophilidæ, Diastatidæ**

654. **Parydra,** head in side view and wing (Cole) Ephydridæ.
655. **Drosophila** (Cole) Drosophilidæ.
656. **Dacus,** wing. Trypetidæ.
657. **Eurosta,** wing (Williston) Trypetidæ.
658. **Meoneura,** wing. Carnidæ.
659. **Desmometopa,** head from front. Milichiidæ.
660. **Cyrtonotum,** head from front. Diastatidæ.
661. **Diastata,** head from front. Diastatidæ.

Arista present; fronto-orbital bristles present (*Lipochæta,* couplet 132, a, with no arista or bristles, has small antennæ); scutellum with rounded edge.....131

131. Postvertical bristles diverging; vibrissæ absent, but often oral and facial hairs variously developed; sternopleural bristles usually present.....132

Postverticals convergent or parallel, rarely wanting; vibrissæ present 133

132. Pubescent, without bristles, scutellum margined with fine bristles; cheeks broad and hairy; front hairy, produced as a subconical process over the antennæ. (**Sélachops**, Eur., an aberrant genus) ..... **AGROMŸZIDÆ**, part

Usually bare, or nearly bare of pubescence; front not produced; second basal and anal cells not formed. A large family, mainly holarctic. (*HYDRÉLLIDÆ*, *NOTIPHÍLIDÆ*).

EPHŸDRIDÆ

a. Antennæ small, widely separated, inserted in cavities; no arista; eyes pubescent; bristleless, gray, seacoast flies. (**Lipochæ̀ta**).

LIPOCHÆTÌNÆ

Antennæ close together, arista developed ..... b

b. Second antennal joint with a spinous bristle at its upper distal edge, or middle tibiæ with a strong extensor bristle; mouthparts usually small c

Second antennal joint without a spinous bristle; middle tibiæ without a strong extensor bristle ..... e

c. Posterior buccal area separated from the concave lower part of occiput by a sharp ridge; clypeus generally narrow but projecting apron-like; parafacials expanding below into the cheeks; no reclinate fronto-orbital bristles. (**Gymnòpa, Athyroglóssa, Cerometòpon, Ochtheròidea**) ..... **GYMNOPÌNÆ**

No sharp post-buccal ridge, the cheeks rounding into the occiput; parafacials paralleling the orbits; lateral frontal bristles proclinate and reclinate ..... d

d. Dorsocentral and acrostichal bristles rarely present. (**Psilòpa** (=*Ephygròbia*), **Atíssa, Allotrichòma, Discocerìna** (=*Clasiòpa*), **Discomŷza, Trimerìna**) ..... **PSILOPÌNÆ**

Acrostichals usually and one or more dorsocentral bristles always present. (**Notíphila, Dichæ̀ta, Ilýthea, Paralímna**).

NOTIPHILÌNÆ

e. Mouth-opening small; eyes usually pubescent. (**Hydréllia, Hydrìna** (=*Philýgria*), **Glenánthe, Axýsta**) .. **HYDRELLIÌNÆ**

Mouth-opening large; eyes without evident pubescence ..... f

f. Face with median area bare and facial series of bristles parallel with orbits; anterior dorsocentrals absent or undeveloped. (**Napæ̀a, Brachydeùtera, Hyadìna, Lytogáster, Párydra** (Fig. 654), **Pelìna**) ..... **NAPÆÌNÆ**

Face with median area setulose and facial series of bristles divergent from orbits above; anterior dorsocentrals usually well developed. (**Ephydra, Cœ̀nia, Scatélla, Scatóphila, Teichomŷza**) ..... **EPHYDRÌNÆ**

133. Inflexed lower fronto-orbital bristles wanting, the lowest or the middle of the superior fronto-orbitals may be proclinate, reclinate, or directed outward.....134
Inflexed lower fronto-orbitals present; interfrontal cruciate bristles usually present.....137

134. Second basal and anal cells lacking; no proclinate fronto-orbital bristles.....135
At least anal cell formed, anal vein present almost to margin; interfrontal cruciate bristles absent; foremost or middle fronto-orbital bristle almost always proclinate.....136

135. Hind metatarsi not short and stout; middle tibiæ not bristly; fronto-orbital bristles reclinate; only one row of acrostichals; ovipositor large, broadly oval, compressed so that the lateral margins form narrow ridges. (**Pseudopomỳza,** Eur., aberrant genus) ..... **MILICHÌIDÆ,** part
Hind metatarsi short and thickened; middle tibiæ bristly; interfrontal cruciate bristles present, fronto-orbitals directed outward; fourth vein continued beyond discal cell only as a fold (Fig. 644). (**Leptócera** (=*Limosìna*) (Fig. 644)).
LEPTOCERÁTIDÆ

136. Subcosta complete, costa usually spinose; mesothorax raised anteriorly, mesopleuræ with bristles, sternopleural bristles present ..... **DIASTÁTIDÆ**

a. Proclinate fronto-orbital bristle arising in front of reclinate ones, both remote from eyes (*Apsinota* has only uppermost fronto-orbital present); arista loosely long-plumose (Fig. 660). (**Cyrtonòtum** (=*Diplocéntra*) (Fig. 660), **Apsinòta, Parapsinòta, Thaumastóphila**) ..... **CYRTONOTÌNÆ**
Proclinate fronto-orbital behind the foremost reclinate pair, close to eyes; arista short-plumose. (**Diástata** (=*Calopterélla*) (Fig. 661), **Euthychæ̀ta, Tryptochæ̀ta**)..... **DIASTATÌNÆ**

Subcosta evanescent beyond base, costa not spinose; mesopleuræ rarely bristly; proclinate fronto-orbital bristle not closer to the eyes than the reclinate ones are. A large family, mostly tropical.
DROSOPHÍLIDÆ

a. Sternopleural bristle absent, mesopleuræ bristly; hind tibiæ without preapical bristles; anal cell apically open; metallic colored. (**Camílla,** palæarc.) ..... **CAMILLÌNÆ**
Sternopleural bristle present, no mesopleural bristles; hind tibiæ usually with preapical bristles.....b

b. Discal and second basal cells separated by a pigmented cross-vein c

Discal and second basal cells united. (**Drosóphila** (Fig. 655) (*D. melanogáster* or *ampelóphila*, Pomace fly, the laboratory fly of experimental genetics), **Chymomỳza, Cladochæ̀ta, Gítona, Leucophénga, Diathoneùra,** neotrop.; **Liodrosóphila,** Malay, **Mycodrosóphila, Scaptomỳza, Zygóthrica**). **DROSOPHILÌNÆ**

c. Middle tibiæ with dorsal row of bristles; eyes longest horizontally. (**Stégana,** largely neotrop.) ..... **STEGANÌNÆ**

Middle tibiæ outwardly without bristles; eyes longest vertically. (**Amiòta** (= *Phórtica*), **Orthostégana, Sinophthálmus**). (*PHORTICÌNÆ*) ..... **AMIOTÌNÆ**

137. Postvertical bristles convergent; proboscis usually long and geniculate; oral hairs smaller than vibrissæ. . **MILICHÌIDÆ**

a. Costa prolonged as a pointed lappet at end of Sc, last section of fourth vein at most twice as long as preceding; calypteres with long cilia; cheeks very narrow, mesopleuræ often bristly. (**Milíchia, Milichiélla,** widespr.; **Pholeomỳia,** Am.; **Pseudomilíchia,** nearc.) ..... **MILICHIÌNÆ**

Costa not prolonged as a lappet at the subcostal break, last section of fourth vein at least three times preceding; calypteres rarely with dense cilia; mesopleuræ rarely with bristles. (**Madìza, Phyllomỳza,** holarc.; **Desmometòpa** (Fig. 659), widespr.; **Aldrichiélla, Eusiphòna, Paramỳia,** nearc.). **MADIZÌNÆ**

Postverticals parallel; proboscis short; some oral bristles as strong as the vibrissæ; ocellar triangle wide. (**Cárnus** (= *Cenchridòbia*), palæarc.; **Meoneùra** (Fig. 658) holarc., ethiop.; **Hemeromỳia** (= *Paramadìza*) nearc.; **Rhodesiélla,** ethiop.). . . . **CÁRNIDÆ**

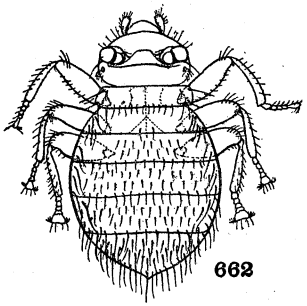
Pupipara

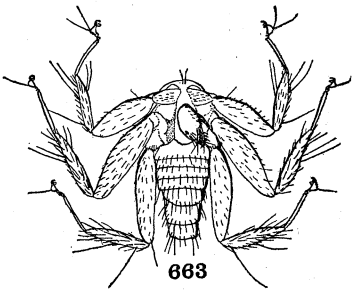
138. Mesonotum short, resembling the abdominal segments, no scutellum, abdomen completely sessile; eyes minute, no ocelli, antennæ set in lateral grooves; vertex without bristles; last tarsal joint broad, bearing an inflexed comb of many microscopic teeth. Small convex wingless insect, widespread, parasitic on the honey-bee. (See couplet 168). .(**Braùla** (Fig. 662), Beelouse) ..... **BRAULIDÆ**

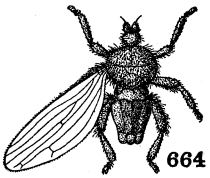
Thorax distinct from abdomen, scutellum developed; head with

bristles; tarsal comb not developed; winged or wingless species, parasitic on birds or mammals.....139

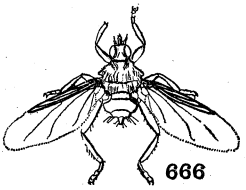
139. Head small, capable of folding back into a groove on the flattened and expanded mesonotum; eyes if present represented at most by two facets; wingless, long-legged species, parasitic on bats. Bat-tick flies. (See couplet 169). (**Nycteríbia** (Fig. 663), **Bacília, Cyclopòdia, Penicillídia**) ..... **NYCTERIBÌIDÆ**


662


663


664


665


666

Figs. 662–666. **Braulidæ, Nycteribiidæ, Streblidæ, Hippoboscidæ**

662. **Braula,** dorsal aspect. Braulidæ.
663. **Nycteribia,** dorsal aspect. Nycteribiidæ.
664. **Trichobius,** dorsal aspect (Brues) Streblidæ.
665. **Trichobius,** profile of head (Brues) Streblidæ.
666. **Pseudolfersia,** dorsal aspect (Lugger) Hippoboscidæ.

Head not folding back upon the mesonotum which is not strongly flattened and expanded.....140

140. Palpi broader than long, projecting leaf-like in front of head; wings when present usually with distinct parallel veins and outer crossveins, at least the principal veins not crowded forward; claws simple; almost always ectoparasites of bats. Bat flies. (See couplet 170). (**Strébla, Aspidóptera, Ascodíp-**

teron, Megistópoda, Nycteróphila, Pterellípsis, Trichòbius (Figs. 664, 665)) ..... **STRÉBLIDÆ**

Palpi slender and elongate, forming a sheath for the proboscis; wings if present with the stronger veins crowded along the costa (Fig. 666); tarsal claws strong and often armed with a series of small teeth; head and body often flattened: parasites of birds and mammals. (See couplet 170) ..... **HIPPOBÓSCIDÆ**

a. Ocelli often present, or when absent the anal cell is formed ..... b
Ocelli absent; anal cell usually not formed c

b. At most with functional wings having greatly reduced venation, usually with vestigial wings which have almost disappeared in the sheep-tick. (**Melóphagus** (*M. ovìnus*, Sheep-tick, cosmop.); **Echéstypus**, ethiop.; **Lipoptèna**, holarc.). (*MELOPHAGÌNÆ*) ..... **LIPOPTENÌNÆ**

Wings functional or vestigial, anal cell usually present. (**Ornithomŷia**, cosmop.; **Ornithœca**, mostly indoaustr.; **Ornithopértha**, neotrop.; **Stenópteryx, Cratærrhìna**, palæarc.) **ORNITHOMYIÌNÆ**

c. Wings well developed ..... d
Wings vestigial, anal vein closing anal cell. (**Allobósca**, ethiop.). **ALLOBOSCÌNÆ**

d. Pronotum not visible from above. (**Olférsia**, cosmop.; **Icósta**, malay.; **Lýnchia**, widespr.) ..... **OLFERSIÌNÆ**

Pronotum visible from above usually as a light colored ring. (**Hippobósca**, mostly palæarc.) ..... **HIPPOBOSCÌNÆ**

Wingless Diptera, or with Vestigial Wings

141. Antennæ and mouthparts absent; body at most pupiform ... 142
Antennæ and mouthparts present; body as in other adult flies. 143

142. Completely submarine; legs vestigial. (**Pontomŷia**, female, Samoa (see couplet 151)) ..... **CHIRONÓMIDÆ**, part

Boring in the skin of bats; completely sac-like, head, thorax and abdomen undifferentiated, without sutures. (**Ascodípteron**, female (Fig. 676), widespr. (see couplet 170)). (*ASCODIPTÉRIDÆ*) ..... **STRÉBLIDÆ**, part

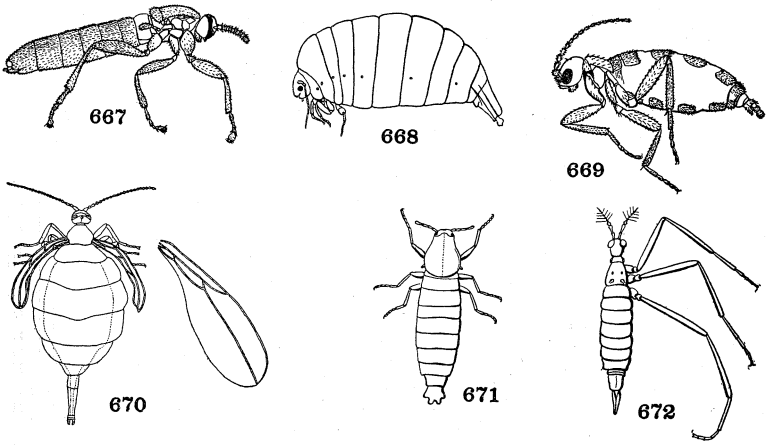
143. Antennæ free, consisting of more than six joints which are all more or less similar; palpi usually plainly jointed; bristles not developed. (NEMATÓCERA) 144
Antennæ consisting of three or less joints, rarely six; palpi not jointed; bristles often present. (BRACHÝCERA) 152

144. Female with long chitinized ovipositor; mesonotum typically with a V-shaped suture 145

No chitinized ovipositor; mesonotum without transverse V-shaped suture 146

145. Flagellum of antennæ short, thin and long-haired. (**Chiònea** (Fig. 672), Snow-flea, apterous, holarc.; **Zalùsa**, Falkl. Isl.; **Zaluscòdes**, antarc.) ..... **LIMONÌIDÆ**, part

Flagellum not much thinner than basal joints of antennæ; wings strap-shaped. (See couplet 7). (**Tipula**, female, widespr.). **TIPÙLIDÆ**, part



Figs. 667–672. **Wingless Nematocera**

667. **Thripomorpha** (Enderlein) Scatopsidæ.
668. **Dahlica** (Dahl) Mycetophilidæ.
669. **Pnyxia** (Schmitz) Sciaridæ.
670. **Termitomastus**, dorsal view and wing (Silvestri) Cecidomyiidæ.
671. **Clunio** (Carpenter, Bezzi) Chironomidæ.
672. **Chionea** (Johnson) Tipulidæ.

146. Eyes meeting over the antennæ 147

Eyes widely separated on the front; mouthparts reduced 150

147. Abdomen enormously swollen, the apical four segments forming a slender projection; antennæ long, filiform or moniliform. Termite guests. (**Termitomástus** (Fig. 670), neotrop.). **CECIDOMYÌIDÆ**, Subfam. **TERMITOMASTÌNÆ**

Abdomen formed otherwise 148

148. Claws dentate, pulvilli absent; antennal joints clavate and verticillate. (See couplet 17). (**Wasmanniélla**, palæarc.).
CECIDOMYÌIDÆ, part

Claws simple 149

149. Scutellum and halteres present; legs strong. (See couplet 20). (**Cobóldia**, myrmecophilous, nearc.; **Thripomórpha** (Fig. 667), palæarc.) ..... **SCATÓPSIDÆ**, part

Scutellum absent; legs slender ..... **SCIÁRIDÆ**, part

Two types of genera may be distinguished:

a. Small halteres and wing-stumps present. (**Austroscìara**, female only, in termite nests, Austr.; **Aptanógyna, Bértea, Dasyscìara**, palæarc.)

b. Halteres and wings wanting. (**Epídapus**, holarc.; **Pnýxia** (Fig. 669), Potato-scab mite, nearc.)

150. Termite guests; antennæ 14-jointed; no ocelli; wings with several veins. (See couplet 14). (**Termitadélphus, Termitodípteron**, neotrop.) ..... **PSYCHÓDIDÆ**, part

Not termite guests 151

151. Mesothorax large, forming a hood over base of head; abdomen constricted at thorax; halteres present. (See couplet 31). (**Clùnio** (Fig. 671), maritime, palæarc.; **Eretmóptera**, maritime, nearc.; **Pontomỳia**, male, marine, legs for swimming, Samoa; **Bélgica, Jacobsiélla**, Patagonia). (*ERETMOPTÉRIDÆ*) ..... **CHIRONÓMIDÆ**, part

Mesothorax small, not projecting over head; abdomen broadly sessile with thorax; halteres and scutellum undeveloped. (**Dáhlica** (Fig. 668), palæarc.).
Probably **MYCETOPHÍLIDÆ**

152. Empodium pulvilliform, legs long; eyes and ocelli well developed; antennæ six-jointed, short, without arista; thorax convex; apterous. (See couplet 36). (**Boreòides**, Austral.).
CHIROMÝZIDÆ, part

Empodium not pulvilliform 153

153. Physogastrous termite guests, the abdomen greatly swollen and anal segments inflexed under venter; arista feathered; mouthparts free; legs not compressed. (**Termitoxènia** (Fig. 678), Ind. Afr.; **Termitomỳia**, Afr.; **Odontoxènia**, Java).
TERMITOXENÌIDÆ

Not physogastrous, or if rarely so, the anus terminal 154

154. Head large, overlapping thorax; abdomen small, not evidently

segmented; eyes present; antennæ in grooves, the last joint with apical arista. (**Thaumatóxena** (Fig. 673), Eur. Afr.). **THAUMATOXÉNIDÆ**

Head not overlapping thorax 155

155. Antennæ consisting apparently of one globular joint, more or less sunk in cavities on the head, arista long and thin, bare or pubescent, three-jointed; legs, especially hind pair, robust and compressed: mostly myrmecophilous or termitophilous females. (See couplet 54). (**Pulicíphora, Chonocéphalus**, widespr.; **Platýphora** (=*Ænigmàtias* = *Oniscomyia*), holarc.; **Acontistóptera** (Fig. 674), **Commóptera, Ecitomỳia, Adelopteromỳia**, neotrop.; **Psyllomỳia, Ænigmatístes, Ænigmatopœus**, ethiop.). (*STETHOPÁTHIDÆ*) .. **PHÓRIDÆ**, part

Antennæ two- or three-jointed; legs never compressed 156

156. Coxæ not separated by sternum; abdomen segmented; not parasitic on warm-blooded animals or on the honey-bee 157

Coxæ separated by sternum; segmentation of abdomen sometimes obscure; parasitic on birds, mammals, or on the hive-bee 168

157. No frontal lunule or suture immediately over antennæ; third antennal joint more or less tapering 158

A Ω-shaped frontal suture over the antennæ; third antennal joint more or less ovate, with dorsal arista; palpi at most one-jointed 159

158. Arista or style usually terminal, if dorsal (*Thinodromia*) the body is heavily gray pollinose. (See couplet 58). (**Ariasélla, Dusmetìna, Pieltània**, S. Europe; **Thinodròmia**, maritime, Pacific Coast of N. Am.) ..... **EMPÍDIDÆ**, part

Arista dorsal, body metallic (*Emperoptera*), or brown (*Schœnophilus*). (See couplet 58). (**Emperóptera** (Fig. 675), Hawaii; **Schœnóphilus**, Antarctic) ..... **DOLICHOPÓDIDÆ**, part

159. Hind metatarsi shorter than following joint. (See couplet 116). (**Aptilòtus**, holarc.; **Apterìna**, palæarc.; **Ántrops, Anatalánta, Siphlópteryx**, Antarct.) ..... **BORBÓRIDÆ**, part

Hind metatarsi longer than following joint 160

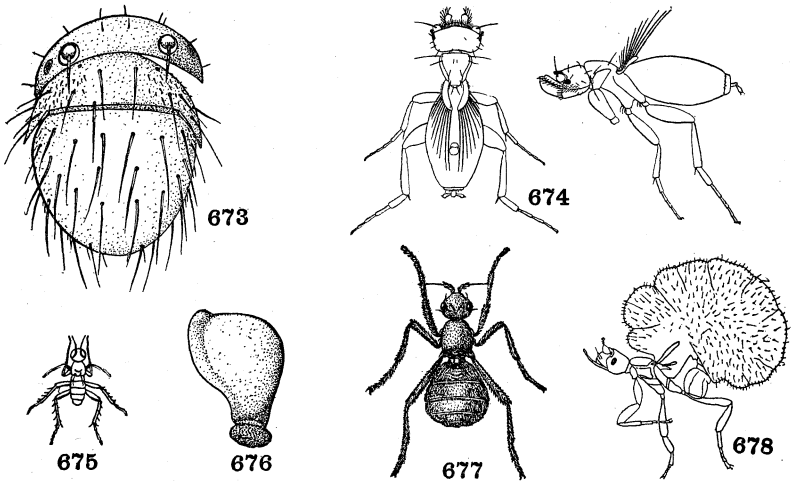
160. Mouth-opening large. (See couplet 132). (**Amalópteryx, Chamæbósca**, Antarc.) ..... **EPHÝDRIDÆ**, part

Mouth-opening normal 161

161. Arista loosely plumose. (See couplet 136). (**Drosóphila**, in vestigial-winged or apterous condition)... **DROSOPHÍLIDÆ**, part

Arista pubescent or bare 162

162. Legs stout, woolly pubescent. (Cf. couplet 89). (**Pezomỳia,** Falkland Isl.) ..... **DRYOMÝZIDÆ,** part
Legs not stout or woolly pubescent..... 163
163. Mesonotum with well developed bristles on anterior portion..... 164
Mesonotum without strong dorsocentral bristles..... 165



Figs. 673–678. **Wingless Diptera**

673. **Thaumatoxena** (Trägårdh) Thaumatoxenidæ.
674. **Acontistoptera** (Brues), dorsal and side views. Phoridæ.
675. **Emperoptera,** dorsal view (Grimshaw) Dolichopodidæ.
676. **Ascodipteron,** degenerate female (Adensamer) Streblidæ.
677. **Anatalanta** (Enderlein, Bezzi) Borboridæ.
678. **Termitoxenia**, side view (Bugnion) Termitoxeniidæ.

164. Thorax flattened; legs hairy; femora of *Icaridion* robust and with heavy spinous bristles beneath. (Cf. couplet 87). (**Apetènus, Icarídion,** Antarc.)..... **CŒLŌPIDÆ,** part
Thorax convex; legs with bristles. (See couplet 69). (**Cœnòsia** sp., Antarct.) ..... **ANTHOMYÌIDÆ,** part
165. Legs lengthened and slender. (Cf. couplet 82). (**Calycópteryx,** Antarc.) ..... **MICROPÉZIDÆ,** part
Legs not elongate..... 166

166. Head without bristles, ocellar triangle large. (See couplet 125). (**Alómbus**, Afr.; **Myrmecomórpha**, Eur.).
CHLORÓPIDÆ, part
Head with vertical and frontal bristles, ocellar triangle not large. 167
167. Wings developing normally, but breaking off at base. (See couplet 137). (**Cárnus** (=*Cenchridòbia*), Eur.).... **CÁRNIDÆ**, part
Wings reduced, not dehiscent. (Cf. couplet 124). (**Penguístus**, Chile) ..... **OPOMÝZIDÆ**
168. Mesonotum short and resembling abdominal segments, no scutellum; parasitic on the honey bee. (See couplet 138). (**Braùla** (Fig. 662), cosmop.) ..... **BRAULIDÆ**
Thorax distinct from abdomen, scutellum developed; parasitic on birds or mammals 169
169. Head small, movable, thrown back into a groove of the thorax; thorax incompletely chitinized; completely apterous. Bat parasites. (See couplet 139). (**Basília**, **Nycteríbia** (Fig. 663), **Penicillídia**, widespr.; **Cyclopòdia**, **Eucampsípoda**, Ind., ethiop.) ..... **NYCTERIBÌIDÆ**
Head not folding back on the thorax; mesonotum completely chitinized 170
170. Head fitting into an emargination of the thorax; palpi forming a sheath for proboscis; eyes more or less reduced, oval or round; antennæ set in grooves. (See couplet 140). (**Lipoptèna** (wings developing normally, but dehiscent at base), widespr.; **Melóphagus** (*M. ovìnus*, Sheep-tick), cosmop.; **Allobósca**, Madagasc.) ..... **HIPPOBÓSCIDÆ**, part
Head with a fleshy movable neck; palpi broad, projecting; eyes wanting or vestigial. (See couplet 140). Bat parasites. (**Ascodípteron**, male, wings normal but dehiscent at base. (See couplet 142 for female), widespr.; **Aspidóptera**, **Megistópoda**, **Metelásmus**, **Paradyschíria**, **Pterellípsis**).
STRÉBLIDÆ, part

KEY TO THE LARVAE OF THE PRINCIPAL FAMILIES OF DIPTERA[1]

1. Head complete (Figs. 679–704), or the posterior portion with deep longitudinal incisions; mandibles moving horizontally, fitted for chewing; more than three larval stages: body consisting of

[1] Based on Malloch: Bull. Ill. State Lab. Nat. Hist., **12**, art. 3 (1917).

thirteen segments in addition to head; with nine pairs of spiracles. (NEMATÓCERA) 3

Head incomplete, without a strongly developed upper arcuate plate (Figs. 705–737); mandibles moving vertically, mouthparts essentially sucking: body comprising fewer than thirteen segments and only exceptionally with as many as nine pairs of spiracles. (BRACHÝCERA) 2

2. Mandibles normally sickle-shaped, not protruding much beyond apices of the well-developed maxillæ, often much shorter, maxillary palpi distinct (Fig. 686); antennæ well developed, situated on the upper surface of a slightly arcuate chitinized dorsal plate; no free pharyngeal skeleton within the head capsule, the exoskeleton of the head at least dorsally indicated. (ORTHÓRRHAPHA) 25

Mandibles short and hook-like, usually capable of protrusion much beyond the poorly developed maxillæ, palpi rarely visible; antennæ poorly developed or absent, when present situated on a membranous surface; a free pharyngeal skeleton present; head very poorly developed, completely unchitinized dorsally. (CYCLÓRRHAPHA) 38

3. Head incomplete, consisting of two parts, the anterior more or less chitinized above, the posterior unchitinized and bearing the eye spots; thorax and abdomen comprising thirteen segments; usually with a "wishbone" or chitin plate on under side of second thoracic segment, at least in mature larvæ; larvæ peripneustic, *i.e.* with series of lateral spiracles; mandibles apparently absent; antennæ long, two- or three-jointed. Usually feeding on plant sap, many larvæ gall makers, some feed on aphids, scale insects, mites, etc. Very small insects. (Fig. 679, **Retinodiplòsis**) ..... **CECIDOMYÏIDÆ**

Without such combination of characters 4

4. Abdominal segments with deep constrictions between them (Fig. 682), venter with series of sucking disks. Clinging to rocks in swift-running streams 5

Abdomen without a series of large sucking disks for attachment to rocks in swift-running water 6

5. Ventral sucking disks median, one on the anterior complex segment and usually one on each of the five following segments; head, thorax and first two abdominal segments fused to form a rather small first segment; mandibles three-toothed. (Fig. 682, **Bibiocéphala**) ..... **BLEPHAROCERÁTIDÆ**

Ventral sucking disks lateral, placed on the prolongations of the abdominal segments; thoracic segments distinct; mandibles deeply incised, the outer arm fringed with a comb of long teeth. **DEUTEROPHLEBÌIDÆ**

6. Head incomplete behind, either with three deep wedge-shaped slits, two on dorsum and one on ventral side (Fig. 685), or the ventral surface very poorly chitinized and the dorsal posteriorly in the form of four slender heavily chitinized rods, with a weakly chitinized divided plate on anterior half of dorsum. . 7

Head capsule complete, *i.e.* at least bounded above behind and not divided into plates or rods; mandibles opposed. 8

7. End of abdomen with six radiating protuberances; body with regularly placed bristles; head heavily chitinized, dorsally slightly arcuate and with two longitudinal slits, ventrally rounded and with a central slit; antennæ longer than maxillary palpi; labium pointed, not divided into two parts, the anterior margin dentate; mandibles very stout, with two apical teeth. Larvæ in damp soil, feeding on roots, or as scavengers, sometimes in water. Larvæ of *Tipula*, etc., known as Leather-jackets. (Fig. 995, **Típula**) . . . . . **TIPÙLIDÆ**

End of abdomen with at most five radiating processes as well as single or double breathing tubes; if six apical processes are present the labium is subdivided centrally; body usually without regularly placed bristles, frequently with dense surface pilosity; head more or less retracted, sometimes weakly chitinized and without distinct labium; antennæ sometimes short and slender and not as long as maxillary lobe; mandibles never with only two teeth. Mostly aquatic, or living in wet ground, sometimes carnivorous, some species are terrestrial and green from feeding on leaves. (Figs. 683, 685, **Limònia**; Fig. 684, **Dicranòta**) . . . . . **LIMONÌIDÆ**

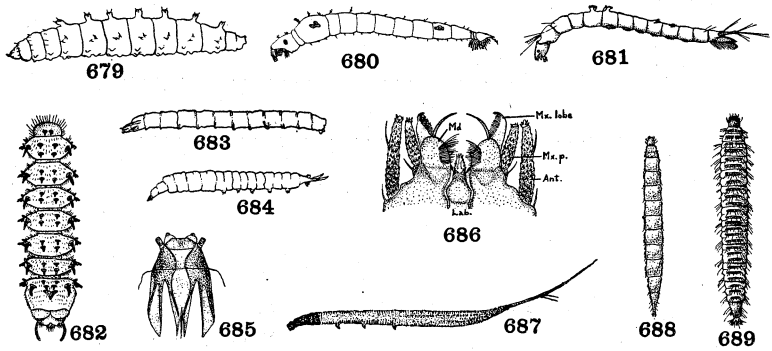
8. The three thoracic segments fused to form a complex more or less dilated mass (Fig. 987); head freely movable, chitinized, at least in mature larvæ with faceted eyes; eighth abdominal segment typically with a stout protruding breathing tube, ninth segment with four anal gill-flaps and with a brush of hairs. Aquatic, free-swimming or suspended. (Fig. 680, **Sayomỳia**; Fig. 987, **Cùlex**) . . . . . **CULÍCIDÆ**

The three thoracic segments separate. 9

9. A many-toothed chitinized mentum or labial plate (Fig. 694) present on the underside of the head, which is divided into sub-

mentum and mentum in primitive forms; larvæ peripneustic only in the aquatic Simuliidæ where the spiracles are vestigial. 10

Mentum more or less reduced or completely wanting, at most three-dentate in the terrestrial and peripneustic Bibionidæ; lateral plates of head capsule usually connected ventrally behind by a chitinous bridge. 16



Figs. 679–689. **Nematocerous Larvæ**

679. **Retinodiplosis,** side view (Malloch) Cecidomyiidæ.
680. **Sayomyia,** side view (Malloch) Culicidæ.
681. **Dixa,** side view (Malloch) Dixidæ.
682. **Bibiocephala,** dorsal view (Malloch) Blepharoceratidæ.
683. **Limonia,** side view (Malloch) Limoniidæ.
684. **Dicranota,** side view (Malloch) Limoniidæ.
685. **Limonia,** head capsule (Malloch) Limoniidæ.
686. **Dixa,** anterior extremity (Malloch) Dixidæ.
687. **Bittacomorpha,** side view (Hart) Ptychopteridæ.
688. **Psychoda,** dorsal view (Malloch) Psychodidæ.
689. **Psychoda,** dorsal view (Malloch) Psychodidæ.

10. Posterior portion of abdomen swollen (Fig. 985), the last segment ventrally armed with a sucking disk which bears concentric series of bristles by means of which the larvæ hold on to rocks in the swiftly running streams in which they live; mouth on each side with a large jointed maxilla which bears a fan-like arrangement of long hairs; thorax with a pair of closely fused pseudopods; minute spiracles opening on all abdominal segments, *i.e.* larvæ peripneustic. (Fig. 985, **Simùlium**).

SIMULÌIDÆ

Body not club-shaped and fitted with terminal sucking disk, nor with large fan-like oral appendages (in Dixidæ the maxillæ bear a small fan); larvæ metapneustic, with only the last pair of spiracles, or amphipneustic, with only the first and last pairs. . 11

11. First and second abdominal segments each dorsally with two wart-like elevations resembling pseudopods (Fig. 681), the apices of which are armed with many small hook-like setæ; behind the posterior spiracles two pairs of fringed processes and a terminal bristly tube: occurring in cold streams. (Figs. 681, 686, **Díxa**) . . . . . **DÍXIDÆ**

First and second abdominal segments without dorsal elevated processes 12

12. Last abdominal segments retractile, terminating in a long slender respiratory tube, ventral pseudopods present and equipped with bristles: aquatic larvæ. (Fig. 687, **Bittacomórpha**). **PTYCHOPTÉRIDÆ**

Abdomen not terminating in a long thin bare respiratory tube. . 13

13. Thorax and abdomen with a secondary segmentation (Figs. 688, 689) due to the presence of narrow transverse chitinized bands, three bands on most of the segments, or the apical segment in the form of a short chitinized tube; rarely the ventral segments bear a central series of sucker-like disks; body tapering at each end. Occurring in sewage, dung, fungi and tree-holes. (Figs. 688, 689, **Psychòda**) . . . . . **PSYCHÓDIDÆ**

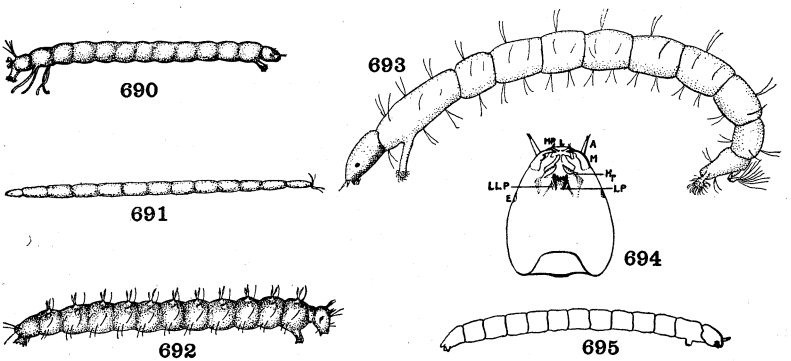
Dorsum without narrow strap-like bands, apical segment not in the form of a short chitinized tube; ventral abdominal segments never with sucking disks. 14

14. Mentum projecting, with chitinized cutting edge; labrum movable; four finger-like anal gills; head capsule with peculiar pointed processes; penultimate segment dorsolaterally humped; prothorax with leg-stumps. Living in woods, on damp rocks; rare . . . . . **THAUMALÈIDÆ**

Mentum not projecting in the form of a cutter; labrum fixed. . 15

15. Either very slender, tapering toward each end, without thoracic or anal pseudopods or surface hairs (Fig. 691), or stouter, with well defined segments which are armed with strong bristles, some of which are lanceolate (Fig. 692); one pair of prothoracic pseudopods present, a single anal pseudopod present or not. Terrestrial, living in manure or under bark, etc., or in water. (Fig. 692, **Forcipomŷia**; Fig. 691, **Palpomŷia**). **CERATOPOGÓNIDÆ**

Usually cylindrical (Figs. 690, 693, 695) rarely with thoracic segments swollen; without distinct body bristles but often with soft hairs, the last segment usually with a dorsal tuft of hairs; pseudopods usually present, one pair each on prothorax and anal segment. Mostly aquatic, living in sand-tubes (Bloodworms), some marine, rarely terrestrial. (Fig. 695, **Camptocl̀adius**; Fig. 690, **Chirónomus**; Fig. 694, **Proténthes**; Fig. 693, **Tánypus**) ..... **CHIRONÓMIDÆ**



Figs. 690–695. **Nematocerous Diptera, Larvæ**

690. **Chironomus,** side view (Malloch) Chironomidæ.
691. **Palpomyia,** side view (Malloch) Ceratopogonidæ.
692. **Forcipomyia,** side view (Malloch) Ceratopogonidæ.
693. **Tanypus,** side view (Brues) Chironomidæ.
694. **Protenthes,** ventral view of head (Malloch) Chironomidæ.
695. **Camptocladius,** side view (Malloch) Chironomidæ.

16. Larvæ peripneustic, *i.e.* most abdominal segments with spiracles 17
Larvæ amphipneustic, *i.e.* only first and last pairs of spiracles present, or metapneustic, *i.e.* only the posterior pair of spiracles remaining; or thoracic and abdominal spiracles not evident..22
17. Antennæ elongate; body furnished with some conspicuous bristles or hairs 18
Antennæ usually short and inconspicuous, sometimes apparently absent; body without conspicuous bristles; principally inhabiting fungi 19

18. Anal spiracles at the apices of long stalk-like process (Fig. 704); no false segment immediately behind the head. Living in decaying vegetation, rotting fruits, excrement, or under old bark. (Fig. 704, **Scatópse**) ..... **SCATÓPSIDÆ**

    Anal spiracles sessile, metathoracic spiracles present; a fully developed false segment behind the head armed dorsally with spinose processes (Fig. 696). Larvæ principally scavengers living in soil, sometimes prevalent about dung, sometimes destructive to root crops. (Fig. 696, **Bíbio**) ..... **BIBIÓNIDÆ**

19. Dorsal or clypeal sclerite of head (præfrons) not distinctly tapering behind; antennæ two-jointed ..... **BOLITOPHÍLIDÆ**

    Dorsal or clypeal sclerite of head conspicuously tapering posteriorly; antennæ almost indistinguishable.....20

20. Lateral plates of head meeting on ventral line only for a short space immediately behind the mouth-opening, then widely diverging and not connected at posterior margin; maxillæ and mandibles apparently grown together to form a pair of many-toothed rasping organs. (Fig. 698, **Exèchia**; Fig. 701, **Lèia**). **MYCETOPHÍLIDÆ**

    Lateral plates of head connected for a short space behind the mouth-opening and again near posterior margin; maxillæ and mandibles distinctly separated from each other, the mandibles apically tridentate.....21

21. Clypeal sclerite reaching back to the occipital margin of the head-capsule; body segmentation distinct, especially on venter where the outline is moniliform; armed with spines which have two or three points ..... **DITOMYÌIDÆ**

    Clypeal sclerite shorter, not attaining the occipital margin of the head-capsule; segmentation distinct but not moniliform; spines simple. Living in soil, essentially as scavengers. (Fig. 703, **Sciara**) ..... **SCIÁRIDÆ**

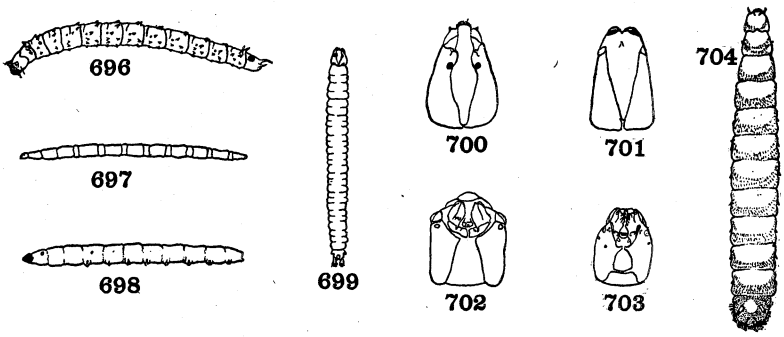
22. Clypeal sclerite (præfrons) tapering behind to a point; head free, body flattened, each abdominal segment with secondary incisures, last segment with four fleshy lobes surrounding the spiracles. Living in humus soil and under leaves. (Fig. 699, **Trichócera**) ..... **TRICHOCERÁTIDÆ**

    Clypeal sclerite not tapering behind to a point.....23

23. Antennæ undeveloped, appearing as pale round spots on sides of head; ventral surface of head with sclerites contiguous anteriorly, widely separated posteriorly. Living in slimy webs on fungi. (Fig. 702, **Ceróplatus**) ..... **CEROPLÁTIDÆ**

Antennæ pedunculate, usually well developed; ventral surface of head with sclerites contiguous on entire length, not separated widely posteriorly; body slender, tapering, abdominal segments each with a single constriction near anterior margin. 24

24. Apical segment with five short but distinct processes around the spiracular disk; mandibles apically rounded and furnished with



Figs. 696–704. **Nematocerous Diptera, Larvæ**

696. **Bibio,** side view (Malloch) Bibionidæ.
697. **Mycetobia,** side view (Malloch) Mycetobiidæ.
698. **Exechia,** side view (Malloch) Mycetophilidæ.
699. **Trichocera,** dorsal view (Malloch) Trichoceratidæ.
700. **Anisopus,** head (Malloch) Anisopodidæ.
701. **Leia,** head (Malloch) Mycetophilidæ.
702. **Ceroplatus,** head, ventral view (Malloch) Ceroplatidæ.
703. **Sciara,** head, ventral view (Malloch) Sciaridæ.
704. **Scatopse,** dorsal view (Malloch) Scatopsidæ.

dense rows of long bristles; the thin ventral chitinous bridge posteriorly connecting the lateral plates not broken. Scavengers, occurring in decaying vegetable matter, manure, and sometimes in sewage. (Fig. 700, **Anìsopus**)

ANISOPÓDIDÆ

Apical segment with minute processes around the spiracular disk; mandibles apically tridentate; the thin chitinous ventral bridge extending posteriorly between the lateral plates interrupted in the middle. Occurring in sap flow of trees. (Fig. 697, **Mycetòbia**) . . . . . **MYCETOBÌIDÆ.**

Brachycera Orthorrhapha

25. Posterior spiracles approximated, situated within a terminal or subterminal cleft or chamber, usually concealed, or with a terminal breathing tube; body usually shagreened or wholly or in part longitudinally striated. 26
Posterior spiracles rather widely separated, visible, situated on apical segment, which may be truncated, chitinized, or armed with apical processes, or upon penultimate or antepenultimate segment; body not shagreened or visibly striated. 28

26. Head not retractile, bristly, body 11-segmented, flattened, surface finely shagreened, without pseudopods; spiracular fissure transverse, sometimes rather small; pupæ enclosed in larval skin. . 27
Head retractile; body 12-segmented, cylindrical, not shagreened, usually longitudinally striated, abdomen with a girdle of pseudopods on each segment; spiracular fissure vertical; pupæ free. Usually aquatic, or semiaquatic; predaceous. . . **TABÂNIDÆ**

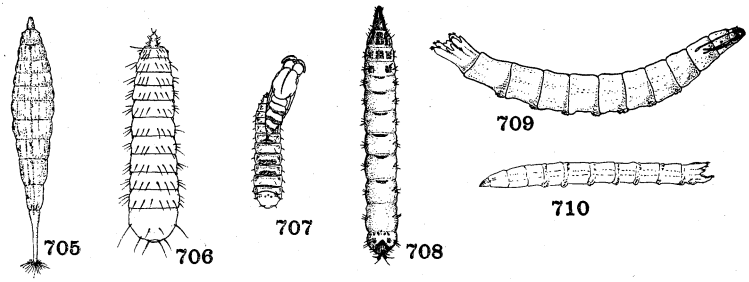
27. Peripneustic, *i.e.* with lateral abdominal spiracles on most segments. Aquatic, or living in semiliquid matter, under bark, in manure, or on rotting vegetation. (Fig. 705, **Stratiomŷia**; Fig. 706, **Hermètia**). . . . . **STRATIOMYÌIDÆ**
Amphipneustic, *i.e.* only prothoracic and last abdominal spiracles present. Living under bark. (Fig. 707, **Xylomŷia**). **XYLOMYÌIDÆ**

28. Posterior spiracles situated on apical segment. 29
Posterior spiracles situated on penultimate or antepenultimate segment. 34

29. Projecting portion of head and the flattened apical plate of last abdominal segment heavily chitinized, the former cone-shaped, entirely closed except at extreme apex, not retractile; apical abdominal segment obliquely truncate and with projecting processes 30
Projecting portion of head more or less retractile, not pointed cone-shaped, the movable parts not enclosed; last abdominal segment without a heavily chitinized flattened terminal plate. 31

30. Head about twice as long as its greatest width; thoracic segments not chitinized above, each with two internal separated chitinized plates; body without long hairs; apical plate very large; spiracles vertically elongated, apical paired protuberances small, widely separated, each with a short hair on inner side. Living in soil or decaying wood. (Fig. 711, **Cœnomŷia**). **CŒNOMYÌIDÆ**

Head at least three times as long as its greatest width; at least the first and second thoracic segments chitinized above, no internal chitinized plates present; body with a number of long hairs, four of which in a vertical series on each abdominal segment are very noticeable; apical plate rather small, spiracles rounded, apical paired protuberances large, fused basally, each with a number of rather long hairs. Living under bark or in soil. (Fig. 708, **Xylóphagus**) ..... **XYLOPHÁGIDÆ**



Figs. 705–710. **Orthorrhaphous Diptera, Larvæ**

705. **Stratiomyia,** dorsal view (Johannsen) Stratiomyiidæ.
706. **Hermetia,** dorsal view (Malloch) Stratiomyiidæ.
707. **Xylomyia,** emergence showing withdrawal of pupa from puparium (Greene) Xylomyiidæ.
708. **Xylophagus,** dorsal view (Greene) Xylophagidæ.
709. **Aphrosylus,** side view (Wheeler) Dolichopodidæ.
710. **Dolichopus,** side view (Malloch) Dolichopodidæ.

31. Posterior spiracles widely separated, located in an apical transverse cleft; head very small, retractile; mature larvæ stout, cylindrical, bare, dorsally with three oval swellings and ventrally with a transverse creeping pad on each segment. Endoparasitic in beetles. ..... **NEMESTRÍNIDÆ**

Spiracles not located in an apical transverse cleft. 32

32. Labial plate and rods behind it flat in one plane, or wanting, or fused with the capsule. 33

Labial plates and rods meeting angularly, grown together in front V-like, in profile appearing bent and usually united behind with the tentorial rods; head mostly membranous, even above to the triangular dorsal plate; usually amphipneustic. Predatory,

mostly living in moist earth, some aquatic, some under bark, some in decaying vegetable matter.
Fig. 713, **Drápetis** ..... **EMPÍDIDÆ**
Fig. 709, **Aphrosỳlus**; Fig. 710, **Dolíchopus**.
DOLICHOPÓDIDÆ

33. Head capsule long, in large part internal, reaching back to the mesothorax, dorsal plate very long, pear-shaped, broader behind; hind spiracles ending separately in two plates or tracheal gills. (Fig. 716, **Athèrix**; Figs. 712 and 717, **Chrysopìla**).
RHAGIÓNIDÆ

Head capsule short, the dorsal plate not covering the part inset in the thorax, the internal part flat or divided into rods; apical abdominal segment without projecting processes, the spiracles very small; endoparasites of spiders .... **ACROCERÁTIDÆ**

34. Posterior spiracles situated on the antepenultimate segment, abdominal segments one to six subdivided, the body apparently consisting of twenty segments exclusive of the head; head free, slightly longer than broad and not set into the thorax.....35

Posterior spiracles situated on penultimate segment; abdominal segments simple, the body apparently consisting of eleven or twelve segments exclusive of the head.....36

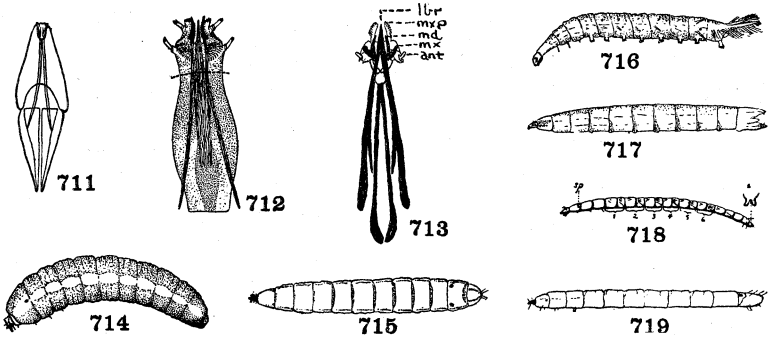
35. Posterior dorsal internal extension of head (*i.e.* the two fused metacephalic rods lying in prothorax and mesothorax) spatulate at apex; ventral posterior projections in the form of two short chitinized rods. Living in soil and decaying wood, predatory, locomotion serpentine, assisted by the mouthparts. (Fig. 718, **Psilocéphala**) ..... **THERÉVIDÆ**

Posterior dorsal internal extension of head not spatulate at apex; ventral posterior projections absent. Found in fungi, rotten wood and in houses, in carpets and furniture; predatory.
SCENOPÍNIDÆ

36. Penultimate abdominal segment longer than the ultimate, with a deep transverse depression near its apex giving it the appearance of two distinct segments; ultimate segment terminating in a sharp ridge with a median sharp point, on each side of which dorsally and ventrally are situated four very closely approximated hairs similar to those of Asilidæ. Living in decaying wood, predatory on beetle grubs. (Fig. 715, **Mỳdas**).
MYDÀIDÆ

Penultimate abdominal segment shorter than ultimate, or if longer without a deep transverse depression; apical segment not as above, the hairs not closely approximated.....37

37. Thoracic segments each with two long hairs, one on each side on ventro-lateral margin; apical segment with six or eight long hairs; head well developed, porrect and more or less cone-shaped when viewed from above, appearing flattened when viewed from the side; penultimate segment usually shorter than ultimate or not much longer; body held straight. Living in soil and decaying wood, predaceous. (Fig. 719, **Prómachus**). **ASÍLIDÆ**



Figs. 711–719. **Orthorrhaphous Diptera, Larvæ**

711. **Cœnomyia,** cephalopharyngeal skeleton (Malloch) Cœnomyiidæ.
712. **Chrysopila,** cephalopharyngeal skeleton (Malloch) Rhagionidæ.
713. **Drapetis,** internal skeleton (Malloch): ant, antenna; lbr, labrum; md, mandible; mx, maxilla; mxp, maxillary palpus. Empididæ.
714. **Sparnopolius,** side view (Malloch) Bombyliidæ.
715. **Mydas,** dorsal view (Malloch) Mydaidæ.
716. **Atherix,** side view (Greene) Rhagionidæ.
717. **Chrysopila,** side view (Malloch) Rhagionidæ.
718. **Psilocephala,** side view (Malloch) Therevidæ.
719. **Promachus,** side view (Malloch) Asilidæ.

Thoracic segments without hairs, or with very weak hairs; apical segment without distinguishable hairs; head not much protruded, directed downward, not cone-shaped, with a dorsal protuberance when viewed from the side; penultimate segment distinctly longer than ultimate; body usually semicircularly curled at rest. Parasites, inquilines or predators, in nests of bees and wasps, egg-cases of grasshoppers, etc. (Fig. 714, **Sparnopòlius**) ..... **BOMBYLÌIDÆ**

Cyclorrhapha

38. Maxillæ and palpi present, near the very small bent mandibles; body comprising only nine distinct segments, the head and prothoracic and the metathoracic and first abdominal segments appearing grown together; much flattened, seed-like, scarcely twice as long as broad; head bearing underneath on each side a triangular flap, retractile into the thorax; frontal sac opening directly into the upper surface of the head; incisures chitinized above, side margins with many incisions, venter membranous, apical segment with two filiform appendages. Living in mud and about decaying organic matter. (Fig. 723, **Lonchóptera**). **LONCHOPTÉRIDÆ**

Maxillæ not developed, only the mouth-hooks present; frontal sac opening in an atrium in the mouth cavity 39

39. Upper lip projecting forward between and below the two mouth-hooks, distally hooked or toothed, the mouth-hooks porrect, single-pointed or more often toothed; body with eleven incisures, lengthened, anteriorly tapering, posteriorly blunt or the eighth abdominal segment tube-like; metapneustic, *i.e.* terminal spiracles alone present. Living in many situations, in dung, carrion, ant nests, etc. . . . . **PHÓRIDÆ**

Mentum never extending between the two mouth-hooks as a point or hook except in Aphis-eating Syrphidæ, in which case the lateral rods of the mentum are produced forward over the mentum and fuse to form a projecting pointed upper lip; mostly amphipneustic, *i.e.* anterior pair as well as terminal spiracles present 40

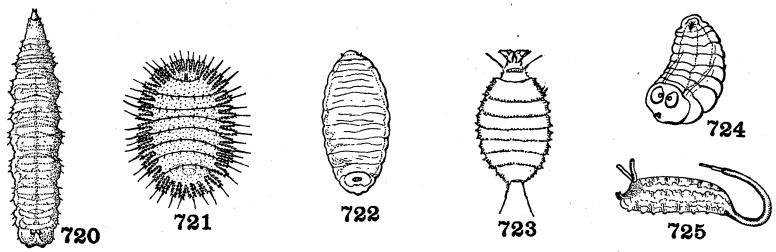
40. Larva broad and depressed, in dorsal aspect appearing to have only nine or ten segments because the head and prothorax are inflexed to the under surface, the sides of the body with long projecting bristles and sometimes deeply incised and serrate; posterior spiracles not or but little prominent, rather widely separated, placed at the base of the last segment, prothoracic spiracles prominent. Developing in fungi. (Fig. 721, **Callimỳia**) . . . . . **PLATYPÉZIDÆ**

Of other conformation 41

41. Hind spiracles three- or four-parted, separate from each other on a common chitin plate some distance before the tip of the body; acephalous, mouthparts very indistinct, the mouth-hooks sessile; body comprising ten or eleven segments. Endoparasitic on Homoptera. (Fig. 722, **Pipúnculus**) . . **PIPUNCÙLIDÆ**

If the posterior spiracles are located on a common chitin plate they are contiguous to each other. 42

42. Posterior spiracles close together at the end of a tracheal tube of greater or less length, which is sometimes chitinized and sometimes greatly extensile; mouthparts various, absent in " rat-tail " larvæ (Fig. 725), developed in the species living in wood, and in the " Aphis-lions " (*Syrphus*, etc.) the mouthparts are



Figs. 720–725. **Aschizous Diptera, Larvæ**

720. **Syrphus,** dorsal view (Metcalf) Syrphidæ.
721. **Callimyia,** dorsal view (de Meijere) Platypezidæ.
722. **Pipunculus,** dorsal view (Perkins) Pipunculidæ.
723. **Lonchoptera,** dorsal view (de Meijere) Lonchopteridæ.
724. **Conops** (Brauer) Conopidæ.
725. **Eristalis,** side view (Metcalf) Syrphidæ.

specialized into piercing organs; larvæ apparently acephalous, body with about eleven obscure segments, skin usually rough, form diverse, conical, more or less cylindrical, even hemispherical. Food habits various, under bark, in tuber-roots, about sewage, in ant or bee nests, or free-living and preying on aphids. (Fig. 720, **Sýrphus**; Fig. 725, **Erístalis**).

SÝRPHIDÆ

Acephalous, true maggots, usually conically tapering (Figs. 728–737), sometimes stout warbles (Fig. 727). (The vast residue of the Diptera are insufficiently known to tabulate as to families, the following incomplete artificial key being largely based on food habits). (MUSCÒIDEA) 43

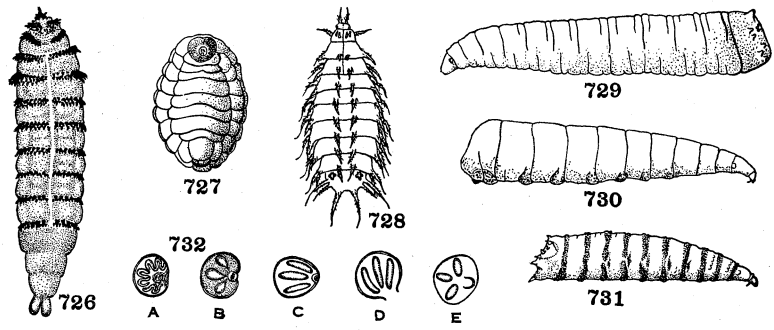
43. Endoparasites of insects or higher animals 44
Not parasitic 50

44. Parasites of insects....45
Parasites of mammals, turtles, frogs, etc....48
45. Body oval or pyriform, with distinct segments; antennæ wart-like, tipped with a chitinous ocellus-like ring; posterior spiracular plates large, round or reniform. Living within the abdomen of wasps or bees. (Fig. 724, **Cònops**) .... **CONÓPIDÆ**
Body more or less elongate, segmentation less evident....46
46. Posterior end of body rather truncate or broadly rounded, without long processes....47
Posterior end of body terminating in two slender tail-like processes, two to five times length of body; young larva hairy on posterior half of body. Living within Cottony cushion scale. (Fig. 736, **Cryptochætum**) .... **CRYPTOCHÆTIDÆ**
47. Posterior spiracular plates with a button. Endoparasites of various insects in their early stages.... **TACHÍNIDÆ**
Posterior spiracular plates without a button. (Figs. 731 and 732 D, **Sarcóphaga**).... **SARCOPHÁGIDÆ**
48. Body not strongly tapering, often obese, usually provided with numerous strong chitinous spines....49
Body strongly tapering in front (Fig. 731), at most with girdles of minute spines. (Figs. 731 and 732 D, **Sarcóphaga**). **SARCOPHÁGIDÆ**
49. Warbles living under skin of various ungulates, rodents, dogs and man, or in nasal sinuses or throat of various animals; body with strong spines or not. (Fig. 727, **Cutérebra**) .... **ŒSTRIDÆ**
Bot parasites in the stomach and intestines, principally of horses. (Fig. 726, **Gastróphilus**) .... **GASTROPHÍLIDÆ**
50. Body with lateral and dorsal spinose processes. (Fig. 728, **Homalomŷia**) .... **ANTHOMYÌIDÆ**, part
Body without such spinose processes....51
51. Body truncate or broadly rounded posteriorly....52
Body with one or two posterior processes; rather small species..57
52. Only one mandibular hook; posterior spiracular plates with sinuous slits (Fig. 732 A); no distinct fusiform pads on the side margins of the segments; posterior end of body with few if any conical processes, anterior end very slender. (Fig. 730, **Músca**) .... **MÚSCIDÆ**, part
With two mandibular hooks; slits of posterior spiracular plates not sinuous 53
53. Distinct tubercles above anal area; often processes around spiracular field; side margins of segments often with fusiform swollen areas 54

No tubercles above anal area; no distinct processes around spiracular field 59

54. Slits in spiracular plates rather short and arranged radially..... 55
Slits slender, subparallel to each other..... 56

55. Two tubercles above anal area; posterior spiracular field with distinct processes around it. (Fig. 729, **Pegomỳia**).
ANTHOMYÌIDÆ, part



Figs. 726–732. **Cyclorrhaphous Diptera, Larvæ**

726. **Gastrophilus,** dorsal view (Hadwen and Cameron) Gastrophilidæ.
727. **Cuterebra,** ventral view (Brauer) Œstridæ.
728. **Homalomyia,** dorsal view (Banks) Anthomyiidæ.
729. **Pegomyia,** side view (Frost) Anthomyiidæ.
730. **Musca,** side view (Banks) Muscidæ.
731. **Sarcophaga,** side view (Greene) Sarcophagidæ.
732. Left posterior spiracle (Banks): A, **Musca,** Muscidæ; B, **Muscina,** Muscidæ; C, **Calliphora,** Calliphoridæ; D, **Sarcophaga,** Sarcophagidæ; E, **Tritoxa,** Ortalidæ.

Four or more tubercles above anal area; slits of spiracular plate usually pointed at inner end. (Fig. 732 B, **Muscìna**).
MŰSCIDÆ, part

56. Posterior spiracular plates each with a button, slits rather transverse. (Fig. 732 C, **Callíphora**) ..... **CALLIPHÓRIDÆ**
Posterior spiracular plates without buttons, slits rather vertical, plates at bottom of a pit. (Figs. 731, 732 D, **Sarcóphaga**).
SARCOPHÁGIDÆ

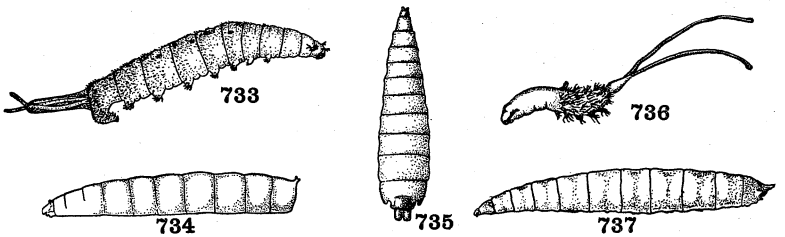
57. Posterior end of body with respiratory and usually forked anal

tube; venter with prolegs furnished with curved hooks. Aquatic larvæ. (Fig. 733, **Párydra**) ..... **EPHÝDRIDÆ**

Posterior end of body with two short fleshy processes.....58

58. Processes bearing spiracular plates. (Fig. 735, **Drosóphila**; Fig. 737, **Scaptomỳza**) .....**DROSOPHÍLIDÆ**

Processes not bearing spiracular plates..... **PIOPHÍLIDÆ**



Figs. 733–737. **Acalyptrate Diptera, Larvæ**

733. **Ephydra,** side view (Jones) Ephydridæ.
734. **Agromyza,** side view (Frost) Agromyzidæ.
735. **Drosophila,** dorsal view (Banks) Drosophilidæ.
736. **Cryptochætum,** side view (Smith and Compere) Cryptochætidæ.
737. **Scaptomyza,** side view (Frost) Drosophilidæ.

59. Spiracular plates on black tubercles; lateral fusiform areas rather weak though distinct; rather slender larvæ. (Fig. 732 E, **Tritóxa**) ..... **ORTÁLIDÆ**

Spiracular plates barely if at all elevated; lateral fusiform areas indistinct; spiracular plates often contiguous or nearly so, slits long and subparallel, no button..... **TRYPÉTIDÆ**

KEY TO THE PUPAE OF THE PRINCIPAL FAMILIES OF DIPTERA [1]

1. Pupa free, not enclosed within the indurated last larval moult, or if so the head is distinct as in the larva, or the puparium is slightly flattened dorso-ventrally, its texture leathery, not chitinous, and the anterior respiratory organs not distinguishable; adult, or pupa, emerging through a rectangular, T-shaped split on dorsum of larval skin (see Fig. 707).....2

[1] Based largely on Malloch: Bull. Ill. State Lab. Nat. Hist., **12**, art. 3 (1917).

Pupa coarctate, *i.e.* enclosed within the indurated last larval moult, and usually barrel-shaped and brown in color; head always retracted, the chitinous portion occupying a position on the inner side of the ventral surface of the puparium; anterior respiratory organs distinct, either protruded from the antero-lateral angles of the head extremity or from dorsum of base of abdomen; adult emerging usually by forcing off the rounded anterior extremity of the puparium in cap-like form (see Fig. 763), or the dorsal half of the thoracic portion — the lines of cleavage being along the lateral margins to a point at base of abdomen; rarely emergence is through rectangular splitting of the dorsum of the puparium (Figs. 760–764).

CYCLORRHAPHA [1]

2. Antennæ much elongated, distinctly visible beneath the pupal skin, normally curving well over upper margin of eyes and extending to or beyond base of wing, in some cases almost to apex of wing; head without strong thorns (except in some Cecidomyiidæ and a few Tipulidæ); thoracic respiratory organs much elongated or sessile; abdomen in species with short antennæ sometimes unarmed. (NEMATÓCERA).....3

Antennæ shorter, projecting downward and outward, not curving over the eyes nor reaching nearly to base of wing; head usually with strong thorns or horns; thoracic respiratory organs sessile, rarely stalk-like; abdomen usually armed with strong spines or bristles, or if unarmed there are only four or five distinct pairs of abdominal segments. (ORTHÓRRHAPHA).....26

3. Head with several strong thorns in a vertical series on the median line; pupæ living in galls on various parts of plants; sometimes pupa enclosed in the hardened larval skin and resembling a flaxseed ..... **CECIDOMYÏIDÆ**, part

Head without strong thorns, or if at base of each antenna there is a protuberance it is not sharp; pupæ not enclosed in galls on living plants, usually free and not enclosed in larval skin, but if so enclosed the larval moult does not resemble a muscid puparium 4

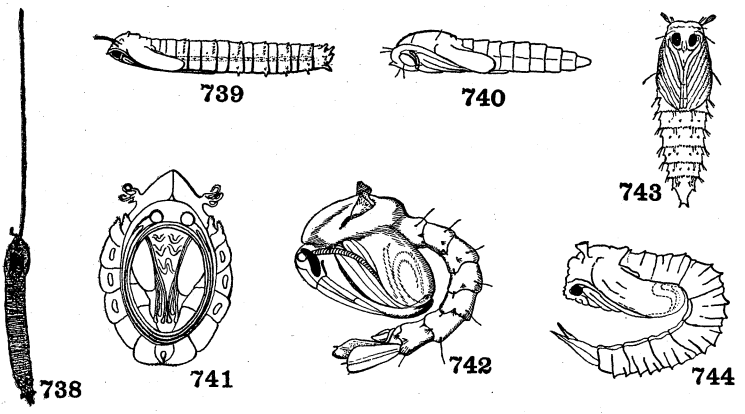
4. Thoracic respiratory organs sessile; abdomen without strong thorns or leaf-like elevations; legs straight.....5

Thoracic respiratory organs stalked, or if sessile the abdomen has strong thorns or leaf-like elevations, or the legs are recurved

[1] The pupæ of this large and important group are so imperfectly known that it is impossible to present a key to the families.

against base of abdomen and apex of thorax, or the coxæ do not conceal the sternopleura and the scape of the antennæ is almost globose; legs straight or recurved.....9

5. Legs short, apices of hind tarsi projecting slightly beyond apices of wings; antennæ short, curved across middle of eye. (Fig. 747, **Bíbio**) ..... **BIBIÓNIDÆ**



Figs. 738–744. **Nematocerous Diptera, Pupæ**

738. **Bittacomorpha,** dorsal view (Hart) Ptychopteridæ.
739. **Pachyrrhina,** side view (Malloch) Tipulidæ.
740. **Monardia,** side view (Malloch) Cecidomyiidæ.
741. **Deuterophlebia,** ventral view (Pulikovsky) Deuterophlebiidæ.
742. **Anopheles,** side view (Howard) Culicidæ.
743. **Psychoda,** ventral view (Malloch) Psychodidæ.
744. **Dixa,** side view (Malloch) Dixidæ.

Legs elongate, usually all tarsi projecting for a considerable distance beyond apices of wings; antennæ elongate, extending to or beyond bases of wings.....6

6. Antennæ almost straight, noticeably flattened, extending to bases of wings; thorax not much swollen in front, its anterior profile not declivous. (Fig. 749, **Ceróplatus**) .... **CEROPLÁTIDÆ**

Antennæ distinctly curved, not flattened, extending beyond bases of wings.....7

7. Thorax conspicuously swollen, almost globose, its anterior profile declivous; sternopleura concealed. (Fig. 750, **Lèia**). **MYCETOPHÍLIDÆ**

Thorax not conspicuously swollen, the anterior profile not sloping downward 8

8. Scape of antennæ much swollen, globose; abdominal spiracles small or absent; sternopleura enlarged, not concealed by fore coxæ and femora ..... **CHIRONÔMIDÆ**

Scape of antennæ not much swollen; abdominal spiracles distinct; sternopleura not visible, concealed by the large coxæ and femora of the fore legs.

(Fig. 740, **Monárdia**) ..... **CECIDOMYÌIDÆ**, part

(Fig. 748, **Scìara**) ..... **SCIÁRIDÆ**, part

9. Thoracic respiratory organs slender, long and tube-like; legs straight, extending well beyond apices of wings; body without armature except a pair of hairs on anterior margin of head; sternopleura concealed ..... **CECIDOMYÌIDÆ**, part **SCIÁRIDÆ**, part

Species without such combination of characters, abdomen usually with hairs or spines, or the sternopleura is exposed 10

10. Pupa in a pocket-shaped or slipper-shaped cocoon consisting of coarse threads, from the wide, open end of which project the thoracic respiratory filaments: aquatic, living in swiftly running streams. (Fig. 745, **Simùlium**) ..... **SIMULÌIDÆ**

Pupa free, or if enclosed or partly so the cocoon is not pocket-like and respiratory organs do not consist of tube-like branches . 11

11. Pupa when seen from above oval or rounded in outline, the abdomen at base not conspicuously narrower than thorax, so that the lateral outline is continuous; dorsal surface with strong integument; venter with sucking disks for adhering to rocks in running streams where the pupæ occur 12

Pupa with abdomen well differentiated from thorax, the dorsum membranous, or if strong and almost chitinized surface spines are developed 14

12. Antennæ excessively long, each forming a double coil on the venter; three pairs of lateral sucking disks; respiratory filaments short tubular. (Fig. 741, **Deuterophlèbia**). **DEUTEROPHLEBÌIDÆ**

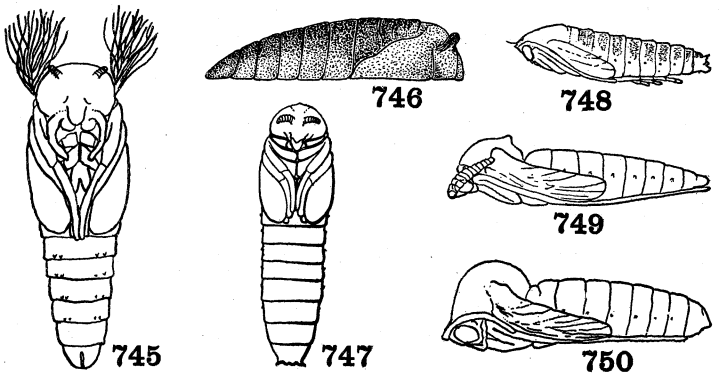
Antennæ not twice coiled; ventral sucking disks median 13

13. Thoracic respiratory organs lamelliform, consisting of four flat plates, the broad sides of which are contiguous. (Fig. 746, **Bibiocéphala**) ..... **BLEPHAROCERÁTIDÆ**

Thoracic respiratory organs simple, tube-like. (**Maurìna**, N. and S. Am.) ..... **PSYCHÓDIDÆ**, part

14. Apical abdominal segment terminating in two or four paddle-like or fin-shaped organs which are fringed on all or part of outer surface by strap-like hairs; or if the apical segment terminates in two long subconic processes the tarsi are recurved against the ventral surface of the base of the abdomen and apex of thorax so that they do not extend beyond apices of wings.....15

Apical segment of abdomen obtuse, armed with short or elongate spines or thorns, or if ending in a pair of long, slender processes



Figs. 745–750. **Nematocerous Diptera, Pupæ**

745. **Simulium,** ventral view (Malloch) Simuliidæ.
746. **Bibiocephala,** side view (Malloch) Blepharoceratidæ.
747. **Bibio,** ventral view (Malloch) Bibionidæ.
748. **Sciara,** side view (Malloch) Sciaridæ.
749. **Ceroplatus,** side view. Ceroplatidæ.
750. **Leia,** side view (Malloch) Mycetophilidæ.

they are more or less oval in transverse section and without strap-like hairs; tarsi generally entirely straight, rarely the apices of the hind pair incurved slightly, but never recurved as above stated.....20

15. Thoracic respiratory organs terminating in numerous thread-like filaments ..... **CHIRONÓMIDÆ,** part

Thoracic respiratory organs consisting of a single stem, in some cases with a few long, or many short, scale-like surface hairs, but never terminating in numerous thread-like filaments; occasionally the thoracic respiratory organs not elevated.....16

16. Thoracic respiratory organs not elevated; sternopleura exposed. **CHIRONÓMIDÆ**

Thoracic respiratory organs conspicuously elevated.....17

17. Thoracic respiratory organs situated close to anterior margin of thorax; no stellate hairs on thorax and abdomen. **CHIRONÓMIDÆ**, part

Thoracic respiratory organs situated close to middle of thoracic dorsum.....18

18. Apical abdominal segment ending in two or four broad, flat, paddle-like plates. (Fig. 742, **Anopheles**; Fig. 997, **Culex**). **CULÍCIDÆ**, part

Apical abdominal segment ending in two long subconical processes.....19

19. Apical processes armed with short hairs at apices and on middle of outer margin..... **CULÍCIDÆ**, part

Apical processes unarmed. (Fig. 744, **Díxa**)..... **DÍXIDÆ**

20. Apices of legs not extending beyond apices of wings.....21

Apices of posterior legs at least extending beyond apices of wings.22

21. Apical segment of abdomen ending in two conical processes. **CERATOPOGÓNIDÆ**

Apical segment of abdomen ending in two upper and two lower short thorns. (Fig. 743, **Psychòda**)..... **PSYCHÓDIDÆ**

22. Thoracic respiratory organs long, bifid; apical abdominal segment rounded, without processes; abdominal spiracles pedunculate. **SCATÓPSIDÆ**

Thoracic respiratory organs simple; apical abdominal segment not rounded, generally armed with protuberances.....23

23. Thoracic respiratory organs elevated but little above disk of thorax; tarsi of fore legs overlapping those of middle pair, which overlap the hind ones, all rather closely fused together and to wings..... **ANISOPÓDIDÆ**

Thoracic respiratory organs very conspicuously elevated; legs otherwise formed.....24

24. Thoracic respiratory organs equal in length, rarely one twice as long as the other; all tarsi distinct.....25

Thoracic respiratory organs of very different length, one short, the other very long; front tarsi overlapping middle pair. (Fig. 738, **Bittacomórpha**)..... **PTYCHOPTÉRIDÆ**

25. Abdominal segments each with one transverse row, sometimes with two rows, of thorn-like protuberances; palpi recurved at apices. (Fig. 739, **Pachyrrhìna**)..... **TIPÙLIDÆ**

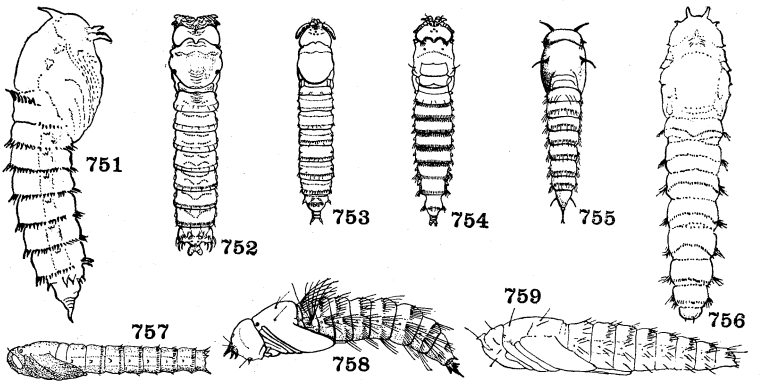
Abdominal segments rarely with distinct thorn-like protuberances, usually with weak hairs; palpi straight, not recurved at apices. **LIMONÌIDÆ**

Orthorrhapha

26. Pupa enclosed within the last larval moult 27
Pupa free 28
27. Thoracic segments one and two each with a smooth plate on dorsum; apical segment with a transverse series of short teeth near base on ventral surface; pupal skin largely or entirely withdrawn from puparium during emergence. (Fig. 707, **Xylomŷia**). **XYLOMYÌIDÆ**
Thoracic segments without smooth dorsal plates; pupal skin not withdrawn from puparium during emergence. **STRATIOMYÌIDÆ**
28. Prothorax with a large aperture mesad of and connected with the spiracle ..... **TABÁNIDÆ**
Prothorax without such an aperture 29
29. Head without strong forwardly directed thorns, at most with one thorn on base of antenna which is directed to the side; abdominal armature weak, becoming gradually stronger toward apex; wings short, extending to or slightly beyond apex of basal abdominal segment; apices of hind tarsi at most extending slightly beyond apices of wings; abdomen with seven pairs of spiracles 30
Head usually with strong thorns, or if these are absent the abdominal armature is stronger on basal or second segment than it is on apical, or there are less than seven pairs of abdominal spiracles; apices of hind tarsi usually extending distinctly beyond apices of wings 33
30. Antennal sheaths much thickened at base, apical portion slender, styliform, the whole directed almost straight downward. (Fig. 757, **Chrysopìla**) ..... **LÉPTIDÆ**
Antennal sheaths thickened throughout their length, the apical portion generally more or less distinctly annulated, the whole directed either straight sideways or in a slightly downward direction 31
31. Antennal sheaths showing much more than ten annulations. (Fig. 753, **Rhachícerus**) ..... **LÉPTIDÆ, RHACHICERÌNÆ**
Antennal sheaths showing not more than ten annulations 32

32. Antennal sheaths very stout, not over twice as long as their basal breadth; face with a small sharp protuberance on each side a little mesad of the vertical line of apices of antennæ and slightly above middle of face, and at the base of each are two short hairs on their inner side; two very strong postspiracular abdominal bristles on each segment. (Fig. 752, **Cœnomỳia**).

CŒNOMYÌIDÆ



Figs. 751–759. **Orthorrhaphous Diptera, Pupæ**

751. **Mydas,** side view (Greene) Mydaidæ.
752. **Cœnomyia,** dorsal view (Greene) Cœnomyiidæ.
753. **Rhachicerus,** dorsal view (Greene) Xylomyiidæ.
754. **Xylophagus,** dorsal view (Greene) Xylophagidæ.
755. **Psilocephala,** dorsal view (Malloch) Therevidæ.
756. **Dasyllis,** dorsal view (Greene) Asilidæ.
757. **Chrysopila,** side view (Malloch) Rhagionidæ.
758. **Sparnopolius,** side view (Malloch) Bombyliidæ.
759. **Rhamphomyia,** side view (Malloch) Empididæ.

Antennal sheaths distinctly annulated, slender, about four times as long as their basal breadth; face without protuberances; postspiracular abdominal bristles slender, eight to ten on each segment. (Fig. 754, **Xylóphagus**) ..... **XYLOPHÁGIDÆ**

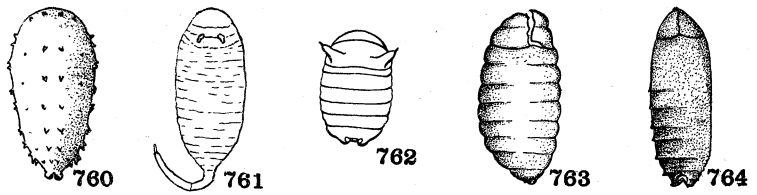
33. Head without strong thorns; abdomen with three or four distinct pairs of spiracles and without spinose armature.

ACROCERÁTIDÆ

Head usually with strong thorns, at least with elevated ridge-like antennal sheath and several small carinated elevations; abdomen with seven pairs of spiracles and spinose armature.....34

34. Head with two thorns.....35
Head with more than two thorns or with several short tubercles .36

35. Abdomen with a single transverse series of spines on each dorsal segment; wing with a long thorn at base. (Fig. 755, **Psilocéphala**) ..... **THERÉVIDÆ**
Abdomen with two transverse series of spines on each dorsal segment; wing without thorn at base..... **SCENOPÍNIDÆ**



Figs. 760–764. **Cyclorrhaphous Diptera, Pupæ**

760. **Didea,** dorsal view (Metcalf) Syrphidæ.
761. **Criorhina,** dorsal view (Greene) Syrphidæ.
762. **Pipunculus,** dorsal view (Perkins) Pipunculidæ.
763. **Sarcophaga,** side view (Greene) Sarcophagidæ.
764. **Exorista,** side view (Greene) Ortalidæ.

36. Upper pair of cephalic thorns directed sideways and slightly upward; apices of wings extending to or very slightly beyond apex of first abdominal segment; apices of middle tarsi not extending to apices of wings. (Fig. 751, **Mȳdas**) ..... **MYDÀIDÆ**
Upper pairs of cephalic thorns directed forward, at most slightly divergent apically, generally slightly curved downward, or head without strong upper thorn.....37

37. Head with strong thorns, or if they are absent the abdomen has the dorsal transverse armature consisting of very strong thorns and intervening long slender hairs; apices of antennæ obtuse.38
Head very rarely with strong thorns, two carinate elevations present on upper anterior margin; antennæ with attenuated apices; body without thorns, sometimes with bristles.....39

38. Lower median portion of face with a closely approximated pair of stout thorns which are occasionally fused almost to apices; abdomen with the transverse armature of dorsal segments con-

sisting of short flattened thorns and long slender hairs, the thorns usually appearing as if attached to, rather than forming part of the abdomen and sometimes turned up at bases and apices. (Fig. 758, **Sparnopòlius**) ..... **BOMBYLÌIDÆ**

Lower median portion of face without thorns; abdomen with the transverse armature consisting of alternating long and short thorns (except in *Leptogaster*). (Fig. 756, **Dasýllis**). **ASÍLIDÆ**

39. Cephalic armature consisting of two carinated elevations on upper anterior margin, on each of which is a very long hair; antennal sheaths raised above level of face, tapering apically, directed downward and slightly outward; proboscis often much elongated. (Fig. 759, **Rhamphomŷia**) ..... **EMPÍDIDÆ**

Similar to Empididæ, but proboscis never elongated.

DOLICHOPÓDIDÆ

LITERATURE ON DIPTERA, GENERAL

ARIAS, J. Classification Catalonian Diptera. Encobet: Entom. de Catalonya, pp. 56 (1917).

AUSTEN, E. E. British blood-sucking Flies. London, Brit. Mus. Publ., pp. 1–74, 34 plates (1906).

COQUILLETT, D. W. The type-species of North American genera of Diptera. Proc. U. S. Nat. Mus., **37**, pp. 499–647 (1910); Can. Ent., **42**, pp. 375–378 (1910).

GRIMSHAW, P. H. Guide to literature of British Diptera. Proc. Roy. Phys. Soc. Edinb., **20**, pp. 78–117 (1917).

HENDEL, F. Zweiflügler. 2: Allgemeiner Teil. Tierwelt Deutschl., pt. 11, pp. 1–135 (1928)

LUNDBECK, W. Diptera Danica. Kopenhag. 7 vols. (1907–1927) (listed under separate families).

OSTEN SACKEN, C. R. Western Diptera (U. S.). U. S. Geol. Geog. Surv. Bull. 3, pp. 189–354 (1877).

PEARCE, E. K. Typical Flies (British). London, 3 photographic atlases (1928).

STACKELBERG, A. Keys to families and genera of blood-sucking Diptera of U.S.S.R. Rev. Microbiol. Epidémiol., **5**, pp. 43–56 (1926).

Our Flies, Keys to species of Russian Diptera. Govt. Publ. Moscow-Leningrad. 152 pp. (1926).

WILLISTON, S. W. Manual of families and genera of North American Diptera. 3 ed., New Haven, Conn. 405 pp. (1908).

CATALOGUES AND LISTS

ALDRICH, J. M. Catalogue of North American Diptera. Smithson. Misc. Coll., **46**, no. 1444, pp. 680 (1905)

BECKER, BEZZI, KERTÉSZ and STEIN. Katalog der palæarkt. Dipteren. Budapest, 4 vols. (1903–1917).

BRUNETTI, E. Catalogue of oriental and South Asiatic Nemocera. Rec. Ind. Mus., **17**, 300 pp. (1920).

COLE, F. R. and A. L. LOVETT. Annotated list of Oregon Diptera. Proc. Cal. Acad. Sci. (4), **11**, pp. 197–344 (1921)

JOHNSON, C. W. List of Diptera of New Jersey. Ann. Rept. N. J. State Mus. 1909, pp. 703–814 (1910).

List of Diptera of New England. Occ. Papers Bost. Soc. Nat. Hist. no. 7, 326 pp. (1925).

KERTÉSZ, K. Catalogus Dipterorum. Budapest, 7 vols. (1902–1910).

SUBORDER NEMATOCERA

ALEXANDER, C. P. Radial field of wing of Nematocerous Diptera. Proc. Linn. Soc. N. S. Wales, **52**, pp. 42–72 (1927).

Nomenclature of radial field in Diptera. 4th Internat. Congr. Entom. Ithaca, Trans., **2**, pp. 700–707 (1929).

BRUNETTI, E. Fauna Brit. India, Diptera Nemocera, excl. Chironomidæ and Culicidæ. London, 581 pp. (1912).

CRAMPTON, G. C. Phylogeny of Nematocera. Psyche, **31**, pp. 238–242 (1924).

Phylogenetic study of thoracic sclerites of Psychodoid Diptera. Ent. News, **37**, pp. 33–38, 65–70 (1926).

EDWARDS, F. W. Phylogeny of Nematocerous Diptera. 3d Internat. Congr. Entom. Verh. **2**, pp. 111–130 (1925).

JOHANNSEN, O. A. Aquatic Nematocerous Diptera. Bull. N. Y. State Mus. no. 68, pp. 327–448 (1903); no. 86, pp. 76–327 (1905).

BIBIONIDÆ AND SCATOPSIDÆ

EDWARDS, F. W. Synopsis British Bibionidæ and Scatopsidæ. Ann. Appl. Biol., **12**, pp. 263–275 (1925).

MCATEE, W. L. Nearctic Bibionidæ. Proc. U. S. Nat. Mus., **60**, art. 11, 27 pp. (1922).

DUDA, O. Scatopsidæ exotic to Europe. Konowia, **7**, pp. 259–297 (1928).

Palæarctic Scatopsidæ. Fliegen pal. Reg., Lief. 26, pp. 1–62 (1928).

MELANDER, A. L. Nearctic Scatopsidæ. Wash. Agr. Exp. Sta. Bull. 130, 21 pp. (1916).

BLEPHAROCERATIDÆ AND DEUTEROPHLEBIIDÆ

BEZZI, M. Blefaroceridi italiani, etc. Bull. Soc. ent. Ital., **44**, pp. 1–114 (1913).

CURRAN, C. H. Key to genera of Blepharoceridæ. Can. Ent., **55**, p. 267 (1923).

EDWARDS, F. W. Neotropical Blepharoceridæ. Dipt. Patagon. and S. Chile, **2**, fasc. 2, pp. 33–75 (1929).

KELLOGG, V. L. Blepharoceridæ of North America. Proc. Cal. Acad. Sci. (3) Zool., **3**, pp. 187–226 (1903).

Family Blepharoceridæ. Gen. Ins., fasc. 56, 15 pp. (1907).

TILLYARD, R. J. Australian Blepharoceridæ. Austr. Zool., **2**, pp. 159–172 (1922); N. Zeal. Jour. Sci. Tech., **5**, pp. 101–107 (1922).

TONNOIR, A. L. Australian Blepharoceridæ. Austr. Zool., **3**, pp. 47–59 (1923).

WALLEY, G. S. Review of Canadian Blephariceridæ. Can. Ent., **59**, pp. 112–115 (1927).

EDWARDS, F. W. Deuterophlebiidæ. Ann. Mag. Nat. Hist. (9), **9**, p. 380 (1922).

CECIDOMYIIDÆ

FELT, E. P. Key to genera and tribes. Philipp. Jour. Sci. D, **13**, pp. 296–324 (1918).

Key to American galls. N. Y. State Mus. Bull. 200, 241 pp. (1918).

Résumé, keys and bibliography. N. Y. State Mus. Bull. 257, 239 pp. (1925).

KIEFFER, J. J. Family Cecidomyiidæ. Gen. Ins., fasc. 152, 346 pp. (1913).

Monograph European and Algerian. Ann. Soc. Ent. Fr. 1900, pp. 181–472 (1900).

RÜBSAAMEN, E. H. and H. HEDICKE. Revision German Cecidomyiidæ. Zoologia, Stuttgart, **29**, Heft 77, Lief. 1, 2, pp. 1–264 (1926).

SENIOR-WHITE, R. Cecidomyidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., pt. 15 (1927).

CHIRONOMIDÆ AND CERATOPOGONIDÆ

EDWARDS, F. W. Revision British Ceratopogonidæ. Trans. Ent. Soc. Lond., **74**, pp. 389–426 (1926).

British Chironomidæ. Trans. Ent. Soc. Lond., **77**, pp. 279–430 (1929).

GOETGHEBUER, M. Ceratopogoninæ de Belgique. Mém. Mus. Nat. Hist. Belg., **8**, fasc. 3, pp. 1–116 (1920).

Tanypodinæ of France. Faune de Fr., **15**, 83 pp. (1927).

HOFFMAN, W. A. Nearctic and neotropical Culicoides. Am. Jour. Hyg., **5**, pp. 274–301 (1925).

JOHANNSEN, O. A. North American Chironomidæ. N. Y. State Mus. Bull. 86, pp. 76–316 (1905).

KIEFFER, J. J. Family Chironomidæ. Gen. Ins., fasc. 42, 78 pp. (1906).

Formosan Chironomidae. Ann. Mus. Hung., **14**, pp. 81–121 (1916).

Australian Chironomidæ. Ann. Mus. Hung., **15**, pp. 175–208 (1917).

American Chironomidæ in Hung. Nat. Mus. Ann. Mus. Hung., **15**, pp. 292–364 (1917).

African and Asiatic Chironomidæ in Hung. Nat. Mus. Ann. Mus. Hung., **16**, pp. 31–139 (1918).

European Chironomidæ in Hung. Nat. Mus. Ann. Mus. Hung., **17**, pp. 1–160 (1919).

Ceratopogoninæ. Faun. de France, Paris, **11**, pp. 139 (1925).

Key to Ceratopogoninæ. Arch. Inst. Past. Algérie, **4**, pp. 96–107 (1926).

LENZ, F. Metamorphosis in relation to classification of Chironomidæ. Ent. Mitt. Berl., **15**, pp. 440–442 (1926).

MALLOCH, J. R. Chironomidæ of Illinois. Illinois State Lab. Nat. Hist. Bull. 10, pp. 275–543 (1915).

THIENEMANN, A. Keys to Swedish larvæ and adults. Arch. Hydrobiol. Suppl., **2**, pp. 465–468 (1915); 550–551 (1916).

WALLEY, G. S. Canadian Tanypus. Can. Ent., **57**, pp. 271–278 (1926).

CULICIDÆ

BARRAUD, P. J. Revision of Culicine mosquitoes of India. Ind. Jour. Med. Res., **14**, et seq., numerous parts (1927–).

BLANCHARD, R. Les moustiques. Paris, 673 pp. (1905).

BONNE, C. and J. BONNE-WEPSTER. Mosquitoes of Surinam. Roy. Col. Inst. Amsterdam, Trop. Med. No. 13, 558 pp. (1925).

BRUG, S. L. Dutch East Indian Anophelines and Culicines. Geneesk. Tijds. Ned. Ind., **65**, pp. 661–671 (1925).

CHRISTOPHERS, SINTON and COVEL. Synoptic table Anophelinæ of India. Health Bull. Calcutta, **10**, 22 pp. (1927).

COOLING, L. E. Synonymic list Australian mosquitoes. Comm. Austr. Dept. Health, Service Publ. 2, pp. 1–61 (1924).

COQUILLETT, D. W. North and Central American mosquitoes. U. S. D. A. Ent. Tech. Bull. 11, 31 pp. (1906).

DYAR, H. G. Canadian mosquitoes. Trans. R. Can. Inst., **13**, pp. 71–120 (1921).

Mosquitoes of United States. Proc. U. S. Nat. Mus., **62**, art. 1, 119 pp. (1922).

DYAR, H. G. and R. C. SHANNON. American Chaoborinæ. Ins. Insc. Menstr., **12**, pp. 201–216 (1924).

Subfamilies, tribes and genera of American Culicidæ. Jour. Wash. Acad. Sc., **14**, pp. 472–486 (1924).

EDWARDS, F. W. Revision palæarctic Culicidæ. Bull. Ent. Res., **12**, pp. 263–351 (1921).

Synopsis Australian mosquitoes. Bull. Ent. Res., **14**, pp. 351–401 (1923).

FELT, E. P. Mosquitoes of New York. N. Y. State Mus. Bull. 79, pp. 241–400 (1904).

FERGUSON, E. W. Mosquitoes of New South Wales. Rept. Dir. Gen. Pub. Health N. S. W. 1925, pp. 187–191 (1924).

FREEBORN, S. B. Mosquitoes of California. Univ. Cal. Publ. Ent. 3, pp. 333–460 (1926).

GILES, G. M. Handbook of Culcidæ. London, 530 pp. (1902).

HOWARD, L. O. Culicidæ of United States. U. S. D. A. Ent. Bull. 25 (1900). Mosquitoes. New York, XVI. and 241 pp. (1901).

HOWARD, DYAR and KNAB. Mosquitoes of North and Central America. Carnegie Inst. Wash., 4 vols., 1064 pp. (1912–1917).

JOHANNSEN, O. A. Tables larvæ, pupæ and adults of nearctic Culicidæ. N. Y. State Mus. Bull. 68, pp. 388–429 (1903).

KIRKPATRICK, T. W. Mosquitoes of Egypt. Govt. Press, Cairo, 224 pp. (1925).

LANG, W. D. Handbook of British mosquitoes. Brit. Mus., 125 pp. (1920).

MARTINI, E. Palæarctic Culicidæ (incl. Dixinæ, pp. 20–43). Flieg. Pal. Reg., Lief. 33, 35, 38, 40, 192 pp. (1929, 1930).

MATHESON, R. Handbook of North American mosquitoes. Springfield and London. 268 pp. (1929).

MATHESON, R. and R. C. SHANNON. Anophelines of N. E. America. Insec. Inscit. Menst., **11**, pp. 57–64 (1923).

SCHWETZ, J. Synopsis Belgian Congo mosquitoes. Rev. Zool. Afr., Brussels, **15**, pp. 271–319 (1927).

SÉGUY, E. Key to French mosquitoes. Bull. Soc. Path. Exot., **14**, pp. 179–187 (1921).

SENIOR-WHITE, R. Indian Culicidæ. Cat. Ind. Mus. Govt. Ind. Centr. Pub. Br., pt. 2, 124 pp. (1923).

STRICKLAND, C. Anophelines of India, etc. Culcutta and Simla. 19 pp. (1925).

THEOBALD, F. Monograph Culicidæ. Brit. Mus., 5 vols., 2459 pp. (1901–1910).

YAMADA, S. Anophelines of Japan. Sci. Repts. Govt. Inst. Infect. Dis. Tokyo, **3**, pp. 215–241 (1924); **4**, pp. 447–493 (1925).

DIXIDÆ

EDWARDS, F. W. British Dixidæ, etc. Ent. Mo. Mag., **56**, pp. 264–270 (1920).

JOHANNSEN, O. A. North American Dixidæ. Psyche, **30**, pp. 52–58 (1923).

MARTINI, E. Palæarctic Dixinæ. Flieg. Pal. Reg., Lief. 33, pp. 20-43 (1929).

MYCETOPHILIDÆ, s. lat.

EDWARDS, F. W. Systematic position of Mycetobia. Ann. Mag. Nat. Hist., **17**, pp. 108–115 (1916).

Ditomyinæ. Ann. Mag. Nat. Hist., **7**, pp. 431–436 (1921).

Revision of Mycetophilidæ. Trans. Ent. Soc. Lond., 1925, pp. 505–670 (1925).

Australian Ceroplatinæ. Proc. Linn. Soc. N. S. W., **54**, pp. 162–175 (1929).

EDWARDS, F. W. and D. KEILIN. Family Pachyneuridæ. Gen. Ins., fasc. 190, pp. 27–29 (1928).

ENDERLEIN, G. Lycoriidæ. Arch. Naturg., **77**, Band 1, 3 Suppl., pp. 116–201 (1911).

JOHANNSEN, O. A. Fungus gnats of North America. Maine Agr. Exp. Sta. Bulls. 172, 180, 196 and 200 (1909–1912).

Family Mycetophilidæ. Gen. Ins., fasc. 93, 141 pp. (1909).

LANDROCK, K. Tables European Mycetophilidæ. Wien. ent. Ztg., **37**, pp. 55–72; 107–120 (1918).

Palæarctic Mycetophilidæ. Flieg. pal. Reg., Lief. 12–15, 196 pp. (1926–1927).

LENGERDORF, F. Lycoriidæ. Flieg. pal. Reg., Lief. 24, 43, pp. 71 (1928–1930).

PETTEY, F. W. Revision species of Sciara. Ann. Ent. Soc. Am., **11**, p. 319–346 (1918).

TONNOIR, A. L. Synopsis Australian Mycetophilidæ. Proc. Linn. Soc. N. S. W., **54**, pp. 584–614 (1920).

PSYCHODIDÆ

ALEXANDER, C. P. Revision of American Bruchomyinæ. Proc. U. S. Nat. Mus., **75**, art. 7, pp. 1–9 (1929).

BANKS, N. Eastern (U. S.) Psychodidæ. Can. Ent., **23**, pp. 273–275 (1901).

HASEMAN, L. Monograph N. American Psychodidæ. Trans. Am. Ent. Soc., **33**, pp. 299–333 (1907).

KINCAID, T. Pacific Coast (N. Am.) Psychodidæ. Ent. News, **10**, pp. 30–37 (1899).

TONNOIR, A. L. African Psychodidæ. Bull. Soc. R. Ent. Egypt., 1921, pp. 80–111 (1921).

European Psychodidæ. Ann. Soc. Ent. Belg., **62**, pp. 49–88, 125–136, 153–181 (1922).

South American Psychodidæ. Dipt. Patagon. Chile, **2**, fasc. 1, 32 pp. (1929).

ANISOPODIDÆ

EDWARDS, F. W. Key to European Anisopus. Ent. Mo. Mag., **62**, p. 113 (1926).

EDWARDS, F. W. and D. KEILIN. Protorhyphidæ, Anisopodidæ, Pachyneuridæ and Trichoceridæ. Gen. Ins., fasc. 190, 41 pp. (1928).

KERTÉSZ, K. Ueber die Familie der Rhyphiden. Természet. Füzet., **25**, pp. 4–6 (1902).

SIMULIIDÆ

BARANOFF, N. Classification Simuliidæ. Neue Beitr. syst. Insektenk., **3**, pp. 161–164 (1926).

COQUILLETT, D. W. Simuliidæ of United States. U. S. D. A. Ent. Bull. 10, pp. 66–69 (1898).

DYAR, H. G. and R. C. SHANNON. North American Simuliidæ. Proc. U. S. Nat. Mus., **69**, art. 10, 54 pp. (1927).

EDWARDS, F. W. British Simuliidæ. Ent. Mo. Mag., **51**, pp. 305–309 (1915); Bull. Ent. Res., **6**, pp. 211–246 (1920).

Malayan female Simuliidæ. Fed. Mal. St. Mus. Jour., **14**, p. 59 (1928).

ENDERLEIN, G. Systematic arrangement, Simuliidæ. Zool. Anz., **53**, pp. 43–46 (1921).

Classification Simuliidæ. Arch. f. Klassif. Phylogen. Ent., **1**, pp. 77–97 (1930).

JOHANNSEN, O. A. Simuliidæ of United States. N. Y. State Mus. Bull. 68, pp. 336–388 (1903).

MALLOCH, J. R. American Blackflies. U. S. D. A. Bur. Ent. Tech. Bull. 26, 71 pp. (1914).

O'KANE, W. C. Bionomics of New Hampshire Simuliidæ. Bull. N. H. Exp. Sta. 32, 24 pp. (1926).

SÉGUY, E. Espèces méditerranéennes, Simulium. Eos, **1**, pp. 231–238 (1925).

TIPULOIDEA

ALEXANDER, C. P. Neotropical Limnobiinæ. Proc. U. S. Nat. Mus., **44**, pp. 481–549 (1913).

Neotropical Tanyderidæ. Proc. U. S. Nat. Mus., **44**, pp. 331–335 (1913).

Crane-flies of New York. Cornell Univ. Mem. 25, pp. 767–993 (1919); 38, pp. 695–1133 (1920).

Revision Australian Trichoceridæ. Proc. Linn. Soc. N. S. W., **51**, pp. 299–304 (1926).

Cylindrotominæ. Gen. Ins., fasc. 187, 16 pp. (1927).

Ptychopteridæ. Gen. Ins., fasc. 188, 12 pp. (1927).

Tanyderidæ. Gen. Ins., fasc. 189, 13 pp. (1927).

Australian Tanyderidæ. Proc. Linn. Soc., N. S. W., **53**, pp. 367–374 (1928).

South American Tipulidæ. Dipt. Patagon. Chile, pt. 1, 240 pp. (1929).

Japanese Trichoceridæ. Konowia, **9**, pp. 103–108 (1930).

ALEXANDER, C. P. and W. L. MCATEE. Tipuloidea of District of Columbia. Proc. U. S. Nat. Mus., **58**, pp. 385–435 (1920).

DIETZ, W. G. North American Pachyrhina. Trans. Am. Ent. Soc., **44**, pp. 105–140 (1918).

EDWARDS, F. W. Craneflies of New Zealand. Trans. N. Zeal. Inst., **54**, pp. 265–352 (1923).

Philippine Tipulidæ. Notulæ Ent., **6**, pp. 33–44 (1926).

EDWARDS, F. W. and D. KEILIN. Trichoceridæ. Gen. Ins., fasc. 190, pp. 30–37 (1928).

ENDERLEIN, G. Studies in Tipulidæ. Zool. Jahrb. Syst., **32**, pp. 1–88 (1912).

KUNTZE, A. Palæarctic Eriopterinæ. Ann. Naturhist. Hofmus. Wien, **28**, pp. 361–388 (1914).

Palæarctic Limoniinæ. Zool. Jahrb. Syst., **43**, pp. 371–432 (1920).
OSTEN SACKEN, C. R. Studies in Tipulidæ longipalpi. Berl. Ent. Zts., **30**, pp. 153–188 (1886).
Studies in Tipulidæ brevipalpi. Berl. Ent. Zts., **31**, pp. 163–242 (1887).
PIERRE, C. Tipulinæ. Gen. Ins., fasc. 186, 68 pp. (1926).

THAUMALEIDÆ

BEZZI, M. Taumaleidi italiani. Boll. Lab. Zool. Gen. Agr., **7**, pp. 227–266 (1913).
DYAR, H. G. and R. C. SHANNON. North American Thaumeleidæ. Jour. Wash. Ac. Sci., **14**, pp. 432–434 (1924).
EDWARDS, F. W. Revision of Thaumaleidæ. Zool. Anz., **82**, Wasmann no., pp. 121–142 (1929)

SUBORDER BRACHYCERA

A. ORTHORRHAPHA

BEZZI, M. Brachycera and Athericera of Fiji Islands. Brit. Mus. Publ., 220 pp. (1928)
BRUNETTI, E. Fauna of British India, Dipt. Brachycera. Lond., **1**, 401 pp. (1920).
COLE, F. R., J. R. MALLOCH and W. L. MCATEE. District of Columbia Tromoptera. Proc. Ent. Soc. Wash., **26**, pp. 181–195 (1924).
HARDY, G. H. Phylogeny of some Diptera Brachycera. Proc. Linn. Soc. N. S. W., **52**, pp. 380–386 (1927).
SHANNON, R. and S. W. BROMLEY. Radial venation in Brachycera. Insec. Inscit. Menstr., **12**, pp. 137–140 (1924).

ACROCERATIDÆ

COLE, F. R. North American Cyrtidæ. Trans. Am. Ent. Soc., **45**, pp. 1–79 (1919).
LUNDBECK, W. Danish Acroceridæ. Dipt. Dan., **1**, pp. 157–163 (1907).
PLESKE, T. Palæarctic Acroceridæ. Konowia, **9**, pp. 156–173 (1930).
SÉGUY, E. French Oncodidæ. Faune de France, **13**, pp. 157–168 (1926).
VERRALL, G. H. British Acroceridæ. Brit. Flies, **5**, pp. 447–469 (1909).

APIOCERATIDÆ

HERMANN, F. Beitrag z. Kenntnis der Apioceriden. Deut. Ent. Zts. 1909, Beiheft, pp. 104–122 (1909).

ASILIDÆ

BACK, E. A. Robberflies of North America. Trans. Am. Ent. Soc., **35**, pp. 137–400 (1909).

BANKS, N. American species of Dasyllis. Bull. Brkl. Ent. Soc., **12**, pp. 52–55 (1917).

BECKER, T. Neue Dioctria. Konowia, **2**, pp. 1–18 (1923).
Formosan Asilinæ. Ent. Mitt., **14**, pp. 62, 123, 240 (1925).

BEZZI, M. Lasiopogon. Boll. Lab. Zool. Gen. Agrar. Portici, **11**, pp. 250–281 (1917).

BROMLEY, S. W. Asilidæ of Cuba. Ann. Ent. Soc. Am., **22**, pp. 272–294 (1929).

CURRAN, C. H. Nearctic Cyrtopogon. Can. Ent., **55**, pp. 93 et seq., 5 pts. (1923).

ENDERLEIN, G. Dasypogoninæ and Archilaphrinæ. Wien. ent. Ztg., **33**, pp. 151–174 (1914).

ENGEL, E. O. Palæarctic Asilidæ. Flieg. pal. Reg., 9 pts., 491 pp. (1925–1930).

HARDY, G. M. Australian Asilidæ. Proc. Linn. Soc. N. S. W., **51**, pp. 305–312, 643–657 (1926); **52**, 387–398 (1927); **54**, 80–88, 353–360 (1929); **55**, 249–260 (1930).

HERMANN, F. So. Am. Asilidæ. Abh. Deut. Akad. Naturf., **96**, pp. 1–275 (1912).
Systematik der Asiliden. Zool. Jahrb., **43**, Syst., pp. 161–194 (1920).
Leptogastrinæ. Verh. z. b. Ges. Wien, **74**, pp. 140–152 (1926).

HINE, J. S. Various American genera. Ann. Ent. Soc. Am., **2**, pp. 136–170 (Asilus) (1909); **4**, 153–172 (Promachus) (1911); **12**, 103–157 (Erax) (1919).

LUNDBECK, W. Danish Asilidæ. Dipt. Dan., **2**, pp. 1–87 (1908).

MACATEE, W. L. and N. BANKS. District of Columbia Asilidæ. Proc. Ent. Soc. Wash., **22**, pp. 13–33 (1920).

MELANDER, A. L. Various nearctic genera. Psyche, **30**, pp. 136–144 (Lasiopogon); 102–119 (Cyrtopogon); 207–219 (misc.) (1923).

MELIN, D. Biology, etc., of Swedish Asilidæ., Zool. Bidrag., **8**, pp. 1–317 (1923).

PANDELLÉ, L. European Asilus. Rev. Ent. France, 1905, pp. 44–98 (1905).

RICARDO, G. Australasian Asilidæ. Ann. Mag. Nat. Hist. (8), **9**, pp. 473, 585; **10**, pp. 142, 350 (1912).

SÉGUY, E. Asilidæ of France. Faun. d. France, No. 17, 190 pp. (1927).

VERRALL, G. H. British Asilidæ. Brit. Flies, **5**, pp. 614–754 (1909).

BOMBYLIIDÆ

BECKER, T. Genera of Bombyliidæ. Ann. Mus. Zool. St. Petersb., **17**, pp. 421–502 (1913).

BEZZI, M. South African Bombyliidæ. Ann. S. Afr. Mus., **18**, pp. 1–180 (1921).
Ethiopian Bombyliidæ. Brit. Mus. Publ., 390 pp. (1924).

BRUNETTI, E. Revised catalog oriental Bombylidæ. Rec. Ind. Mus., **2**, pp. 437–492 (1909).

COQUILLETT, D. W. Various nearctic genera. Can. Ent., **24**, pp. 9–, 123– (1892); Trans. Am. Ent. Soc., **14**, pp. 159– ; (1887); **19**, 168– (1892); **21**, 89– (1894).

ENDERLEIN, G. Systropodinæ. Wien. ent. Ztg., **43**, pp. 69–92 (1926).

JOHNSON, C. W. Bombylius of eastern United States. Psyche, **14**, pp. 95–100 (1907).

LUNDBECK, W. Danish Bombyliidæ. Dipt. Dan., **2**, pp. 88–132 (1908).

PAINTER, R. H. Review of Heterostylum. Jour. Kans. Ent., **3**, pp. 1–7 (1930).

PARAMONOW, S. J. Hemipenthes. Encycl. Ent., B. Dipt. **2**, pp. 150–190 (1926).

Monograph palæarctic Bombylius. Mém. cl. sci. phys. math. Acad. Sci. Ukraine, **3**, pp. 77–184 (1926).

ROBERTS, F. H. S. Revision Australian Bombyliidæ. Proc. Linn. Soc. N. S. W., **53**, pp. 90–144, 413–455 (1928); **54**, 553–583 (1929).

SÉGUY, E. Bombyliidæ of France. Faune de France, **13**, pp. 178–254 (1926).

SENIOR-WHITE, R. Indian Bombyliidæ. Cat. Indian Ins. Govt. Ind. Centr. Pub. Br., pt. 3 (1923).

VERRALL, G. H. British Bombyliidæ. Brit. Flies, **5**, pp. 474–536 (1909).

DOLICHOPODIDÆ

ALDRICH, J. M. Keys to various nearctic genera. Trans. Am. Ent. Soc., **30**, pp. 269–286 (1904).

Nearctic Hydrophorus. Psyche, **18**, pp. 45–73 (1911).

BECKER, T. Review palæarctic Dolichopodidæ. N. Acta Leop.-Carol. Akad. Naturf. Halle, **102**, pp. 115–249 (1917); **103**, 205–315 (1918); **104**, 38–212 (1918).

American Dolichopodidæ. Abh. z. b. Ges. Wien, **13**, pp. 1–394 (1922).

Indo-australian Dolichopodidæ. Capita Zool., **1**, pp. 1–247 (1922).

Æthiopische Dolichopodiden. Entom. Mitt., **12**, pp. 1–50 (1923).

CURRAN, C. H. South African Dolichopodidæ. Ann. Transv. Mus., **10**, pp. 212–232 (1924); Ann. S. Afr. Mus., **23**, pp. 377–416 (1926).

Nearctic Rhaphium species. Tr. R. Can. Inst. Toronto, **15**, pp. 249–260 (1926); **16**, 99–179 (1927).

Ethiopian Chrysosoma, etc. Rev. Zool. Afr., **15**, pp. 242–262 (1927).

GREENE, C. T. Nearctic species of Tachytrechus. Proc. U. S. Nat. Mus., **60**, art. 17, 21 pp. (1922).

Nearctic species of Scellus. Proc. U. S. Nat. Mus., **65**, art. 16, 18 pp. (1924).

HARDY, G. M. Australian Dolichopodidæ. Austr. Zool., **6**, pp. 124–134 (1930).

LOEW, H. Monograph North American Dolichopodidæ. Smithson. Misc. Coll. No. 171 (1864).

LUNDBECK, W. Danish Dolichopodidæ. Dipt. Dan., **4**, 407 pp. (1912).

PARENT, O. Reviews of palæarctic genera, in Ann. Soc. Sci. Brux., **42**, pp. 281– (Chrysotus) (1923); **44**, pp. 46– (Thrypticus), pp. 93– (Aphrosylus),

pp. 221– (Diaphorus) (1925); **47**, pp. 1– (Medetera), pp. 83– (Tachytrechus) (1927).

Ethiopian Dolichopodidæ. Bull. Soc. Ent. Egypt, 1929, pp. 151–190 (1929).

VAN DUZEE, M. C. Reviews of nearctic genera: Neurigona, Ann. Ent. Soc. Am., **6**, pp. 22–60 (1913). Asyndetus, Psyche, **23**, pp. 88–94 (1916). Medeterus, Proc. Cal. Acad. Sci., **9**, pp. 257–270 (1919); Psyche, **35**, pp. 36–43 (1928). Diaphorus, Bull. Buff. Soc. Nat. Sci., **11**, No. 2, pp. 161–194 (1922). Xiphandrium, Tr. Am. Ent. Soc., **48**, pp. 79–87 (1922). Pelastoneurus, Ann. Ent. Soc. Am., **16**, pp. 30–48 (1923). Chrysotus, Bull. Buff. Soc. Nat. Sci., **13**, No. 3, pp. 52 (1924). Argyra, Proc. U. S. Nat. Mus., **66**, art. 23, 43 pp. (1925). Syntormon, Tr. Am. Ent. Soc., **50**, pp. 257–287 (1925). Thinophilus, Ann. Ent. Soc. Am., **19**, pp. 35–49 (1926). Hydrophorus, Pan.-Pacif. Ent., **3**, pp. 4–11 (1927). Sympycnus, Pan-Pacif. Ent., **7**, pp. 35– , 51– (1930).

South American Dolichopodidæ. Dipt. Patagon. Chile, **5**, fasc. 1, 92 pp. (1930).

VAN DUZEE, M. C., F. R. COLE and J. M. ALDRICH. North American Dolichopus. U. S. Nat. Mus. Bull. 116, pp. 1–304 (1921).

WHEELER, W. M. Many nearctic genera. Proc. Cal. Ac. Sci. (3), **2**, Zool. pp. 1–78 (1899).

EMPIDIDÆ

BEZZI, M. Indo-australian Empididæ. Ann. Mus. Hung., **2**, pp. 320–361 (1904).

Neotropical Empididæ. Ann. Mus. Hung., **3**, pp. 424–460 (1905); Nova Act. Akad. Naturf. Halle, **91**, pp. 293–407 (1910).

COLLIN, J. E. Notes on British Empididæ. Several issues of Ent. Mo. Mag., **62** (1926) and **63** (1927).

New Zealand Empididæ. Brit. Mus. Nat. Hist. Publ., 110 pp. (1928).

COQUILLETT, D. W. North American Empididæ. Proc. U. S. Nat. Mus., **18**, pp. 387–440 (1897); Proc. Ent. Soc. Wash., **5**, pp. 245–272 (1903).

ENGEL, E. Das Dipterengenus Atalanta (Clinocera). Deut. ent. Zts. 1918, pp. 1–80, 197–268 (1918).

FREY, R. Rhamphomyia. Notulæ Ent., **2**, pp. 1–10, 34–45, 65–77 (1922).

KUNTZE, A. Table of European Empis. Zts. Hym. Dipt., **6**, (1906), **7** (1907) several issues.

LUNDBECK, W. Danish Empididæ. Dipt. Dan., **3**, pp. 1–324 (1910).

MELANDER, A. L. North American Empididæ. Trans. Am. Ent. Soc., **28**, pp. 195–367 (1902).

Family Empididæ. Gen. Ins., fasc. 185, 434 pp. (1927).

MILLER, D. New Zealand Empididæ. Tr. N. Zeal. Inst., **45**, pp. 198–206 (1911); **54**, 437–464 (1923).

MYDAIDÆ

ARIAS, J. Mydaidæ of Spain. Inst. Nac. cienc. fisico-nat. Ser. zool., **15**, 40 pp. (1914).

BEZZI, M. So. African Mydaidæ. Ann. S. Afr. Mus., **19**, pp. 191–234 (1924).

HARDY, G. H. Australian Mydaidæ. Proc. Linn. Soc. N. S. W., **50**, pp. 139–144 (1925).

JOHNSON, C. W. North American. Proc. Bost. Soc. Nat. Hist., **38**, pp. 131–145 (1926).

MACKERRAS, I. M. Australian. Proc. Linn. Soc. N. S. W., **53**, pp. 539–543 (1928).

NEMESTRINIDÆ

BEQUAERT, J. North American Hirmoneuras. Jour. N. Y. Ent. Soc., **27**, pp. 301–306 (1919).

Notes on American. Psyche, **37**, pp. 286–297 (1930).

BEZZI, M. South African Nemestrinidæ. Ann. S. Afr. Mus., **19**, pp. 164–190 (1924).

COCKERELL, T. D. A. Review of Nemestrinidæ. Tr. Am. Ent. Soc., **34**, pp. 247–253 (1908).

HARDY, G. H. Australian. Proc. Linn. Soc. N. S. W., **49**, pp. 448–460 (1924).

LICHWARDT, B. Beiträge z. Kenntnis der Nemestriniden. Deut. ent. Zts. 1909, 1910.

MACKERRAS, I. M. Revision Australasian. Proc. Linn. Soc. N. S. W., **50**, pp. 489–561 (1925).

VERRALL, G. H. Palæarctic. Brit. Flies, **5**, pp. 440–446 (1909).

WILLISTON, S. W. Synopsis nearctic. Can. Ent., **15**, p. 69 (1883).

PANTOPHTHALMIDÆ

AUSTEN, E. E. Revision. Proc. Zool. Soc. Lond. 1923, pt. 3, pp. 551–598 (1923).

ENDERLEIN, G. Keys to species. Zool. Anz., **41**, pp. 97–118 (1912); **52**, p. 228 (1921).

RHAGIONIDÆ, including XYLOPHAGIDÆ

ALDRICH, J. M. North American Symphoromyia. Proc. U. S. Nat. Mus., **49**, pp. 113–142 (1915).

BECKER, T. Neue Rhagionidæ. Zts. f. wiss. Insektenbiol., **2**, pp. 41, 54, 69 (1922).

BEZZI, M. South African Rhagionidæ. Ann. S. Afr. Mus., **23**, pp. 297–324 (1926).

ENDERLEIN, G. Xylophagidæ. Zool. Anz., **43**, pp. 533–552 (1913).

FERGUSON, E. W. Australian Leptidæ. Jour. R. Soc. N. S. W., **49**, pp. 233–243 (1915).

LEONARD, M. D. Nearctic Rhagionidæ. Mem. Am. Ent. Soc. 7, 181 pp. (1930).
LINDNER, E. Palæarctic. Flieg. pal. Reg., Lief. 1–3, 49 pp. (1924–1925).
LUNDBECK, W. Danish. Dipt. Dan., **1**, pp. 75–82 (Xylophagidæ), 133–157 (Leptidæ) (1907).
SÉGUY, E. French. Faun. d. France, **13**, pp. 81– (Errinidæ), 88– (Cœnomyiidæ), 90–118 (Rhagionidæ) (1926).
VERRALL, G. H. British. Brit. Flies, **5**, pp. 232–319 (1909).

SCENOPINIDÆ

CRESSON, E. T. North American. Trans. Am. Ent. Soc., **33**, pp. 109–114 (1907).
KRÖBER, O. Die Omphraliden. Ann. Hist. Nat. Mus. Hung., **2**, pp. 174–210 (1913).
Family Omphralidæ. Gen. Ins., fasc. 161, 15 pp. (1914).
Egyptian. Bull. Soc. R. Ent. Egypt. 1923, pp. 70–84 (1924).
Palæarctic. Flieg. pal. Reg., Lief 4, 8 pp. (1925).
LUNDBECK, W. Danish. Dipt. Dan., **2**, pp. 155–160 (1908).
SÉGUY, E. Omphralidæ of France. Faune de France, **13**, pp. 275–279 (1926).

STRATIOMYIIDÆ

BRUNETTI, E. Oriental Stratiomyiidæ. Rec. Ind. Mus., **1**, pp. 85–132 (1907); **25**, pp. 45–180 (1923).
CURRAN, C. H. Canadian. Trans. R. Soc. Can. Ottawa, Sec. V (3), **21**, pp. 191–228 (1927).
ENDERLEIN, G. Subfamilies, etc. Zool. Anz., **43**, pp. 289–315, 577–615 (1914); **44**, 1–25 (1915).
Stratiomyiidæ and related families. Mitt. Zool. Mus. Berl., **10**, pp. 153–214 (1921).
JOHNSON, C. W. Nearctic Stratiomyia and Odontomyia. Tr. Am. Ent. Soc., **22**, pp. 227–278 (1895).
KERTÉSZ, K. Notacanthen. Ann. Mus. Hung., **14**, pp. 123–218 (1916).
Revision of Potamidinæ. Ann. Mus. Hung., **18**, pp. 153–165 (1921).
LUNDBECK, W. Danish. Dipt. Dan., **1**, pp. 13–75 (1907).
MALLOCH, J. R. Nearctic Pachygasterinæ. Ann. Ent. Soc. Am., **8**, pp. 305–320 (1915).
MELANDER, A. L. Nearctic Nemotelus. Psyche, **10**, pp. 171–183 (1903).
Several nearctic genera. Can. Ent., **36**, pp. 14–24, 53–54 (1904).
MILLER, D. New Zealand Beridinæ. Tr. N. Zeal. Inst., **49**, pp. 172–194 (1917).
PLESKE, T. Palæarctic. Encycl. Ent. B. Dipt. II., **1**, pp. 95– (Pachygasterinæ); 105– , 165– , (Clitellarinæ) (1924); **2**, pp. 23– (Eulalia) (1925);
Palæarctic Errinidæ and Cœnomyiidæ. Encycl. Ent. B. II. Dipt. 2, pp. 161–184 (1926).
Studies on palæarctic Stratiomyidæ. Eos, **2**, pp. 385–420 (1926).

SÉGUY, E. French. Faune de France, **13**, pp. 16–80 (1926).
VERRALL, G. H. British. Brit. Flies, **5**, pp. 51–229 (1909).

TABANIDÆ

BEQUAERT, J. Tabanid Fauna of Belgian Congo. Rept. Harvard Afr. Exped., Harv. Univ. Press, **2**, pp. 859–971 (1930).
EFFLATOUN, H. C. Egyptian. Mem. Soc. R. Ent. Egypt, **4**, fasc. 1, 114 pp. (1930).
ENDERLEIN, G. Ein neues Tabanidensystem. Mitt. Zool. Mus. Berl., **10**, pp. 333–351 (1922); **11**, 253–409 (1925).
FERGUSON, E. W. and G. F. HILL. Australian, Proc. Linn. Soc. N. S. W., **45**, pp. 460–467 (1920); **48**, 381–435 (1923).
HINE, J. S. Tabanidæ of Ohio. Ohio Acad. Sci. Spec. Pap. 5, 63 pp. (1903).
Tabanidæ of Western U. S. and Canada. Ohio Nat., **5**, pp. 217–248 (1904).
Louisiana horseflies. La. Crop Pest Comm. Circ. 6, 43 pp. (1906); La. Exp. Sta. Bull. 93, 59 pp. (1907).
Neotropical. Occ. Papers Mus. Zool. Univ. Mich. 162, 35 pp. (1925).
KNAB, F. Stibasoma. Proc. U. S. Nat. Mus., **46**, pp. 407–412 (1913).
KRÖBER, O. Palæarctic Chrysops. Zool. Jahrb., **43**, Syst., pp. 41–160 (1920).
Palæarctic. Arch. Naturg., **89**, Abt. A, 12 Heft, pp. 55–118; **90**, A, 9 Heft, pp. 1–195 (1924).
Egyptian. Bull. Soc. R. Ent. Egyp., 1925, pp. 77–137 (1925).
Neotropical Chrysopini. Konowia, **4**, pp. 210–375 (1925).
Palæarctic. Flieg. pal. Reg., Lief. 5–8, 146 pp. (1925).
Nearctic Chrysops. Stett. ent. Ztg., **87**, pp. 209–353 (1926).
African Chrysops. Zool. Jahrb., **53**, Syst., pp. 175–268 (1927).
Diachlorinæ. Beih. Arch. Schiffs- u. Tropenhyg., **32**, pp. 73–123 (1928).
Neotropical. Zool. Anz., **88**, pp. 225–238 (Silvini); 305–312 (Pitocerini); **89**, 211–228 (Pangoniini) (1930).
Patagonian. Dipt. Pat. Chile, **5**, fasc. 2, pp. 106–161 (1930).
LUNDBECK, W. Danish. Dipt. Dan., **1**, pp. 85–132 (1907).
LUTZ, A. Brazilian. Zool. Jahrb. Suppl., **10**, pp. 619–692 (1909).
MCATEE, W. L. and W. R. WALTON. District of Columbia species. Proc. Ent. Soc. Wash., **20**, pp. 188–206 (1919).
OSTEN SACKEN, C. R. United States species. Mem. Bost. Soc. Nat. Hist., **2**, pp. 365–397, 421–479, 555–560 (1878).
SÉGUY, E. French. Faune de France, **13**, pp. 119–157 (1926).
SENIOR-WHITE, R. Indian. Govt. India Centr. Publ. Br., pt. 12, 70 pp. (1927).
SURCOUF, J. M. R. Monogr. des Taban. d'Afrique. Paris. 258 pp. (1909).
Family Tabanidæ. Gen. Ins., fasc. 175, 182 pp. Suppl., pp. 183–205 (1921).
SZILADY, Z. Palæarctic Chrysops. Arch. f. Nat., **83**, pp. 85– (1917).
VERRALL, G. H. British. Brit. Flies, **5**, pp. 320–439 (1909).
WEHR, E. E. Nebraska Tabanidæ. Univ. Studies, Nebr., **12**, pp. 107–118 (1922).

THEREVIDÆ

BECKER, T. Synopsis of Thereva. Konowia, **1**, pp. 16–34 (1922).

COLE, F. R. Revision N. Am. Therevidæ. Proc. U. S. Nat. Mus., **62**, art. 4, 140 pp. (1923).

KRÖBER, O. Therevidæ of S. and Centr. America. Ann. Hus. Hung., **9**, pp. 475– (1911).

Palæarctic and ethiopian. Deut. ent. Zts. 1912, 6 parts (1912).

Indoaustralian. Ent. Mitt., **1**, p. 115 et seq., 6 parts (1912).

North American. Stett. ent. Ztg., **73**, pp. 209–272 (1912).

Family Therevidæ. Gen. Ins., fasc. 148, 69 pp. (1913).

Egyptian. Bull. Soc. R. Ent. Egypt. 1923, pp. 85–107; 1929, 73–80.

Palæarctic. Flieg. pal. Reg., Lief. 1–3, 60 pp. (1925).

LUNDBECK, W. Danish. Dipt. Dan., **2**, pp. 132–155 (1908).

MANN, J. S. Australian. Austr. Zool., **5**, pp. 151–194 (1928); **6**, 17–49 (1929).

OSTEN SACKEN, C. R. Tables, etc. Verh. z. b. Ges. Wien, **62**, pp. 289–319 (1912).

SÉGUY, E. French. Faune de France, **13**, pp. 255–275 (1926).

VERRALL, G. H. British. Brit. Flies, **5**, pp. 537–589 (1909).

B. CYCLORRHAPHA, GROUP ASCHIZA

CONOPIDÆ

BANKS, N. Synopsis of nearctic Zodion and Myopa. Ann. Ent. Soc. Am., **9**, pp. 191–200 (1916).

BECKER, T. Neue Dipteren: Conopidæ. Konowia, **1**, pp. 195–208; 282–295 (1922).

KRÖBER, O. Stylogaster. Entom. Mitt., **3**, pp. 338–353 (1914).

N. Am. Conops. Arch. Naturg., **81**, A, Heft 5, pp. 121–160 (1915).

Katalog Conopidæ (with tables). Arch. Naturg., **83**, A., Heft 8. pp. 1–91; Heft 9, pp. 1–52 (1917).

Egyptian Conopidæ. Bull. Soc. R. Ent. Egypt, 1923, pp. 57–70 (1924).

Palæarctic Conopidæ. Flieg. pal. Reg. Nos. 1–3, 48 pp. (1924–1925).

Conopidæ of Philippines. Philipp. Jour. Sci., **34**, pp. 331–347 (1927).

Conopidæ of C. Eur. Tierwelt Deutschl., pt. 20, pp. 119–142 (1930).

SÉGUY, E. Conopidæ of W. Eur. Encycl. Ent. ser. A, No. 9, pp. 9–52 (1928).

VAN DUZEE, M. C. N. Am. Conopidæ. Proc. Cal. Acad. Sci. (4), **16**, pp. 573–604 (1927).

WILLISTON, S. W. N. Am. Conopidæ. Trans. Conn. Acad. Sci., **4**, pp. 325–342 (1882); **6**, pp. 5–, 377– (1883).

LONCHOPTERIDÆ

DUDA, O. Lonchoptera. Konowia, **6**, pp. 89–99 (1927).

LUNDBECK, W. Danish Lonchopteridæ. Dipt. Dan., **5**, pp. 1–18 (1916).

DE MEIJERE, J. C. H. Palæarct. Lonchopteren. Tijd. Ent., **49**, pp. 44–98 (1906).

PHORIDÆ AND TERMITOXENIIDÆ

BECKER, T. Monograph European Phoridæ. Abhandl. z. b. Ges. Wien, **1**, pp. 1–100 (1901).

BRUES, C. T. Monograph N. Am. Phoridæ. Trans. Am. Ent. Soc., **29**, pp. 331–404 (1903).

Family Phoridæ. Gen. Ins., fasc. 44, 21 pp. (1906).

Synonymic catalogue of Phoridæ. Bull. Wisc. Nat. Hist. Soc., **12**, pp. 85–152 (1915).

LUNDBECK, W. Danish Phoridæ. Dipt. Dan., **6**, pp. 69–447 (1922).

MALLOCH, J. R. U. S. Phoridæ. Proc. U. S. Nat. Mus., **43**, pp. 411–529 (1913).

SCHMITZ, H. Myrmecophilous Phoridæ. Zool. Jahrb., **37**, Syst., pp. 509–566 (1914).

Myrmecophilous and termitophilous Phoridæ. Jaarb. Natuurh. Gen. Limburg, 1913, pp. 123–133 (1914).

Neue termitophile Dipteren. Zool. Jahrb., **39**, Syst., pp. 211–266 (1916).

Keys to European Phoridæ. Jaarb. Natuurb. Gen. Limburg, 1917, pp. 79–150; 1919, 91–152 (1919).

Geograph. distribution Europ. Phoridæ. Natuurhist. Maanblad, Limburg, **17**, pt. 10, pp. 139–147 (1928).

Revision of Phoridæ. Dümler's, Berlin u. Bonn. 211 pp. (1929).

WASMANN, E. Revision of oriental Termitoxeniidæ. Ann. Soc. Ent. Belg., **57**, pp. 16–22 (1913).

PIPUNCULIDÆ

BECKER, T. Revision of European Pipunculidæ. Berl. Ent. Zts., **42**, pp. 25–100 (1897).

Tables of new Pipunculidæ. Wien. ent. Ztg., **38**, pp. 123–132; 149–167 (1921).

CRESSON, E. T. N. Am. Pipunculidæ. Trans. Am. Ent. Soc., **36**, pp. 267–320 (1910).

HOUGH, G. DE N. Pipunculidæ of U. S. Proc. Bost. Soc. Nat. Hist., **29**, pp. 77–86 (1899).

LUNDBECK, W. Danish Pipunculidæ. Dipt. Dan., **6**, pp. 1–69 (1922).

PERKINS, R. C. L. Australian and Hawaiian Pipunculidæ. Bull. Haw. Sugar Plant. Assn., Entom., **1**, pp. 123–157 (1905).

VERRALL, G. H. British Pipunculidæ. Brit. Flies, **8**, pp. 60–126 (1901).

PLATPEZIDÆ AND SCIADOCERATIDÆ

JOHNSON, C. W. Platypezidæ of Eastern N. Am. Occ. Pap. Bost. Soc. Nat. Hist. 5, pp. 51–58 (1923).

LUNDBECK, W. Danish Platypezidæ. Dipt. Dan., **7**, pp. 1–39 (1927).

SCHMITZ, H. Sciadoceridæ. Dipt. Patagon. S. Chile, **6**, pt. 1, pp. 1–11 (1929).

SNOW, W. A. American Platypezidæ. Kans. Univ. Quart., **3**, pp. 143–152 (1894); 205–207 (1895).

VERRALL, G. H. British Platypezidæ. Brit. Flies, **8**, pp. 11–59 (1901).

SYRPHIDÆ

BANKS, GREENE, MCATEE AND SHANNON. Syrphidæ of District of Columbia, Proc. Biol. Soc. Wash., **29**, pp. 173–204 (1916).

BECKER, T. Revision of Chilosia. Acta Ac. Germ., **62**, pp. 195–522 (1894).

Genus Helophilus. Berl. ent. Zts., **55**, pp. 213–232 (1910).

New Syrphidæ. Mitt. Zool. Mus. Berl., **10**, pp. 1–93 (1921).

BEZZI, M. Syrphidæ of ethiop. region. Brit. Mus. Pub. 146 pp. (1915).

BRÈTHES, J. Masarygidæ, n. fam. An. Mus. Buen. Air. (3), **10**, p. 439 (1909).

BRUNETTI, E. Fauna Brit. India, Lond., **3**, 424 pp. (Pipunculidæ, Syrphidæ, Conopidæ, Œstridæ) (1923).

CURRAN, C. H. Nearct. Pipiza. Proc. Cal. Acad. Sci. (4), **11**, pp. 345–393 (1921).

Review of nearct. Syrphus, pt. Can. Ent., **53**, pp. 152–159 (1921).

Revision N. Am. Syrphidæ. Kans. Univ. Sci. Bull., **15**, pp. 1–216 (1925).

S. Afr. Syrphidæ. Bull. Am. Mus. Nat. Hist., **57**, pp. 44–83 (1927).

Syrphidæ of Malay Peninsula. Jour. Fed. Mal. States Mus., **14**, pt. 2, pp. 141–324 (1928).

CURRAN, C. H. and C. L. FLUKE. Revision of nearct. Helophilus. Trans. Wisc. Acad. Sci., **22**, pp. 207–281 (1926).

EFFLATOUN, H. C. Monograph Egyptian Syrphidæ. Mem. Soc. R. Ent. Egypt, **2**, fasc. 1, 123 pp. (1922).

FERGUSON, E. W. Revision Australian Syrphidæ. Proc. Linn. Soc. N. S. W., **51**, pp. 517–544 (1926).

FLUKE, C. L. Revision Wisconsin Syrphidæ. Trans. Wisc. Acad. Sci., **20**, pp. 215–253 (1921).

HULL, F. M. N. Am. Eristalis. Ohio Jour. Sci., **25**, pp. 11–42; 285–310 (1925).

JONES, C. R. Syrphidæ of Colorado. Ann. Ent. Soc. Am., **10**, pp. 219–231 (1917); Col. Agr. Exp. Sta. Bull. 269, 72 pp. (1922).

KERTÉSZ, K. S. Am. Ceria. Termes. Füzet., **25**, pp. 85–90 (1902).

LUNDBECK, W. Danish Syrphidæ. Dipt. Dan., **5**, pp. 18–591 (1916).

METCALF, C. L. Syrphidæ of Ohio. Ohio State Univ. Bull. **17**, No. 31, pp. 1–123 (1913).

Syrphidæ of North Carolina. Jour. Elisha Mitchell Soc., **32**, pp. 95–112 (1916).

Syrphidæ of Maine. Maine Exp. Sta. Bull. 253, pp. 193–264 (1916); 263, pp. 153–176 (1917).

MILLER, D. New Zealand Syrphidæ. Trans. N. Z. Inst., **53**, pp. 289–333 (1921).

SACK, P. Salpingogaster and Meromacrus. Zool. Jahrb. Syst., **43**, pp. 235–272 (1920).

Palæarct. Syrphidæ. Flieg. Pal. Reg., Lief. 30, 32, 34, 144 pp. (1928–1929).

C. Eur. Syrphidæ. Tierwelt Deutschl., pt. 20, pp. 1–118 (1930).

SHANNON, R. C. Keys to various groups nearct. Syrphidae. Proc. Ent. Soc. Wash., **18**, pp. 101–113 (1916). Proc. Biol. Soc. Wash., **29**, p. 203 (1916). Bull. Brkl. Ent. Soc., **16**, pp. 65–72; 120–128 (1921); **17**, pp. 30–42 (1922); **18**, pp. 17–21 (1923).

N. Am. Chilosia. Insecutor Insc. Menstr., **10**, pp. 117–145 (1922).

N. Am. Xylotinæ. Proc. U. S. Nat. Mus., **69**, art. 9, 52 pp. (1926).

N. Am. Chrysotoxinæ. Proc. U. S. Nat. Mus., **69**, art. 11, 20 pp. (1926).

N. Am. Cerioidinæ. Jour. Wash. Acad. Sci., **17**, No. 2, pp. 38–55 (1927).

Review of S. Am. Syrphidæ. Proc. U. S. Nat. Mus., **70**, art. 9, 34 pp. (1927).

SHIRAKI, T. Syrphidæ of Japan. Mem. Taihoku Imp. Univ. Ent., **1**, 446 pp. (1930).

STACKELBERG, A. A. Palæarct. Cinxiinæ. Acad. Sci. U. R. S. S., **20**, 27 pp. (1927).

Palæarct. Zelima (= Xylota). Deut. ent. Zts., 1925, pp. 279–288 (1925).

Palæarct. Cynorrhina. Konowia, **7**, pp. 252–258 (1928).

VERRALL, G. H. British Syrphidæ. Brit. Flies, **8**, pp. 127–676 (1901).

WEHR, E. E. Syrphidæ of Nebraska. Univ. Studies, Nebr., **22**, pp. 119–162 (1922).

WILLISTON, S. W. N. Am. Syrphidæ. Bull. U. S. Nat. Mus. 31, xxx. and 335 pp. (1886).

CALYPTRATÆ, GENERAL

BRAUER, F. and BERGENSTAMM, J. E. Monograph of Schizometopa (tables of about 50 fams.) Denks. kais. Wiss. Akad. Wien, **56**, pp. 69–158 (1889).

Zweiflügler des kaiserlichen Museums Wien. Denks. kais. Wiss. Akad. Wien, 7 pts., 1880–1894 Facsimile reprint, Junk, Berlin, 760 pp. (1923).

GIRSCHNER, E. Beiträge z. Systematik der Musciden. Berl. Ent. Zts., **38**, pp. 297–312 (1893).

Ein neues Musciden-System. Ill. Wochenschr. Ent., **1**, pp. 12–16; 30–32, etc., 16 pp. (1896).

SHANNON, R. C. and E. DEL PONTE. Argentine muscoids. Rev. Inst. bact. Buen. Aires, **4**, pp. 549–590 (1926); **5**, pp. 141–147 (1927).

TOWNSEND, C. H. T. Catalog S. Am. Calyptrate Muscidæ. Ann. N. Y. Acad. Sci., **7**, pp. 1–44 (1893).

Taxonomy of Muscoidean flies. Smiths. Misc. Coll., **51**, pp. 1–138 (1908).

Muscoideos da regiao humida tropical da America. Rev. Mus. paul., São Paulo, **15**, pt. 1, 205–386 (1927).

ANTHOMYIIDÆ

ALDRICH, J. M. Nearctic Lispa. Jour. N. Y. Ent. Soc., **21**, pp. 126–146 (1913).

Kelp flies (Fucellia) of N. Am. Proc. Cal. Acad. Sci., **8**, pp. 157–179 (1918).

BECKER, T. Palæarctic Lispa. Zts. f. Ent., **29**, pp. 1–70 (1904).

HUCKETT, H. C. Anthomyiinæ of New York. Cornell Univ. Mem. 77, pp. 1–91 (1923).

KARL, O. German Anthomyiidæ. Tierw. Deutsch. No. 13, pp. 15–232 (1928).

MALLOCH, J. R. Subfamilies of Anthomyiidæ. Can. Ent., **49**, pp. 406–408 (1917).

Synopsis of various N. Am. genera. Can. Ent., **52**, pp. 253–, 271– (1920); **53**, various parts (1921). Ann. Mag. Nat. Hist. (9), **11**, pp. 74–81, 664– (1923).

Cœnosiinæ. Ent. News, **32**, pp. 106–, 201– (1921). Ann. Mag. Nat. Hist. (9), **10**, pp. 576– (1922).

N. Am. Phaoniinæ. Trans. Am. Ent. Soc., **48**, pp. 227–282 (1922).

Various Australian genera. Proc. Linn. Soc. N. S. W., **50**, pp. 36–45 (1925).

RINGDAHL, O. Nordische Anthomyiden. Ent. Tidskr., **39**, pp. 148–194 (1918).

SCHNABL, J. and H. DZIEDZICKI. Die Anthomyiden. Nova Acta Leop., Halle, **95**, pp. 53–358 (1911).

SÉGUY, E. Anthomyiidæ of S. W. Europe. Faune de France, 393 pp. (1923).

STEIN, P. Homalomyia group. Berl. ent. Zts., **40**, pp. 1–141 (1895).

Die Anthom. Europas. Arch. f. Natg., **81**, A (10), pp. 1–224 (1916).

Revision N. Am. Anthomyiidæ. Berl. ent. Zts., **42**, pp. 161–288 (1897).

Arch. Naturg., **84**, pt. 2, A, 8, pp. 1–106 (1920).

Anthomyiidæ of S. Am. Arch. Naturg, **77**, pp. 61–189 (1911).

Genera of world. Arch. Naturg., **83**, A, 1 (1917), pp. 85–178 (1919).

CALLIPHORIDÆ AND SARCOPHAGIDÆ

ALDRICH, J. M. N. Am. Sarcophaga and allies. Thos. Say Foundat., **1**, 302 pp. (1916).

ALLEN, H. W. N. Am. Miltogrammini. Proc. U. S. Nat. Mus. 68, art. 9, 106 pp. (1926).

ENDERLEIN, G. Sarcophaginæ, s. str. Arch. Klass. Phylog. Ent. Wien, **1**, pp. 1–56 (1928).

ENGEL, E. O. Rutiliidæ, s. lat. Zool. Jahrb. Syst., **50**, pp. 339–376 (1925).

JOHNSON, T. H. and G. H. HARDY, Australian Sarcophaga. Proc. Linn. Soc. N. S. W., **48**, pp. 94–129 (1923).

MALLOCH, J. R. Australian Calliphoridæ. Proc. Linn. Soc. N. S. W., **52**, pp. 299–335 (1927).

African Calliphoridæ. Ann. Mag. Nat. Hist. (10), **3**, pp. 272–278; **4**, p. 113 (1929).

PARKER, R. R. Ravinia and Boettcheria of N. Engl. Proc. Bost. Soc. Nat. Hist., **35**, pp. 1–77 (1914).

ROHDENDORF, B. Subfams. Sarcophagidæ. Konowia, **7**, pp. 319–321 (1928). Palæarct. Sarcophagidæ. Flieg. pal. Reg. Lief. 39, pp. 1–48 (1930).

SÉGUY, E. Calliphoridæ of France. Encycl. Ent., A, **9**, pp. 89–192 (1928).

SENIOR-WHITE, R. Oriental Sarcophagidæ. Rec. Ind. Mus., **26**, pp. 193–283 (1924).

Oriental Calliphoridæ. Rec. Ind. Mus., **28**, pp. 127–140 (1926).

SHANNON, R. C. N. Am. Calliphoridæ. Insec. Insc. Menstr., **11**, pp. 101–118 (1923); **12**, pp. 67–81 (1924). Soc. Ent. Stuttgart, **28**, pp. 115–139 (1926). Proc. Ent. Soc. Wash., **28**, pp. 115–139 (1926).

SHANNON, R. C. and E. DEL PONTE. Argentine Calliphoridæ. Rev. Inst. Bact. Buen. Aires, **4**, pp. 583–587 (1926).

TOWNSEND, C. H. T. Genera of Sarcophagini. Proc. Biol. Soc. Wash., **30**, pp. 189–198 (1917).

MUSCIDÆ AND GLOSSINIDÆ

ALDRICH, J. M. Neotrop. Mesembrinella. Proc. U. S. Nat. Mus., **62**, art. 11, 24 pp. (1922).

AUSTEN, E. E. Monogr. Tsetse-flies. Brit. Mus. Publ., 319 pp. (1903). Handbook of the Tsetse. Brit. Mus. Publ., 110 pp. (1911).

AUSTEN, E. E. and E. HEGH. Tsetse flies. Imp. Bur. Ent. Publ., 188 pp. (1922).

ENDERLEIN, G. Stomoxinæ. Zts. angew. Ent., **14**, pp. 356–368 (1928).

HEGH, E. Les Tsé-tsés. Bruxelles, 742 pp. (1929).

KARL, O. German Muscidæ. Tierw. Deutsch. No. 13, pp. 1–15 (1928).

MALLOCH, J. R. Australian Muscinæ. Proc. Linn. Soc. N. S. W., **50**, pp. 45, 46 (1925).

SURCOUF, J. M. R Revision de Muscides testaceæ. Nouv. Arch. Mus. Hist. nat. (5), **6**, pp. 27–124 (1919).

TOWNSEND, C. H. T. Connectant forms between muscoid and anthomyoid flies. Ann. Ent. Soc. Am., **7**, pp. 160–167 (1914).

CORDYLURIDÆ

BECKER, T. Scatomyzidæ. Berl. ent. Zts., **39**, pp. 77–196 (1894).

COQUILLETT, D. W. Scatophagidæ. Jour. N. Y. Ent. Soc., **8**, pp. 160–165 (1898).

CURRAN, C. H. Several nearct. genera. Can. Ent., **59**, pp. 253–261 (1927).

JOHNSON, C. W. Several nearct. genera. Psyche, **34**, pp. 100–104 (1927).

MALLOCH, J. R. Generic key, etc. Rept. Can. Arct. Exped. 1913–18, **3**, pt. C, pp. 75–81 (1919).

Various nearct. genera. Ohio Jour. Sci., **20**, pp. 286– (1920). Bull. Brkl. Ent. Soc., **17**, pp. 77– (1922). Ent. News, **34**, pp. 139– , 179– (1923). N. Am. Fauna, **46**, pp. 201– (1923).

ŒSTRIDÆ

BAU, A. Family Œstridæ. Gen. Ins., fasc. 43, 31 pp. (1906).

BRAUER, F. Œstridæ. Verh. z. b. Ges. Wien, **43**, pp. 447–525 (1893).

BRAUER, F. and J. E. BERGENSTAMM. Tables genera, etc. Denks. kais. Akad. Wiss. Math. Naturw. Wien, **56**, pp. 158–161 (1889); **60**, pp. 89–240 (1893).

PLESKE, T. Palæarct. Œstridæ. Ann. Mus. Zool. Leningrad, **26**, pp. 215–230 (1926).

RODHAIN, J. and J. BEQUAERT. African Œstrinæ. Bull. scient. France, Belg., (7), **50**, p. 53–165 (1916–17).

SÉGUY, E. Genera Œstridæ. Encycl. Ent. B. Dipt., **2**, pt. 3, pp. 1–10 (1926). Œstridæ of W. Eur. Encycl. Ent. A, **9**, pp. 53–88 (1928).

TOWNSEND, C. H. T. Revision Cuterebridæ. Insecut. Insc. Mens., **5**, pp. 23–28 (1917).

TACHINIDÆ

ALDRICH, J. M. Metallic green tachinids. Insecut. Insc. Mens., **14**, pp. 51–58 (1926).

Species with retracted hind crossvein. Trans. Am. Ent. Soc., **52**, pp. 7–28 (1926).

ALDRICH, J. M. and R. T. WEBBER. N. Am. Phorocera, etc. Proc. U. S. Nat. Mus., **63**, art. 17, 90 pp. (1924).

BAER, W. Classification, etc. Zts. angew. Ent., **6**, pp. 185–246 (1920); **7**, pp. 97–163; 349–423 (1921).

BEZZI, M. Fissicorn Tachininæ. Proc. Linn. Soc. N. S. W., **48**, pp. 647–659 (1923).

Genera with 4 vein obliterated at apex. Ann. Mag. Nat. Hist. (9), **17**, pp. 236–238 (1926).

COQUILLETT, D. W. N. Am. Tachinidæ. Bull. U. S. Dept. Agr. Tech. Ser. No. 7, 156 pp. (1897).

CURRAN, C. H. African Tachinidæ. Bull. Ent. Res., **17**, pp. 319–340; **18**, pp. 103–128 (1927), 237–245 (1928).

Am. Archytas. Can. Ent., **60**, pp. 201–, 218–, 249–, 275–, (1928).

ENGEL, E. O. Neotrop. Hystriciidæ. Zool. Jahrb. Syst., **43**, 273–328 (1920).

LUNDBECK, W. Danish Tachinoidea. Dipt. Dan., **7**, pp. 40–560 (1927).

MALLOCH, J. R. Exotic Rhiniinæ. Ann. Mag. Nat. Hist. (9), **18**, pp. 496–522 (1926).

Catalog Australian Tachinidæ. Proc. Linn. Soc. N. S. W., **53**, pp. 651–662 (1928). Keys, **54**, p. 337 (1929).

Ormiini. Ann. Mag. Nat. Hist. (10), **3**, pp. 278–280 (1929).

MÜLLER, A. Determination of German, by ♂ genitalia. Nova Acta, Leop., **108**, pp. 1–30 (1926). Konowia, **5**, pp. 72–, 233, 246 (1926).

SENIOR-WHITE, R. Oriental Rhiniinæ. Rec. Ind. Mus., **27**, pp. 81–96 (1925).

TOTHILL, J. D. Nearct. Ernestia. Can. Ent., **53**, pp. 199–, 226–, 247–, 270– (1921).

TOWNSEND, C. H. T. Tables, etc., N. Am. Trans. Am. Ent. Soc., **19**, pp. 88–289 (1892).

Dejeaniini. Psyche, **20**, pp. 102–106 (1913).

Relationships of muscoid flies. Can. Ent., **45**, pp. 37–60 (1913).

Indian Rhiniinæ. Rec. Ind. Mus., **13**, Pt. 4, pp. 185–202 (1917).

WAINWRIGHT, C. J. British Tachinidæ. Trans. Ent. Soc. Lond., **76**, pt. 1, pp. 139–254 (1928).

ACALYPTRATÆ, GENERAL

FREY, R. Dipt. schizophora. Act. Soc. Fenn., **48**, 245 pp. (1921).

HENDEL, F. Papers on various Acalyptrates. Wien. ent. Ztg., **29**, pp. 101–127 (1910); **30**, pp. 19–46 (1911). Deut. ent. Zts. 1914, pp. 151–176 (American); 1917, pp. 33–47. Entom. Mitt., **5**, pp. 294–299 (1916).

Palæarct. Acalyptratæ. Konowia, **1**, pp. 145–160; 253–365 (1922). Tierw. Deutschl., Dipt., pt. 2, 135 pp. (1928).

STURTEVANT, A. H. Notes on Acalyptratæ. Am. Mus. Novitat., No. 76, 12 pp. (1923).

MICROPEZIDÆ, NERIIDÆ, TANYPEZIDÆ

CRESSON, E. T. N. Am. Micropezidæ. Trans. Am. Ent. Soc., **52**, pp. 260–274 (1926).

ENDERLEIN, G. Classification of Tanypezidæ. Zool. Anz., **42**, pp. 224–229 (1913).

Classification of Micropezidæ. Arch. Naturg. Berl., A, **88**, pt. 5, pp. 140–229 (1922).

FREY, R. Micropezidæ. Not. Ent., **7**, pp. 65–76 (1927).

African Tanypodinæ. Ann. Mag. Nat Hist. (10), **3**, pp. 313–318 (1929).

VAN DUZEE, M. C. Nearctic Micropeza. Pan-Pacif. Ent., **3**, pp. 1-11 (1926).

CLUSIIDÆ, CŒLOPIDÆ, MEGAMERINIDÆ, SEPSIDÆ

CZERNY, L. Heteroneuriden. Wien. ent. Ztg., **22**, pp. 61–107 (1903).

Palæarct. Clusiidæ. Flieg. pal. Reg., pt. 28, 12 pp. (1928).

DUDA, O. Monograph of Sepsidæ. Ann. Nat. Hist. Mus. Wien, **39**, pp. 1–153 (1925); **40**, pp. 1–110 (1926).

FREY, R. Finland spp. of Sepsis. Deut. ent. Zts. 1908, 577–588 (1908).

Palæarct. Sepsidæ. Notulæ Ent., **5**, pp. 69–76 (1925).

HENDEL, F. Megamerinidæ. Suppl. Entom., **2**, pp. 90–93 (1913).

MALLOCH, J. R. Nearctic Clusiidæ. Proc. Ent. Soc. Wash., **20**, pp. 2–8 (1918).

Nearctic Cœlopa. N. Am. Fauna, **46**, p. 214 (1923).

MELANDER, A. L. and NAOMI ARGO. Family Clusiidæ. Proc. U. S. Nat. Mus., **64**, art. 11, 54 pp. (1924).

MELANDER, A. L. and A. SPULER. Sepsidæ and Piophilidæ. Wash. Agr. Exp. Sta. Bull. 143, 103 pp. (1917).

RHOPALOMERIDÆ, RHINOTORIDÆ, DIOPSIDÆ

FREY, R. Philippine Diopsidæ. Notulæ Ent., **8**, pp. 69–77 (1928).

LINDNER, E. Revision of Rhopalomeridæ. Deut. ent. Zts. 1930, 122–137 (1930).

WILLISTON, S. W. Rhopalomeridæ. Psyche, **7**, pp. 183–186 (1895).

LAUXANIIDÆ, CELYPHIDÆ, PERISCELIDÆ, PALLOPTERIDÆ

FREY, R. Philippine Lauxaniidæ. Act. Soc. F. Fl. Fenn., **56**, No. 8, pp. 1–44 (1927).

HENDEL, F. Table of genera of Lauxaniidæ. Encycl. Ent. B. Dipt., **2**, No. 2, pp. 103–142 (1925).

Family Lauxaniidæ. Gen. Ins., fasc. 68, 66 pp. (1908).

JACOBSEN, G. Catalog of Celyphidæ. Ann. M. Z. Acad. Petersb. 1896, pp. 246–252 (1896).

KERTÉSZ, K. Indo-austr. Sapromyza. Termesz. Füz., **23**, pp. 254–276 (1900).

Lauxaniidæ of Hungary. Math. Termt. Ert., **38**, pp. 352–359 (1921).

MALLOCH, J. R. and W. L. MCATEE. Lonchæidæ, Pallopteridæ and Sapromyzidæ of E. U. S. Proc. U. S. Nat. Mus., **65**, art. 12, 26 pp. (1925).

MALLOCH, J. R. Periscelidæ. Proc. U. S. Nat. Mus., **68**, art. 21, p. 24 (1926).

Australian Sapromyzidæ. Proc. Linn. Soc. N. S. W., **52**, pp. 399–421 (1927).

Oriental Lauxaniidæ. Proc. U. S. Nat. Mus., **74**, art. 6, 97 pp. (1929).

MELANDER, A. L. Nearctic Sapromyzidæ. Psyche, **20**, pp. 57–82 (1913).

TONNOIR, A. L. and J. R. MALLOCH. New Zealand Sapromyzidæ. Rec. Cant. Mus., **3**, pt. 1, pp. 19–26 (1926).

TETANOCERATIDÆ, DRYOMYZIDÆ

CRESSON, E. T. Nearctic Sciomyzidæ. Trans. Am. Ent. Soc., **46**, pp. 27–89 (1920).

FREY, R. North-palæarct. Tetanocera. Notulæ Ent., **4**, pp. 47–53 (1924).

HENDEL, F. Palæarct. Sciomyzidæ. Abh. z. b. Ges. Wien., **2**, pt. 1, 92 pp. (1902).

Ethiopian and Indo-mal. Sepedon. Ann. Mus. Nat. Hung., **9**, pp. 266–277 (1911).

KERTÉSZ, K. Hungarian Tetanoceridæ. Adlatt. Közlem., **14**, pp. 81–126 (1915). Math. Termt. Ert. Budapest, **39**, pp. 124–130 (1922).

MELANDER, A. L. Nearct. Tetanoceridæ. Ann. Ent. Soc. Am., **13**, pp. 305–322 (1920).

TONNOIR, A. L. and J. R. MALLOCH. New Zealand Sciomyzidæ. Rec. Cant. Mus., **3**, pt. 3, pp. 151–179 (1928).

ORTALID SERIES: PHYTALMIIDÆ, PLATYSTOMATIDÆ, PTEROCALLIDÆ, PYRGOTIDÆ, RICHARDIIDÆ, TACHINISCIDÆ, ULIDIIDÆ

Bezzi, M. Phytalmiidæ. Rev. Zool. Afr., **12**, pp. 225–239 (1924).

Bezzi, M. and J. R. Malloch. Australian Prygotidæ. Proc. Linn. Soc. N. S. W., **54**, pp. 1–31 (1929).

Enderlein, G. Platystominen. Mitt. Zool. Mus. Berl., **11**, pp. 97–153 (1924).

Hendel, F. Pyrogotinæ. Gen. Ins., fasc. 79, 33 pp. (1908).

Pterocallinæ. Gen. Ins., fasc. 96, 50 pp. (1909). Deut. ent. Zts. 1909, Beih. S, pp. 1–84 (1909).

Chrysomyza. Zool. Anz., **34**, pp. 612–622 (1909).

Euxesta. Ann. Mus. Nat. Hung., **7**, pp. 151–172 (1909).

Ulidiinæ. Gen. Ins., fasc. 106, 76 pp. (1910).

Richardiinæ. Deut. ent. Zts. 1911, pp. 181–270; 367–396 (1911). Gen. Ins., fasc. 113, 56 pp. (1911).

Pyrgotinen. Arch. f. Naturg., **79**, Abt. A, pp. 77–117 (1913).

Platystoma. Zool. Jahrb. Syst., **35**, pt. 1, pp. 55–126 (1913).

Platystominæ. Abh. z. b. Ges. Wien, **8**, 410 pp. (1914). Gen. Ins., fasc. 157, 179 pp. (1914).

Loew, H. N. Am. Ortalidæ. Monogr. Dipt. N. Am., **3**, 209 pp. (1873).

Malloch, J. R. African Pyrgotidæ. Ann. Mag. Nat. Hist. (10), **3**, pp. 249–261 (1929).

Tachiniscidæ. Ann. Mag. Nat. Hist. (10), **7**, pp. 334–338 (1931).

TRYPETIDÆ

Bezzi, M. Ceratitis, Anastrepha and Dacus. Boll. Lab. Portici, **3**, pp. 273–313 (1909).

Indian Trypaneids. Mem. Ind. Mus., **3**, No. 3, pp. 53–175 (1913).

Philippine Dacus. Phil. Jour. Sci., **15**, pp. 411–443 (1919).

Ethiop. Fruit-flies. Bull. Ent. Res., **8**, pp. 215–251 (1918); **9**, pp. 13–46 (1919); **10**, pp. 211–271 (1920); **15**, pp. 73–155 (1924).

S. Afr. Trypetidæ. Ann. S. Afr. Mus., **19**, pp. 449–577 (1924).

Coquillett, D. W. Genera of Trypetidæ, etc. Jour. N. Y. Ent. Soc., **7**, pp. 259–268 (1899).

Cresson, E. T. N. Am. Rhagoletis. Trans. Am. Ent. Soc., **55**, pp. 401–414 (1929).

Efflatoun, H. C. Egyptian Trypetidæ. Mem. Soc. R. Ent. Egypt, **2**, No. 2, 132 pp. (1924).

Enderlein, G. Studies on Trypetidæ. Zool. Jahrb. Syst., **31**, pp. 407–460 (1911).

Hendel, F. Bohrfliegen Südamerikas. Abh. Ber. K. Zool. Anthrop. Mus. Dresden, **14**, pp. 1–84 (1914).

Table of genera of Tephritinæ. Wien. ent. Ztg., **33**, pp. 60–98 (1914).

LOEW, H. N. Am. Trypetidæ. Monogr. Dipt. N. Am., pt. 1, pp. 49–102 (1862); pt. 3, pp. 211–347 (1873).

Europäischen Bohrfliegen. Wien, 128 pp. (1862). Reprint, Junk, Berlin (1923).

PHILLIPS, V. T. N. Am. Trypetidæ. Jour. N. Y. Ent. Soc., **31**, pp. 119–154 (1923).

SENIOR-WHITE, R. Indian Trypetidæ. Cat. Ind. Ins. Govt. Centr. Pub. Br., pt. 4, 33 pp. (1924).

LONCHÆIDÆ, PIOPHILIDÆ, PSILIDÆ

BEZZI, M. Lonchæidæ. Bull. Ent. Res. **9**, pp. 241–254 (1919); **11**, pp. 199–210 (1920).

DUDA, O. Piophila. Konowia, **3**, pp. 97–203 (1924).

KERTÉSZ, K. Indo-austral. Lonchæidæ. Termés. Füzet., **24**, pp. 82–87 (1901).

MALLOCH, J. R. and W. L. MCATEE. Lonchæidæ, Pallopteridæ and Sapromyzidæ of E. U. S. Proc. U. S. Nat. Mus., **65**, art. 12, 26 pp. (1924).

MELANDER, A. L. Nearct. Psilidæ. Psyche, **27**, pp. 91–101 (1920).

Nearct. Piophilidæ. Psyche, **31**, pp. 78–86 (1924).

MELANDER, A. L. and A. SPULER. N. Am. Piophilidæ. Wash. Agr. Exp. Sta. Bull. 143, pp. 53–76 (1917).

HELOMYZIDÆ, CHYROMYIIDÆ, TRICHOSCELIDÆ

ALDRICH, J. M. Key to genera of Helomyzidæ. Insecut. Insc. Mens., **14**, pp. 96–102 (1926).

ALDRICH, J. M. and P. S. DARLINGTON. N. Am. Helomyzidæ. Trans. Am. Ent. Soc., **34**, pp. 67–100 (1908).

BECKER, T. Peletophila. Zts. Hym. Dipt., **4**, pp. 129–133 (1904).

BEZZI, M. Chyromyiidæ. Atti Soc. It. Sci. Nat. Milano, **43**, 177–181 (1904).

CZERNY, L. Palæarct. Helomyzidæ, Trichoscelidæ and Chyromyiidæ. Flieg. pal. Reg., pt. 22, 54 pp. (1927).

Palæarct. Helomyzidæ. Wien. ent. Ztg., **23**, pp. 199–244, 263–286 (1904). Konowia, **6**, pp. 35–49 (1927).

MALLOCH, J. R. Nearc. Chyromyia. Proc. Ent. Soc. Wash., **16**, pp. 179–181 (1914).

Nearct. Spilochroa. Proc. U. S. Nat. Mus., **78**, art. 15, p. 29 (1931).

TONNOIR, A. L. and J. R. MALLOCH. New Zealand Helomyzidæ. Rec. Cant. Mus., **3**, pp. 83–100 (1927).

EPHYDRIDÆ, CANACEIDÆ

BECKER, T. Palæarct. Ephydridæ. Berl. ent. Zts., **41**, pp. 91–276 (1896). Flieg. pal. Reg., pts. 10, 11, 115 pp. (1926).

CRESSON, E. T. Nearct. Paralimna, etc. Trans. Am. Ent. Soc., **42**, pp. 101–124 (1916).

Nearct. Notiphila and Dichæta. Trans. Am. Ent. Soc., **43**, pp. 27–69 (1917).

Nearct. Gymnopinæ. Trans. Am. Ent. Soc., **47**, pp. 325–343 (1922).

JONES, B. J. Catalog Ephydridæ (with bibliogr.). Univ. Cal. Publ. Ent., **1**, pp. 153–198 (1906).

TONNOIR, A. L. and J. R. MALLOCH. New Zealand Ephydridæ. Rec. Cant. Mus., **3**, pp. 1–18 (1926).

CHLOROPIDÆ, ASTIIDÆ, CRYPTOCHÆTIDÆ

BECKER, T. Chloropidæ. I. Palæarct. Arch. Zool., **1**, pt. 10, pp. 33–174 (1910). II. Ethiop. Ann. Mus. Nat. Hung., **8**, pp. 377–443 (1911). III. Indoaustr. Ibid., **9**, pp. 35–170 (1911). IV. Nearct. Ibid., **10**, pp. 21–120 (1912). V. Neotrop. Ibid., **10**, pp. 121–156 (1912).

DUDA, O. Palæarct. Astiidæ. Deut. ent. Zts. 1927, pp. 113–147 (1927).

ENDERLEIN, G. Oscinosominæ. Zool. Anz., **38**, pp. 10–23 (1911). Sb. Ges. natf. Fr. 1911, pt. 4, pp. 185–244 (1911).

KNAB, F. Cryptochætum. Insecut. Insc. Mens., **2**, pp. 33–36 (1914).

MALLOCH, J. R. Botanobiinæ. Proc. U. S. Nat. Mus., **46**, pp. 239–266 (1913).

Chloropidæ. Can. Ent., **46**, pp. 113–120 (1914).

Australian Botanobiinæ. Proc. Linn. Soc. N. S. W., **52**, pp. 434–445 (1927).

Cryptochætum. Proc. Linn. Soc. N. S. W., **52**, pp. 421–423 (1927).

BORBORIDÆ, LEPTOCERATIDÆ

DUDA, O. European Limosina. Abh. z. b. Ges. Wien, **10**, pt. 1, 240 pp. (1918). Zool. Jahrb. Syst., **43**, pp. 433–446 (1920). Konowia, **7**, pp. 162–174 (1928).

Palæarct. Sphærocera. Tijds. Ent., **63**, pp. 1–39 (1920).

Palæarct. Borborus. Arch. Naturges., **89**, A, pt. 4, pp. 35–112 (1923).

Leptocera (non-European). Arch. Naturges., **90**, A, pt. 11, pp. 5–215 (1924).

MALLOCH, J. R. Costa Rican Borboridæ. Trans. Am. Ent. Soc., **40**, pp. 1–24 (1914).

SPULER, A. N. Am. Borboridæ, genera. Proc. Acad. Nat. Sci. Phila., **75**, pp. 369–378 (1923).

Nearct. Sphærocera and Aptilotus. Pan-Pacif. Ent., **1**, pp. 66–71 (1924).

Nearctic Leptocera. Ann. Ent. Soc. Am., **17**, pp. 106–116 (1924). Psyche, **31**, pp. 121–135 (1924). Jour. N. Y. Ent. Soc., **33**, pp. 70–84, 147–162 (1925). Can. Ent., **57**, pp. 99–104, 116–124 (1925).

Nearct. Borborus and Scatophora. Bull. Brkl. Ent. Soc., **20**, pp. 1–16 (1925).

AGROMYZIDÆ, ODINIIDÆ, ANTHOMYZIDÆ, OCHTHIPHILIDÆ, OPOMYZIDÆ, TETHINIDÆ

CZERNY, L. Europ. Geomyza. Wien. ent. Ztg., **22**, pp. 123–127 (1903).
Palæarct. Anthomyza. Wien. ent. Ztg., **21**, pp. 249–254 (1902).
Ochthiphilidæ. Wien. ent. Ztg., **23**, pp. 167–170 (1904).
Palæarct. Anthomyzidæ, Opomyzidæ, Tethinidæ. Flieg. pal. Reg., pt. 28, 31 pp. (1928).

HENDEL, F. Palæarct. Agromyzidæ. Arch. Naturg., **84**, A, pt. 7, pp. 109–174 (1918). Zool. Anz., **69**, p. 248 (1927).

HERING, M. German Agromyzidæ. Tierw. Deutschl., No. 6, 172 pp. (1927).

MALLOCH, J. R. Nearct. Agromyza. Ann. Ent. Soc. Am., **6**, pp. 269–336 (1913).
Nearct. Agromyzidæ. Proc. U. S. Nat. Mus., **46**, pp. 127–154 (1913).
Nearct. Ochthiphilinæ. Nat. Hist. Surv. Ill. Bull. 13, art. 14, pp. 345–361 (1921). Ann. Mag. Nat. Hist. (9), **19**, pp. 575–577 (1927).

MELANDER, A. L. Agromyzinæ, Milichiinæ, Ochthiphilinæ and Geomyzinæ. Jour. N. Y. Ent. Soc., **21**, pp. 219–273, 283–300 (1913).

DROSOPHILIDÆ, DIASTATIDÆ, MILICHIIDÆ

BECKER, T. Milichiinæ. Ann. Mus. Nat. Hung., **5**, pp. 507–550 (1907).

DUDA, O. Europ. Drosophila. Ent. Meddel., **14**, pp. 246–313 (1924).
Drosophilidæ. Arch. f. Naturges., **90**, A, pp. 172–234 (1924).
Neotrop. Drosophilidæ. Ann. Mus. Nat. Hung., **22**, pp. 149–229 (1925); Arch. f. Naturges., **91**, A, pts. 11, 12, pp. 1–229 (1925).

HENDEL, F. Cyrtonotum. Deut. ent. Zts. 1913, pp. 618–630 (1913).
Milichiiden. Entom. Mitt., **8**, pp. 196–200 (1919).

KAHL, H. Leucophenga. Ann. Carnegie Mus., **11**, pp. 364–393 (1917).

MALLOCH, J. R. Various Drosophilidæ. Ent. News., **32**, pp. 311, 312 (1921); Proc. U. S. Nat. Mus., **68**, art. 21, pp. 28–34 (1921).

MALLOCH, J. R. and W. L. MCATEE. Drosophilidæ of Distr. Col. Proc. Biol. Soc. Wash., **37**, pp. 25–41 (1924).

STURTEVANT, A. H. Nearct. Drosophilidæ. Ann. Ent. Soc. Am., **9**, pp. 325–342 (1916). Bull. Am. Mus. Nat. Hist., **38**, pp. 441–446 (1918). Carnegie Inst. Wash. Publ. 301, 150 pp. (1921).
Zygothrica. Proc. U. S. Nat. Mus., **58**, pp. 155–158 (1920).

PUPIPARA

ALDRICH, J. M. Table genera of Hippoboscidæ. Insecut. Insc. Mens., **11**, pp. 75–79 (1923).

DA COSTA LIMA. S. Am. Streblidæ. Arch. Est. Agr. Med. vet. Nictheroy, **5**, pp. 25–32 (1921).

AUSTEN, E. E. Hippoboscidæ. Ann. Mag. Nat. Hist. (7), **12**, pp. 255–266 (1903).

BEQUAERT, J. Hippoboscinæ. Psyche, **37**, pp. 303–326 (1930).
FALCOZ, L. Pupipara of France. Faun. de Fr., **14**, pp. 21–52 (1926).
FERRIS, G. F. Ectoparasites of bats. Ent. News, **27**, pp. 433–438 (1916).
New world Nycteribiidæ. Ent. News, **35**, pp. 191–199 (1924).
Samoan Hippoboscidæ. Ins. Samoa, **6**, pp. 10–21 (1927).
FERRIS, G. F. and F. R. COLE. Hippoboscidæ. Parasitol., **14**, pp. 178–204 (1922).
MASSONAT, E. Pupipara. Ann. Univ. Lyon, N. S. (1), **28**, pp. 1–356 (1909).
MUIR, F. Ascodipteron. Bull. Mus. Comp. Zool. Harvard, **54**, pp. 349–366 (1912).
SCOTT, H. Nycteribiidæ. Parasitol., **9**, pp. 593–610 (1917).
SPEISER, P. Strebliden. Arch. f. Naturg., **66**, pp. 31–70 (1901).
Nycteribiden. Arch. f. Naturg., **67**, pp. 11–77 (1901).
Hippobosciden. Ann. Mus. Genova, **40**, pp. 553–562 (1901).
Checklist N. Am. Pupipara. Ent. News, **18**, pp. 103–105 (1907).
Phylogeny and distribut. of Pupipara. Zts. Wiss. Insektenbiol., **4**, pp. 241–, 301–, 420–, 437– (1908).
SWENK, M. H. N. Am. Hippoboscidæ. Jour. N. Y. Ent. Soc., **24**, pp. 126–(1916).

ORDER **SIPHONÁPTERA**

(*SUCTÒRIA, APHANÍPTERA, ROPHOTEÌRA*)

Small, wingless, strongly compressed, jumping insects, with dark colored, heavily chitinized bristly body and legs; parasitic in the adult condition on mammals, or rarely on birds. Head small, closely articulated with the thorax. Antennæ short and thick, with two large basal joints and an oval or elongate indistinctly jointed apical portion, lying in depressions behind the small, simple eyes which are sometimes wanting. Mouthparts fitted for piercing and sucking, the mandibles setiform, maxillæ blade-like; both pairs of palpi well developed. Thorax small, composed of three similar, freely movable segments. Abdomen large, composed of nine segments; cerci one-jointed. Legs large, stout; coxæ large, tarsi five-jointed with stout claws. Metamorphosis complete; larvæ elongate, cylindrical, legless, with well developed head and biting mouthparts; free living. Pupæ enclosed in cocoons. Fleas.

1. Head divided above the antennæ into two distinct parts by a suture, the anterior dorsal portion more or less freely articulated with the posterior portion and overlapping it. (Suborder FRACTICÍPITA) 2

   Head without transverse suture above, the dorsal surface continuous and not thus articulated. (Suborder INTEGRICÍPITA) . 4

2. Head simple at sides, without an articulated, flattened lobe on each side anteriorly; not parasitic on bats. 3

   Head on each side below with a pair of chitinous flaps that project downward from the anterior corner of the head at the sides of the mouth opening; species parasitic on bats. (**Ischnopsýllus**). **ISCHNOPSÝLLIDÆ**

3. Occipital region with a transverse dorsal thickening near the middle; vertical suture of head extending below the antennæ to the lower margin of the head; posterior margin of front usually with a comb-like row of stout spines. **MACROPSÝLLIDÆ**

   Occipital region entire, without such a dorsal thickening; head spinose, but without such a comb-like row along the posterior margin of the front. (Including *CTENOPSÝLLIDÆ* and *TYPHLOCERÁTIDÆ*) . . . . . **HYSTRICHOPSÝLLIDÆ**

4. Thoracic segments not strongly shortened and constricted, their tergites together longer than the first abdominal segment, sides of metathorax sometimes extending over two or three abdominal segments; labial palpi with three or more false joints; maxillary palpi almost always shorter than the front coxæ; third joint of antennæ with nine more or less distinctly separated false joints. 5

   Thoracic segments strongly shortened and constricted, their tergites together shorter than the first abdominal segment; labial palpi without false joints; maxillary palpi almost always extending beyond the front coxæ; third antennal joint without distinctly separated false joints; abdomen of fully matured female greatly distended. 8

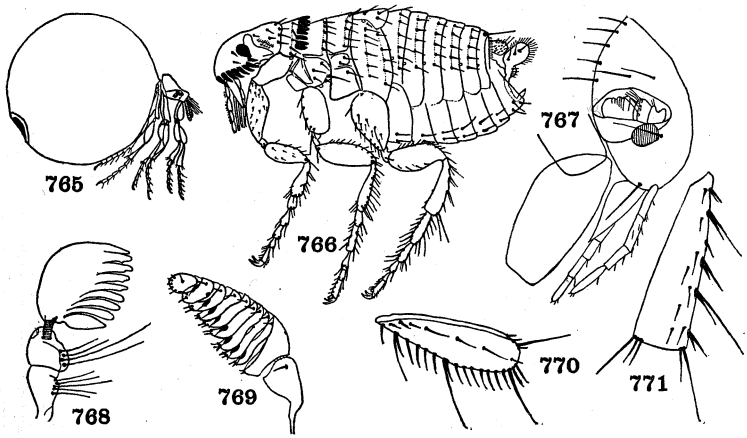
5. Abdominal tergites provided with numerous setæ arranged in two or more rows; eyes greatly reduced in size, or usually absent . . 6

   Abdominal segments with few setæ, forming only a single row on all or on most of the abdominal tergites; eyes almost always present. (Figs. 766, 767, 768, 770). (**Pùlex, Ctenocephálides** (=*Ctenocéphalus*) (*C. fèlis*, Cat-flea; *C. cànis*, Dog-flea), **Archæopsýlla, Xenopsýlla** (=*Lœmopsýlla*) (*X. cheòpis*, Plague flea), **Hoplopsýllus, Ornithopsýlla**). (Including *ARCHÆOPSÝLLIDÆ*) . . . . . **PULÍCIDÆ**

6. Head without a comb of spines on each cheek. 7

   Head with a comb of from two to six stout bristles or spines on each cheek. (**Ctenophthálmus, Rhadinopsýlla, Micropsýlla**) (*NEOPSÝLLIDÆ*, part) . . . **CTENOPHTHÁLMIDÆ**

7. Head with a notch or tubercle on the front margin; eyes frequently absent (Figs. 769, 771). (**Ceratophýllus, Ctenophýllus, Dolichopsýlla, Amphipsýlla, Parapsýllus, Vermipsýlla**). (*CERATOPHÝLLIDÆ*; *VERMIPSÝLLIDÆ*, part) ..... **DOLICHOPSÝLLIDÆ**



Figs. 765–771. **Siphonaptera**

765. **Tunga,** mature female (Butler) Tungidæ.
766. **Ctenocephalides** (Patton and Cragg) Pulicidæ.
767. **Xenopsylla,** side view of head (Fox) Pulicidæ.
768. **Ctenocephalides,** antenna (Patton and Cragg) Pulicidæ.
769. **Ceratophyllus,** antenna (Fox) Dolichopsyllidæ.
770. **Ctenocephalides,** hind tibia (Fox) Pulicidæ.
771. **Ceratophyllus,** hind tibia (Fox) Pulicidæ.

Head without a notch or tubercle on the front margin; eyes usually present. (**Uropsýlla, Malacopsýlla, Acanthopsýlla**). (*MALACOPSÝLLIDÆ*; *MEGAPSÝLLIDÆ*; *VERMIPSÝLLIDÆ*, part) ..... **UROPSÝLLIDÆ**

8. Maxillæ with a long, narrow, curved lamina which projects downward and backward; maxillary palpi as long as the front coxæ; head evenly rounded above; side pieces of metathorax extending over only the first abdominal segment; abdomen of fully matured female vermiform. (**Hectopsýlla**, ind.). **HECTOPSÝLLIDÆ**

Maxillæ without, or with a very short and broad projecting lamina, their palpi extending beyond the front coxæ; head strongly angulated anteriorly above; side pieces of metathorax extending over nearly two or three abdominal tergites; abdomen of fully matured female enormously swollen, globose (Fig. 765). (**Túnga** (=*Sarcopsýlla, Dermatóphilus*) (*T. pénetrans,* Chigoe or Jigger flea) tropicopol.; **Echidnóphaga** (*E. gallinàcea,* Sticktight or Hen flea) tropicopol.). (*SARCOPSÝLLIDÆ, ECHIDNOPHÁGIDÆ, DERMATOPHÍLIDÆ, RHYNCHOPRIÓNIDÆ*) ..... **TÚNGIDÆ**

LITERATURE ON SIPHONAPTERA

BAKER, C. F. Revision of American Siphonaptera. Proc. U. S. Nat. Mus., **27**, pp. 265–469 (1904).

Classification of American Siphonaptera. Proc. U. S. Nat. Mus., **29**, pp. 121–170 (1905).

DALLA TORRE, C. G. Aphaniptera orbis terrarum. Ber. naturw. med. Ver., Innsbruck, **39**, pp. 1–29 (1924).

DAMPF, A. Die Aphanipteren Westdeutschlands. Ber. bot. zool. Ver. Rheinlande, 1911, pp. 73–113 (1912).

Kritisches Verzeichnis der Aphaniptera Deutschlands. Entom. Mitt., **15**, pp. 377–386 (1926).

FOX, C. Insects and Diseases of Man. London and Philadelphia, 349 pp. (1925) (Key to genera of Siphonaptera).

JORDAN, K. and W. ROTHSCHILD. Revision of Sarcopsyllidæ. Thompson Yates and Johnston Lab. Repts., **7** (1906).

Revision of the non-combed eyed Siphonaptera. Parasitology, **1**, pp. 1–100 (1908).

OUDEMANS, A. C. Anteekningen over Suctoria. Entom. Bericht. (numerous parts) (1909–1917).

Neue Ansichten über die Morphologie des Flohkopfes, sowie über die Ontogenie, Phylogenie und Systematik der Flöhe. Novit. Zool., **16**, pp. 133–158 (1910).

Kritisch Overzicht du Nederlandische Suctoria. Tijdschr. v. Entom., **58**, pp. 60–97 (1915).

ROTHSCHILD, N. C. Synopsis of British Siphonaptera. Entom. Monthly Mag., **51**, pp. 49–112 (1915).

TASCHENBERG, O. Die Flöhe. 118 pp. Halle (1880).

WAGNER, J. N. Revue systématique des espèces des Aphaniptères. Hor. Soc. Entom. Ross., **39**, pp. 508–569 (1910).

ORDER **COLEÓPTERA**

(*ELEUTERÀTA*; *ELYTHRÓPTERA*)

Moderate-sized, small or minute, more rarely very large, hard-bodied insects. Head free, usually prominent, sometimes produced forward to form a snout or beak; mandibles well developed; maxillæ well developed, usually bilobed with the palpi three- to five-jointed; labial palpi shorter, two- or three-jointed; antennæ ten- or eleven-jointed, sometimes less, very rarely more, filiform or variously modified, often with the apical joints enlarged; ocelli nearly always absent. Prothorax free; two pairs of wings, the front pair (elytra) thickly chitinized, sheathing the meso- and metathorax and also nearly always the abdomen, almost always meeting in a straight line down the middle of the back; hind wings occasionally absent, front ones rarely reduced or absent. Legs homonomous, the tarsi usually with five or four joints; no cerci. Metamorphosis complete, the larvæ mandibulate. A very large and widely distributed group, including Beetles and Weevils.[1]

1. First ventral segment divided by the hind coxal cavities, so that its sides are separated from the usually very small median part (Fig. 772); the first three sternites (ventral abdominal segments) immovably united; antennæ usually filiform or nearly so; hind wings with a triangular or oval cell at the apex of an elongate discal cell. (Figs. 774, 777). (Suborder ADÉPHAGA).....2

   First visible sternite extending for its entire breadth behind the coxal cavities; hind wing without closed cell at apex of discal cell (except Cupidæ), the latter also often absent. (Figs. 775, 776, 778). (Suborder POLÝPHAGA).....12

2. Mentum and submentum not separated by a suture.....3

   Mentum and submentum separated by a distinct suture.....5

3. Abdomen with four visible sternites; small myrmecophilous beetles with the antennæ remarkably thickened and the apical joints usually fused into a club or into a broad, more or less unsegmented lamina (Fig. 780). (**Paussus** Afr., Indomal.; **Cerápterus**, Afr.; **Arthrópterus**, Austr.). (PAUSSÒIDEA).

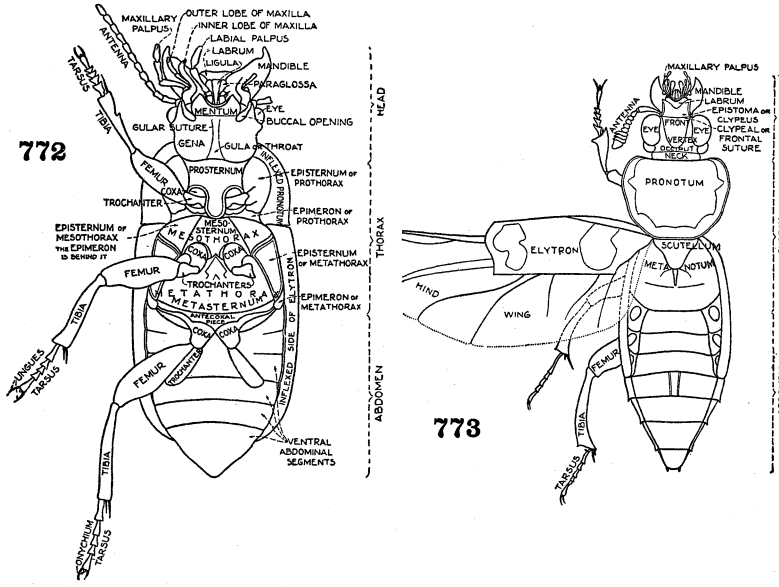
   PAUSSIDÆ

   Abdomen with six visible sternites; antennæ filiform (if antennæ are bead-like and the hind coxæ widely separated, see Jacobsoniidæ, couplet 119) 4

[1] A few highly degenerate forms of more or less larviform appearance that will not otherwise run out in the key, may be identified by reference to couplet 198.

4. Head with antennal grooves beneath, between the eyes and the maxillary fissures. Terrestrial species. (**Pseudomórpha**, Am.; **Sphallomórpha, Silphomórpha**, Austr.; **Adelótopus**, Austr. and E. Ind.; **Hydroporomórpha**, Afr.).

PSEUDOMÓRPHIDÆ



Figs. 772–773. **Coleoptera**

772. **Harpalus,** underside (Hayward) Carabidæ.
773. **Necrophorus,** wings spread on left side and removed on the right (Hayward) Silphidæ.

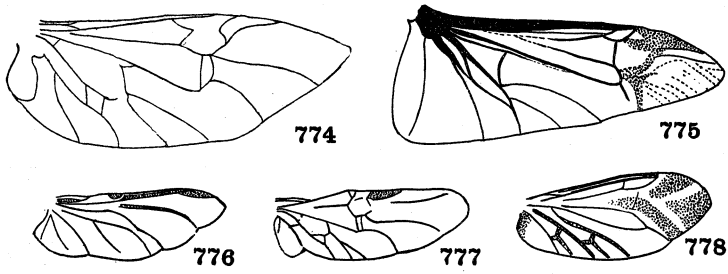
Head without antennal grooves beneath. Aquatic species. (**Amphizòa**, N. Am., Thibet) ..... **AMPHIZOIDÆ**

5. Metasternum with a transverse, triangular antecoxal sclerite, separated by a well marked suture (Fig. 772).....6
   Metasternum without an antecoxal sclerite; usually prolonged into a triangular process posteriorly.....10
6. Antecoxal piece of metasternum extending from one side to the other 7

Antecoxal piece not extending from one side to the other, truncate behind. Aquatic species, the tibiæ and tarsi with swimming hairs. (**Hygròbia** (=*Pelòbius*), palæarc., Austr.). (*PELOBÌIDÆ*) ..... **HYGROBÌIDÆ**

7. Antennæ 11-jointed; hind coxæ movable and simple; terrestrial species 8

Antennæ 10-jointed; hind coxæ fixed, expanded into large plates so as almost to conceal the base of the abdomen (Fig. 786); small aquatic species. (**Halíplus**, cosmop.; **Peltódytes** (=*Cnemídotus*), holarc.) ..... **HALÍPLIDÆ**



Figs. 774–778. **Coleoptera**

774. Hind wing of Adephaga (Kempers).
775. **Hydrophilus,** hind wing. Hydrophilidæ.
776. **Necrophorus,** hind wing (Kempers) Silphidæ.
777. **Tachypus,** hind wing (Kempers) Carabidæ.
778. **Lygistopterus,** hind wing (Kempers) Lycidæ.

8. Antennæ inserted on the front, above the base of the mandibles; eyes prominent; head wider than the thorax, vertical, with large mandibles. Tiger-beetles. (**Cicindèla**, cosmop.; **Tétracha**, widespr.; **Oxychìla**, neotrop.; **Mantíchora**, Afr.; **Tricóndyla**, Indo-austr.; **Pogonóstoma**, Afr.; **Òmus**, nearc.). **CICINDÉLIDÆ**

Antennæ inserted on the sides of the head between the base of the mandibles and the eyes; head usually held horizontally and generally narrower than the thorax. 9

9. Scutellum present. Ground beetles. A very large diverse, abundant and widespread family. (Figs. 772, 777, 783, 818). (**Táchys, Hárpalus, Bembídion,** cosmop.; **Calosòma, Dyschìrius, Scarìtes, Chlænius, Brachinus, Lèbia,** widespr.; **Pteró-**

stichus, Amàra, Cárabus, Anophthálmus, Trèchus, Nèbria, holarc.; **Mormólyce,** indomal.; and many other genera). (Including *PASIMÁCHIDÆ, MORMOLÝCIDÆ*).

CARÁBIDÆ

Scutellum absent; prosternum covering the mesosternum; rounded convex, riparian species. (**Ómophron,** cosmop., exc. Austr.).

OMOPHRÓNIDÆ

10. Metasternum prolonged behind as a triangular process; aquatic species 11

Metasternum not prolonged between the coxæ; scutellum absent; antennæ like a string of beads, with globular joints; bark beetles (Fig. 785). (If tarsi are two-jointed, see the dubious genus *Jacobsonium*, couplet 119). (**Rhysòdes,** cosmop.; **Clinídium,** widespr.; **Rhysodiástes,** widespr.)... **RHYSÓDIDÆ**

11. Antennæ slender, filiform; abdomen with six visible tergites; eyes two. Diving beetles. Water tigers. (Figs. 779, 781). (**Canthỳdrus, Laccóphilus, Bidéssus, Rhántus,** cosmop.; **Cybíster, Cœlámbus,** widespr.; **Hydróporus, Deronéctes, Ágabus, Acílius, Dytíscus,** holarc.)..... **DYTÍSCIDÆ**

a. Episternum of metathorax not reaching the middle coxal cavity. b
Episternum of metathorax reaching the middle coxal cavity... d

b. Greatest anterior extension of the hind coxa near the middle (longitudinally) of the body; metasternum more or less pointed in the middle behind, and not marked by a transverse suture.

NOTERÌNÆ

Greatest anterior extension of the hind coxa nearer to the epipleura than to the medial line of the body..... c

c. Prosternal process not reaching the metasternum. **VATELLÌNÆ**
Prosternal process reaching the metasternum. **LACCOPHILÌNÆ**

d. Prosternum deflected between the front coxæ so that the prosternal process is placed on a quite different plane of direction from that of the prosternum; the latter not incrassate along middle; front tarsi often 4-jointed..... e
Prosternal process on the same plane of direction as the prosternum; front tarsi 5-jointed..... f

e. Prosternal process much deflected from the plane of direction of the prosternum. Front tarsi usually with only four joints.

HYDROPORÌNÆ

Prosternal process but little deflected from the plane of direction of the prosternum; front tarsi 5-jointed; scutellum not visible.

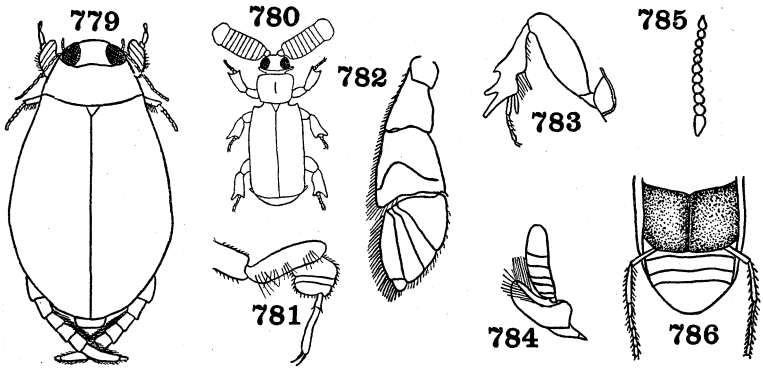
METHLÌNÆ

f. Inferior spur of hind tibia not or but little broader than the other..... g

Inferior spur of the hind tibia dilated, much broader than the other ..... **CYBISTRÌNÆ**

g. Hind margins of joints of posterior tarsi not set with flattened and appressed cilia..... h

Hind margins of joints of posterior tarsi provided externally with flattened, appressed cilia..... **HYDATICÌNÆ**



Figs. 779–786. **Coleoptera**

779. **Cybister** (Maxwell-Lefroy) Dytiscidæ.
780. **Arthropterus** (Westwood) Paussidæ.
781. **Dytiscus,** front tibia and tarsus of male (Kolbe) Dytiscidæ.
782. **Gyrinus,** hind leg (Berlese) Gyrinidæ.
783. **Scarites,** front leg (Kolbe) Carabidæ.
784. **Dineutes,** antenna. Gyrinidæ.
785. **Rhysodes,** antenna. Rhysodidæ.
786. **Haliplus,** coxal plate (Maxwell-Lefroy) Haliplidæ.

h. Spiracles of last two dorsal segments not, or but little, broader than the preceding ones; outline of eye notched by the free margin of front of head..... **COLYMBETÌNÆ**

Spiracles of the last two dorsal segments enlarged, each on the penultimate segment being about one-fourth of the total breadth of the segment; circular outline of the eye uninterrupted ..... **DYTISCÌNÆ**

Antennæ very short, stout and irregular; eyes four; abdomen with seven visible tergites. Whirligig beetles. (**Dineûtes, Gyrìnus; Aulonogỳrus,** old world; **Gyrètes,** neotrop.; **Orec-**

tochìlus, palæarc., Indomal.; **Orectogỳrus**, ethiop.; **Macrogỳrus**, neotrop., Indo-Austr.). (*GYRINÒIDEA*).

GYRÍNIDÆ

12. Antennæ clubbed or not, if clubbed, not with the club-joints lamellate; tarsi frequently with less than five joints; antennæ very rarely somewhat lamellate in certain aquatic Hydrophilidæ. (Figs. 793 to 813) 13

Antennæ with the last three to seven joints enlarged on one side to form a comb-like or lamellate club which can often be opened and closed (Figs. 814, 815, 816). Legs often fitted for digging; tarsi almost always 5-jointed, the front tarsi very exceptionally reduced or absent; larvæ with thick, curved body and well developed legs. Never aquatic. (LAMELLICÓRNIA). 76

13. Head not prolonged into a beak, gular sutures double, at least before and behind; prosternal sutures distinct; proepimera not meeting behind the prosternum 14

Head generally prolonged in front of the eyes and snout-like (Figs. 787, 873, 878); gular sutures confluent along the median line or obsolete; proepimera united behind the prosternum, prosternal sutures wanting; antennæ usually elbowed (Fig. 879); palpi usually rigid; all tarsi apparently with four or three joints (Fig. 788); larvæ legless or with short legs. (RHYNCÓPHORA) 165

14. Fourth and fifth tarsal joints if present, not immovably united, the articulation between them like that between the other joints (Fig. 789). (If rarely united, as in some Erotyldiæ, the antennæ are clavate) 15

Fourth tarsal joint minute, fused with the fifth; tarsi usually densely pubescent below, with the first three joints dilated and with a sole, the third joint usually bilobed (Figs. 790, 791); antennæ filiform, rarely serrate or thickened apically; larvæ vegetarian. (PHYTÓPHAGA, CERAMBYCÒIDEA) 147

15. Hind tarsi with at least as many joints as the others 16

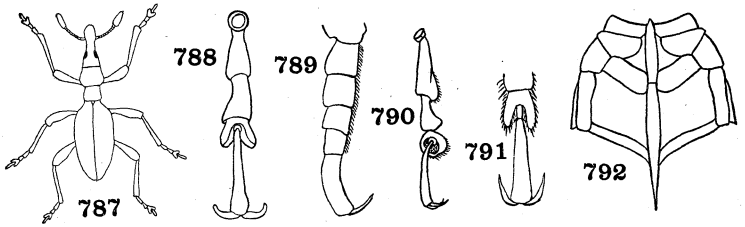
Hind tarsi four-jointed; front and middle tarsi five-jointed (rarely with the penultimate joint very short so that the hind tarsi are apparently three-jointed and the others apparently four-jointed; in very exceptional cases with the front tarsi five-jointed and both other pairs four-jointed). (HETERÓMERA) 120

16. Maxillary palpi long and slender, almost always as long as or longer than the short antennæ; antennæ six- to ten-jointed, the outer

joints forming a distinct, pubescent, sometimes asymmetrical club; elytra with an alula; small to large, almost always aquatic species (Figs. 775, 792). Water scavenger beetles. (**Hydrèna, Cércyon, Enòchrus, Hýdrous** (= *Hydróphilus* auctt.) **Berò-sus,** cosmop.; **Ochthèbius, Sphærídium, Laccòbius,** widespr.; **Hydróphilus, Helóphorus,** holarc.; **Tropistérnus,** Am.). (PALPICÓRNIA, HYDROPHILÓIDEA).

HYDROPHÍLIDÆ

a. Eyes normal, not divided . . . . . b
Eyes divided, each into two parts . . . . . **AMPHIOPÌNÆ**



Figs. 787–792. **Coleoptera**

787. **Cylas** (Pierce) Cyladidæ.
788. **Camptocerus,** tarsus (Hopkins) Scolytidæ.
789. **Megalodacne,** tarsus. Erotylidæ.
790. **Leptinotarsa,** tarsus (Sharp) Chrysomelidæ.
791. **Saperda,** apical part of tarsus. Lamiidæ.
792. **Hydrophilus,** mesosternum (Berlese) Hydrophilidæ.

b. Second joint of posterior tarsi elongate, longer than third; first joint very short; pronotum at base as wide as elytra c
Second joint of posterior tarsi short, about equal to the third . . d
c. Posterior tarsi oar-shaped; metasternum prolonged into a sharp elongate spine . . . . . **HYDROPHILÌNÆ**
Posterior tarsi not oar-shaped; metasternum not prolonged into a spine . . . . . **HYDROBIÌNÆ**
d. Pronotum at base narrower than the base of the elytra, with distinct longitudinal furrows . . . . . **HELOPHORÌNÆ**
Pronotum at base not narrower than the base of the elytra, without distinct longitudinal furrows . . . . . e
e. Clypeus emarginate; scutellum long, triangular; anterior coxal cavities open behind . . . . . **SPERCHEÌNÆ**
Clypeus truncate; scutellum small and short; anterior coxal cavities closed behind . . . . . **HYDRÆNÌNÆ**

Maxillary palpi much shorter than the antennæ, if rarely comparable to the antennæ in length the alula is absent and the last tarsal joint abnormally long (some Dryopidæ), or only the last joint is greatly lengthened (Telegeusidæ) 17

17. Elytra short, exposing much of the abdomen; tergites entirely corneous in texture; wings usually present and folded beneath the elytra in repose; free portion of media atrophied or absent, not joining the cubitus to form a long closed axial cell. (If external parasites of the beaver, compare Platypsyllidæ, couplet 73). (STAPHYLINIFÓRMIA) 18

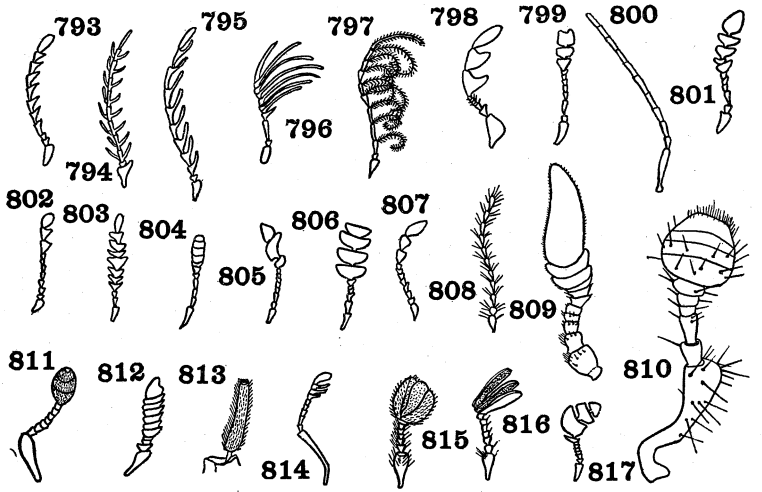
Elytra covering most of the abdomen, not much shortened and covering all or all but one, two or three abdominal segments; rarely much shortened in which case the wings either do not fold beneath the elytra or are wanting; tergites membranous or semimembranous, except sometimes those of the two or three apical segments (five in the beaver parasite, *Platypsyllus*, couplet 73) 20

18. Abdomen flexible, not enlarged apically, parallel or tapering, with six to eight freely movable sternites; antennæ usually eleven-jointed; tarsi usually five-jointed; usually small, occasionally large, slender species. (If wings do not fold beneath elytra and maxillary palpi are flabellate, compare Atractocerídæ (couplet 92) or if palpi are nearly as long as the antennæ, compare Telegeusidæ (couplet 93); or if body is very greatly flattened, compare Cucujidæ (Hemipeplinæ) (couplet 52) 89

Abdomen not flexible, swollen, oval, the segments anchylosed; usually only five sternites, rarely with seven or eight; antennæ often with less than eleven joints; tarsi three-jointed; small or minute, robust species; abdomen very much wider than the prothorax 19

19. Abdomen with five dorsal segments; antennæ five to eleven-jointed (usually 11), the last joint never truncate (Figs. 805, 821); maxillary palpi usually four-jointed. (**Psélaphus**, cosmop.; **Eupléctus, Batrisòdes**, widespr.; **Bryáxis, Tỳchus**, holarc.; **Eupînes**, Indo-Austr.) ..... **PSELÁPHIDÆ**

Abdomen with three dorsal segments, antennæ with two to six joints (Fig. 813); maxillary palpi one-jointed. (**Fústiger**, Am.; **Adrânes**, nearc.; **Cláviger**, palæarc.; **Artícerus**, Austr.). **CLAVIGÉRIDÆ**



Figs. 793–817. **Antennæ of Various Coleoptera**

793. **Ludius** (Leconte and Horn) Elateridæ.
794. **Prionocyphon** (Leconte and Horn) Helodidæ.
795. **Corymbites** (Leconte and Horn) Elateridæ.
796. **Acneus** (Leconte and Horn) Helodidæ.
797. **Dendroides** (Leconte and Horn) Pyrochroidæ.
798. **Dorcatoma** (Leconte and Horn) Anobiidæ.
799. **Corynetes** (Leconte and Horn) Corynetidæ.
800. **Brontes.** Cucujidæ.
801. **Liodes** (Leconte and Horn) Histeridæ.
802. **Temnochilus** (Leconte and Horn) Ostomatidæ.
803. **Catoptrichus** (Leconte and Horn) Silphidæ.
804. **Colon** (Leconte and Horn) Silphidæ.
805. **Bryaxis** (Leconte and Horn) Pselaphidæ.
806. **Anogdus** (Leconte and Horn) Silphidæ.
807. **Aulicus** (Leconte and Horn) Cleridæ.
808. **Dasycerus** (Leconte and Horn) Lathridiidæ.
809. **Anthrenus** (Felt) Dermestidæ.
810. **Dendroctonus** (Felt) Ipidæ.
811. **Epierus** (Leconte and Horn) Histeridæ.
812. **Heterocerus** (Leconte and Horn) Heteroceridæ.
813. **Adranes** (Leconte and Horn) Clavigeridæ.
814. **Lucanus** (Leconte and Horn) Lucanidæ.
815. **Bolboceras** (Leconte and Horn) Geotrupidæ.
816. **Phyllophaga** (Leconte and Horn) Melolonthidæ.
817. **Phymaphora** (Leconte and Horn) Mycetæidæ.

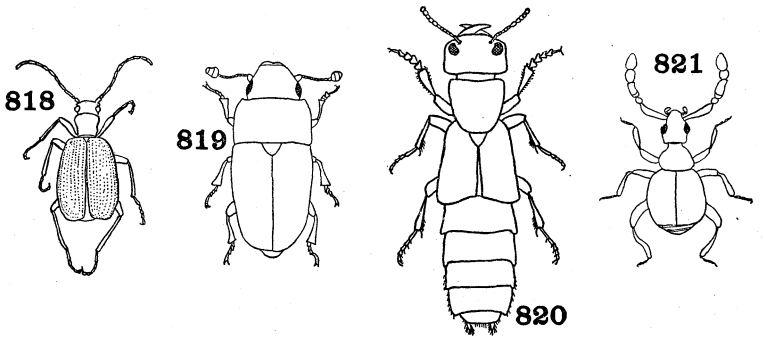
20. Tarsi five-jointed on at least one pair of legs, and almost always on all pairs 21
    All tarsi with less than five joints 95
21. Abdomen with five sternites, or less 22
    Abdomen with at least six sternites 72
22. Five abdominal sternites 23
    Only three visible sternites, the first very long; small beetles living in ants' nests; antennæ with only three joints, all but the two basal ones fused into a large club-shaped mass. (**Gnóstus,** Brazil, Florida) ..... **GNŌSTIDÆ**
23. Front coxæ globular or transverse, usually projecting but little from the coxal cavities; trochanters never interstitial 24
    Front coxæ more or less conical and prominent 56
24. Front coxæ transverse, more or less cylindrical 25
    Front coxæ globular 37
25. Hind coxæ grooved to receive the femora 26
    Hind coxæ flat, not grooved 32
26. Strongly convex beetles with more or less retractile legs; tibiæ dilated and usually grooved near the outer end to receive the tarsi; tibial spurs distinct 27
    Slightly convex, oval species with non-retractile slender legs; tibial spurs more or less reduced 29
27. Antennæ inserted at the sides of the head 28
    Antennæ inserted on the front; head retracted; third joint of tarsi lobed; thorax margined; oval species. (**Chelonàrium,** Am.) ..... **CHELONARÌIDÆ**
28. Head prominent; mentum large, elongate and sub-elliptical; tarsi not lobed. (**Nosodéndron,** widespr.) ..**NOSODĒNDRIDÆ**
    Head retracted; mentum small and quadrate. (**Límnichus, Pedilóphorus, Syncalýpta,** widespr.; **Cýtilus, Býrrhus,** holarc. ..... **BÝRRHIDÆ**

a. Clypeus not distinct from the front; posterior coxæ almost touching one another ..... **BYRRHÌNÆ**
   Clypeus separated from the front by a fine suture; posterior coxæ more or less widely separated ..... b
b. Prosternum without antennal grooves ..... **LIMNICHÌNÆ**
   Prosternum within the front angles with a deep furrow for the reception of the antennal club ..... **BOTHRIOPHORÌNÆ**

29. Front coxæ with distinctly separated side-piece (trochantin) .. 30
    Front coxæ without trochantin 31

30. First three tergites connate; last joint of tarsi long, with very large claws; small, aquatic or subaquatic beetles. (**Dryops, Hèlicus,** widespr.; **Lùtrochus,** Am.; **Sóstea,** Indomal.). (*PÁRNIDÆ*) ..... **DRYÓPIDÆ**

All tergites free; last tarsal joint not elongated, the claws not enlarged; terrestrial species. (**Dascíllus, Eubrìanax,** holarc.; **Artemátopus,** neotrop.; **Platydascýllus,** E. Ind.; **Veronàtus,** Austr. (*DASCÝLLIDÆ*)) ..... **DASCÍLLIDÆ**



Figs. 818–821. **Coleoptera**

818. **Brachinus.** Carabidæ.
819. **Glischrochilus** (Felt) Nitidulidæ.
820. **Staphylinus.** Staphylinidæ.
821. **Goniastes** (Westwood) Pselaphidæ.

31. Posterior coxæ at most moderately dilated internally. (**Cỳphon,** cosmop.; **Helòdes, Scírtes,** widespr.; (Figs. 794, 796, 825). (*CYPHÓNIDÆ*) ..... **HELÓDIDÆ**

Posterior coxæ very large. (**Eucinètus,** widespr.; **Euscaphùrus,** nearc.) ..... **EUCINÉTIDÆ**

32. Antennæ geniculate, very strongly clavate or capitate; elytra shortened, leaving two tergites uncovered; all tibiæ usually dilated, the front ones usually toothed; head very much narrower than the prothorax (if head is nearly as wide as prothorax and the clypeus is rounded on the sides, see Synteliidæ, couplet 62; or if clypeus bears a projection at each side, see Niponiidæ, couplet 46). (See couplet 46) ..... **HISTÉRIDÆ,** part

Antennæ straight, not geniculate.....33

33. Tarsi more or less dilated, the first joint not shortened; fourth joint very small; elytra not usually extending to the tip of the abdomen 34
Tarsi slender; metatarsus very short; elytra entire, never truncate, covering the abdomen. (**Tenebriòides, Ancỳrona,** widespr.; **Péltis, Temnochìla,** holarc., neotrop.; **Nemosòma,** Eur., Am.; **Thýmalus,** holarc.). (Figs. 802, 823). (*TROGOSÍTIDÆ, TEMNOCHÍLIDÆ*) ..... **OSTOMÁTIDÆ**

34. Maxillæ with well developed inner and outer lobe.....35
Maxillæ with only a single lobe (Fig. 819). (**Carpóphilus, Epurèa,** cosmop.; **Meligèthes, Cryptárcha,** widespr.; **Nitídula,** palæarc., Am.; **Omosìta,** holarc.)..... **NITIDŬLIDÆ**

35. Antennæ clavate; elytra usually not covering the tip of the abdomen 36
Antennæ filiform; elytra entirely covering the abdomen; moderately large, elongate beetles. (**Parándra,** widespr.; **Archándra,** palæarc., neotrop.; **Neándra,** nearc.) .... **PARÁNDRIDÆ**

36. Antennæ 11-jointed; with a three-jointed club; labrum free. (**Brachýpterus,** widespr.) ..... **BRACHYPTÉRIDÆ**
Antennæ 10-jointed, with a two-jointed club; labrum fused with the clypeus. (**Rhizóphagus, Anomóphagus,** holarc.). **RHIZOPHÁGIDÆ**

37. First two or three sternites fused or immovably united.....38
All sternites free, or at least separated by equally distinct sutures, except in very rare cases.....39

38. First two sternites connate, the suture between them very weak; antennæ serrate, very rarely pectinate in the male; tarsi with membranous lobes beneath; last tarsal joint not lengthened, claws moderate or small; active, hard-bodied beetles, of more or less metallic color; not aquatic. (Fig. 824). (**Acmæódera, Antháxia, Chrysobóthris, Ágrilus,** cosmop.; **Psilóptera, Stigmódera, Bupréstis,** widespr.; **Bráchys,** Am.; **Chrysóchroa,** Indomal.) ..... **BUPRÉSTIDÆ**

a. Middle coxal cavity formed entirely by the mesosternum (except in certain South African species of *Julodis* and *Amblysterna*)..b
Middle coxal cavity formed laterally by the mesosternum and at its posterior part by the metasternum.....e

b. Antennal pores scattered over two faces of the serrate joints....c
Antennal pores concentrated in a depression or fovea on the serrate joints .....d

c. Posterior coxæ slightly dilated on their inner side, their posterior

margin transverse and slightly sinuate; scutellum invisible; antennal pores hidden by silky pubescence. . **JULODÌNÆ**

Posterior coxæ distinctly dilated on their inner side, their posterior margin oblique; antennal pores bare. **THRINCOPYGÌNÆ**

d. Lateral pieces of the metathorax narrow . . . . . **POLYCESTÌNÆ**

Lateral pieces of the metathorax very broad; tergites membranous . . . . . **SCHIZOPÌNÆ**

e. Lateral branches of mesosternum elongate (except in *Belionota*) . . f

Lateral branches of the mesosternum very short and set back on the sides, or invisible . . . . . j

f. Antennal pores scattered over the two faces of the serrate joints . g

Antennal pores concentrated in a depression or fovea on the serrate joints . . . . . h

g. Scutellum absent, or hidden . . . . . **CHRYSOCHROÌNÆ**

Scutellum visible . . . . . **CHALCOPHORÌNÆ**

h. Front not narrowed at the insertion of the antennæ; eyes not very close together, sometimes distant on the vertex i

Front narrowed at the insertion of the antennæ; eyes strongly oblique and closely approaching one another on the upper surface . . . . . **CHRYSOBOTHRÌNÆ**

i. Scutellum broad and acuminate behind; mentum large, triangular; poriferous foveæ terminal . . . . . **SPHENOPTERÌNÆ**

Scutellum at most moderate, never enlarged in front or acuminate behind; mentum strongly transverse; poriferous foveæ terminal or inferior . . . . . **BUPRESTÌNÆ**

j. Front narrowed at the insertion of the antennæ; antennal cavities very large and situated at a considerable distance from the eyes; posterior coxæ not dilated on their inner side, with their posterior margins horizontal and slightly sinuate; poriferous foveæ terminal . . . . . k

Front not narrowed at the insertion of the antennæ; antennal cavities moderate and situated near the eyes; posterior coxæ dilated on their inner side, their posterior margin oblique; poriferous foveæ variable . . . . . **STIGMODERÌNÆ**

k. Base of pronotum more or less sinuate . . . . . **AGRILÌNÆ**

Base of pronotum straight . . . . . **MASTOGENÌNÆ**

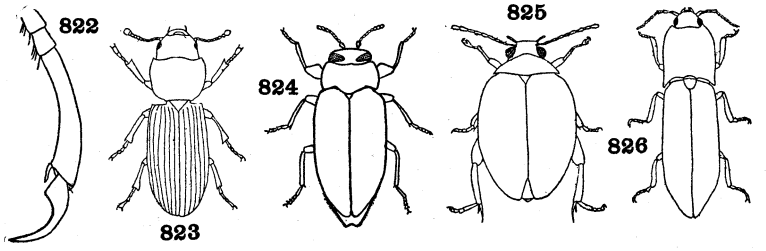
First three sternites connate; antennæ slender, slightly thickened externally; last joint of tarsi greatly elongated, with very large claws; small aquatic beetles. (Fig. 822). (**Hélmis**, cosmop.; **Stenélmis**, widespr.; **Macrónychus**, holarc.; **Rìolus**, **Lathélmis**, palæarc.) . . . . . **HÉLMIDÆ**

39. Prosternum prolonged behind into a median process which is received in the mesosternum 40

Prosternum without such backwardly directed process (if rarely with such a process, it is not received in the mesosternum). . 43

40. Prothorax loosely joined to the mesothorax, freely movable, its hind angles usually prolonged backward into teeth; prosternal spine loosely received in a notch in the mesosternum; front coxal cavities contained entirely in the prosternum. 41

Prothorax firmly attached, not movable; front coxal cavities closed behind by the mesosternum. (**Drapètes, Thróscus**, cosmop.; **Paradrapètes, Aulonothróscus**, widespr.; **Páctopus**, nearc.). (*TRIXÁGIDÆ*) . . . . . **THRÓSCIDÆ**



Figs. 822–826. **Coleoptera**

822. **Macronychus,** apical portion of tarsus. Helmidæ.
823. **Tenebrioides** (Back and Cotton) Ostomatidæ.
824. **Chrysobothris** (Chittenden) Buprestidæ.
825. **Scirtes** (Grandi) Helodidæ.
826. **Melanotus** (Hyslop) Elateridæ.

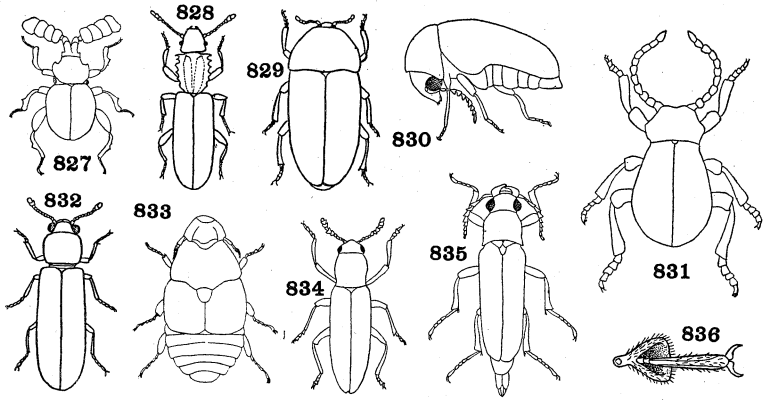
41. Hind coxæ laminate; trochanter short. 42

Hind coxæ not laminate; middle and hind trochanters very long; labrum short, transverse, connate with the clypeus; antennæ serrate (♀) or pectinate (♂). (**Ceróphytum**, holarc.). **CEROPHÝTIDÆ**

42. Labrum visible, free; antennæ arising near the eyes under the frontal margin; last two sternites connected by a membranous suture; prosternum lobed in front; beetles capable of moving the prothorax by its basal joint with a sudden clicking motion. (If the middle coxæ are not distinctly separated, see couplet 76). Click-beetles, Wireworm beetles. (**Làcon, Drastèrius, Élater, Cardióphorus,** cosmop.; **Adelócera, Melanòtus, Álaus, Monocrepídius,** widespr.; **Pyróphorus,** Am., Austr.; **Dichró-**

nychus, ethiop., Ind.). (Figs. 793, 795, 826). (Including *DICHRONÝCHIDÆ*) ..... **ELATÉRIDÆ**

Labrum concealed; no membranous fold between the last two sternites; prosternum not lobed in front; antennæ inserted on the front between the eyes, received in transverse grooves on the front; not able to leap by the prothoracic joint. (**Dro-**



Figs. 827–836. **Coleoptera**

827. **Ectrephes** (Westwood) Ectrephidæ.
828. **Silvanus** (Chittenden) Silvanidæ.
829. **Dermestes** (Howard and Marlatt) Dermestidæ.
830. **Lasioderma** (Smith) Anobiidæ.
831. **Mezium** (Smith) Ptinidæ.
832. **Lyctus** (Hopkins) Lyctidæ.
833. **Platypsyllus** (Westwood) Platypsyllidæ.
834. **Languria.** Languriidæ.
835. **Cebrio** (Hyslop) Cebrionidæ.
836. **Moncœdus,** tarsus (Sharp) Moncœdidæ.

mæolus, Fórnax, cosmop.; **Mélasis,** palæarc., Am.; **Eucnèmis,** holarc.). (*EUCNÉMIDÆ*) ..... **MELÁSIDÆ**

43. Hind coxæ in contact 44
Hind coxæ not in contact, although very closely approximate in certain very much flattened species 45
44. Antennæ filiform; elytra with longitudinal rows of large pit-shaped punctures with ribs between; moderate-sized, elongate beetles. (**Cùpes,** widespr.; **Ómma,** Austr.) ..... **CÙPIDÆ**

Antennæ clavate; elytra simple; very small or minute, convex, oval or rounded beetles. (**Phálacrus, Ólibrus, Stílbus,** wide-spr.) ..... **PHALÁCRIDÆ**

45. Elytra shortened, leaving two segments of the abdomen exposed; antennæ elbowed, very strongly clavate or capitate (Fig. 811); tibiæ compressed, the front pair usually toothed; hard-bodied, smooth and shining; small, convex or much flattened, rarely elongate, beetles 46

Elytra entire, covering the pygidium 47

46. Prothorax much wider than the head, its front margin concave; clypeus without projections; tarsi short (Fig. 801). (**Saprînus, Parómalus,** cosmop.; **Híster, Hololépta, Platysòma,** wide-spr.; **Phelíster,** Am.) ..... **HISTÉRIDÆ**

a. Head not retractile, horizontal, visible from underneath; mouth-parts projecting beyond the front of the prosternum ..... b

Head retractile, not visible from underneath when retracted; mouthparts covered by the prosternum c

b. Mandibles projecting; clypeus not prolonged into a rostrum; body more or less flat and depressed ..... **HOLOLEPTÎNÆ**

Mandibles retracted, covered by the long rostriform clypeus; body elongate, cylindrical ..... **TRYPANÆÎNÆ**

c. Prosternum with a shorter or longer lobe or throat-plate, separated off by a more or less distinct suture ..... d

Prosternum without a lobe or throat-plate ..... e

d. Club of antennæ round or oval, pubescent, consisting of four joints, closely compacted, but separated by sutures. **HISTERÎNÆ**

Club of antennæ without sutures, smooth, cylindrical, truncate at apex ..... **HETÆRIÎNÆ**

e. Antennæ inserted under the side margin of the front. **SAPRINÌNÆ**

Antennæ inserted on the front ..... **ABRÆÎNÆ**

Prothorax as wide as the head, its front margin straight; clypeus with a projection at each side; tarsi very long and slender. (**Nipònius,** Indomal.) ..... **NIPONÌIDÆ**

47. Antennæ consisting of only two apparent segments, the distal one greatly elongate, enlarged and flattened; minute, more or less globose beetles, living in ants' nests. (Fig. 827). (**Ectrephes,** Austr.) ..... **ECTRÉPHIDÆ**

Antennæ normal, ten or eleven-jointed, filiform or clavate 48

48. Elytra each with a pair of large wax-like spots; antennæ short, with a four-jointed club; rather large beetles, with the prothorax widened behind. (**Helòta,** As., Indo-malay.) . **HELÓTIDÆ**

Elytra not thus ornamented; prothorax not noticeably widened behind 49

49. Middle coxal cavities open externally, *i.e.* not closed by the meeting of the meso- and metasterna; body elongate, usually greatly flattened 50

Middle coxal cavities closed externally by the sterna..... 53

50. Maxillæ covered by corneous plates; front coxal cavities open behind. (**Passándra,** ethiop., neotrop.; **Catógenus,** widespr.; **Scalídia,** Am.). (Including *SCALIDÌIDÆ*). **PASSÁNDRIDÆ**

Maxillæ exposed..... 51

51. Tarsi with the third joint simple, not lobed 52

Tarsi with the third joint lobed; front coxal cavities closed behind (Fig. 839); elytra sometimes shortened. (**Hemipéplus,** Am.; **Diagrypnòdes,** Austr.) ..... Some **CUCÙJIDÆ**

52. Front coxal cavities open behind. (Figs. 800, 840). (**Cùcujus, Læmophlœus, Brόntes,** widespr.). (Including *LÆMOPHLŒIDÆ*) ..... **CUCÙJIDÆ**

Front coxal cavities closed behind. (Figs. 828, 839). (**Silvànus,** cosmop.; **Nausíbius,** widespr.) ..... **SILVÁNIDÆ**

53. Prosternum not prolonged behind; small, oval, coarsely punctate species with the fourth tarsal joint short, the third lobed. (**Diphýllus, Diplocœlus,** widespr.) ..... **DIPHÝLLIDÆ**

Prosternum prolonged behind, meeting the mesosternum.....54

54. Front coxal cavities open behind (Fig. 840); small or minute species. (**Lobèrus, Micrámbe, Cryptóphagus, Antheróphagus,** widespr.; **Cænóscelis, Atomària,** holarc.). **CRYPTOPHÁGIDÆ**

Front coxal cavities closed behind (Fig. 839) 55

55. Antennæ with an abrupt club; moderate-sized beetles usually black with orange markings. (Fig. 789). (**Megalodácne, Dácne,** widespr.; **Epíscapha,** palæarc.). Some **EROTÝLIDÆ**

Antennæ gradually clavate, short; very small beetles. (**Catopochròtus,** Turkestan) ..... **CATOPOCHRÓTIDÆ**

56. Hind coxæ dilated into plates which are grooved for the reception of the femora 57

Hind coxæ not thus dilated, not grooved for the reception of the femora..... 61

57. Front coxal cavities closed behind (Fig. 839).....58
Front coxal cavities open behind (Fig. 840).....59
58. Second and third joints of tarsi lobed beneath; plate of hind coxæ feeble; small pubescent beetles. (**Bytûrus,** holarc.; **Satorýstia,** palæarc.) ..... **BYTÛRIDÆ**
Tarsi simple, not lobed; ocelli often present; small, coarsely punctured beetles. (**Derodóntus, Laricòbius, Peltástica,** holarc.) ..... **DERODÓNTIDÆ**
59. Antennæ with the last three joints much enlarged, forming a strong club; small or rather small, often scaly beetles. (**Dermêstes, Attágenus, Trogodérma,** cosmop.; **Anthrènus,** widespr.; **Cryptorhópalum,** neotrop., Austr.). (Figs. 809, 829) ..... **DERMÉSTIDÆ**

a. Head without frontal ocellus; mouthparts not covered. **DERMESTÎNÆ**
Head with frontal ocellus.....b
b. Mouthparts not covered; anterior coxæ strongly projecting. **ATTAGENÎNÆ**
Mouthparts covered by the prosternum or by the coxæ and trochanters of the front legs.....c
c. Prosternum horizontal; hind coxæ not reaching the side margins of the body, which is hairy or squamose.....d
Prosternum vertical; hind coxæ reaching the side margins of the body; upper surface bare and glabrous..... **ORPHILÎNÆ**
d. Form oblong; posterior coxæ contiguous; upper surface with recumbent hairs ..... **MEGATOMÎNÆ**
Form short, round or short-oval; posterior coxæ not contiguous.e
e. Upper surface squamose; head with deep antennal grooves beneath ..... **ANTHRENÎNÆ**
Upper surface with stiff upright bristles; head without antennal grooves beneath ..... **TRINODÎNÆ**
Antennæ not capitate 60

60. Tarsi with a long, hairy pad (onychium) between the claws; tibial spurs present, small; moderate-sized or large, elongate beetles with prominent porrect head; antennæ usually flabellate in the male, often with more than eleven joints. (**Sándalus,** widespr.; **Zénoa,** nearc.; **Callirhìpis,** Indo-Austr., neotrop.; **Rhipícera,** Austr.). (*SANDÁLIDÆ, RHIPICÉRIDÆ, RHIPIDOCÉRIDÆ*) ..... **RHIPICERÁTIDÆ**
Onychium not developed, or very small; no tibial spurs; small, usually oval or cylindrical beetles with the head strongly de-

flexed. (Figs. 798, 830). (**Sitódrepa, Anòbium,** cosmop.; **Ernòbius,** widespr.; **Hadrobrégmus, Lasiodérma,** widespr.; **Dorcátoma,** holarc.) ..... **ANOBÌIDÆ**

61. First joint of tarsi very short and indistinctly separated from the second 62

First joint of tarsi distinct, when rarely very short, the first ventral segment is not elongate and the head not deflexed 64

62. All the tibiæ dilated and toothed externally; antennæ more or less geniculate, with a three-jointed club; head almost as wide as the prothorax; clypeus rounded on the sides; elytra not covering the tip of the abdomen; large beetles. (**Syntèlia,** Mex., Japan, India) ..... **SYNTELÌIDÆ**

Tibiæ not dilated or toothed 63

63. First sternite elongated, always much longer than the second; antennæ with a quite distinct, two-jointed club; small elongate beetles with prominent head not covered by the prothorax. Powder-post beetles. (Fig. 832). (**Lýctus,** cosmop.). **LÝCTIDÆ**

First sternite not elongated; antennal club three- or four-jointed; head usually deflexed and protected by the prothorax; declivity of elytra often toothed or spined; elongate, more or less cylindrical beetles. (*APÁTIDÆ*) ..... **BOSTRÝCHIDÆ**

64. Hind coxæ flat or oval, not prominent 65

Hind coxæ prominent internally, more or less conical 69

65. Fourth joint of tarsi extremely short, not visible from above; small beetles of rather bright colors. (Fig. 799). (**Corynètes, Necròbia,** cosmop.; **Pelònium,** widespr.; **Phyllobànus, Orthopleùra,** Am.; **Epiphlœus,** neotrop.) .. **CORYNÉTIDÆ**

Fourth joint of tarsi not abnormally short 66

66. Fifth segment of abdomen conically produced, as long as the three preceding ones, elytra not completely covering the abdomen. (**Scaphídium, Scaphosòma,** cosmop.; **Bæócera,** widespr.). **SCAPHIDÌIDÆ**

Fifth abdominal segment not elongated, not conically produced. 67

67. Antennæ 11-jointed, with a solid club, consisting of three almost entirely fused joints; very small beetles, with tufts of golden hairs at the sides of the prothorax or beneath the body, living in ants' nests. (**Thoríctus,** palæarc., ethiop.). **THORÍCTIDÆ**

Joints of antennal club not thus fused, or antennæ with fewer joints 68

68. Trochanters attached to the internal margin of the femora. (Fig. 807). (**Tíllus, Opìlo, Thanásimus,** widespr.; **Clèrus, Cymatódera, Hydnócera,** Am.; **Trichòdes,** holarc.). **CLÉRIDÆ**

Trochanters interstitial, *i.e.* attached to the base of the femora. (Fig. 831). (**Ptìnus, Gíbbium,** cosmop.; **Mèzium,** widespr.; **Sphæricus,** holarc.) ..... **PTÍNIDÆ**

69. Antennæ capitate, *i.e.* the last three joints forming a very abrupt club; elytra truncate; rather broad, slightly metallic beetles. (**Sphærìtes,** holarc.) ..... **SPHÆRÍTIDÆ**

Antennæ simple, not clubbed 70

70. Prothorax very large, oval, longer than the elytra; hind coxæ very large, almost dividing the first sternite; antennæ very short; hind legs greatly thickened. Large beetles of burrowing habits. (**Hypocéphalus,** neotrop.) ... **HYPOCEPHÁLIDÆ**

Of a different conformation 71

71. Front coxæ with a distinct side-piece (trochantin). (See couplet 86) ..... Some **DASÝTIDÆ**

Front coxæ without trochantin; long narrow beetles. (**Lyméxylon, Melittómma,** widespr.; **Hylecœtus,** holarc., Austr.) (See couplet 88) *LYMEXYLÓNIDÆ*..... **LYMEXÝLIDÆ**

72. Front coxæ flat, rounded or globular, small and not prominent. 73

Front coxæ conical, prominent, usually large 77

73. Front coxæ flat; elytra not longer than the prothorax, exposing five abdominal segments; eyes absent; small flattened wingless beetles living as external parasites of beavers. (Fig. 833). (**Platypsýllus,** holarc.). (*ACREIÓPTERA*). **PLATYPSÝLLIDÆ**

Front coxæ rounded or globular; not such beetles 74

74. Last joint of tarsi not excessively lengthened; tarsal claws not enlarged 75

Last joint of tarsi greatly lengthened; tarsal claws very large; first three sternites connate; small, aquatic beetles. (**Psephènus,** Am.; **Psephènops, Tychepsephènus,** neotrop.; **Metaeopsephènus,** holarc.) ..... **PSEPHÉNIDÆ**

75. Prosternum prolonged behind into a process which is received in a notch in the mesosternum; prothorax loosely attached to the mesothorax 76

Prosternum without such a backwardly directed process; eyes very small or wanting; rare, minute beetles living in the nests of rodents. (**Leptìnus,** holarc.; **Leptiníllus,** nearc.). **LEPTÌNIDÆ**

76. Labrum fused with the clypeus; antennæ distant at base; tibial spurs well developed. (Fig. 835). (**Cèbrio**, palæarc.; **Scaptolènus**, Am.; **Cebriorhìpis**, Indo-malay) .. **CEBRIÓNIDÆ**
Labrum free; tibial spurs very weak. (**Plastócerus**, Am.; **Phyllócerus**, palæarc.; **Euthysànius, Aplástus**, nearc.). (*PHYLLOCÉRIDÆ*) ..... **PLASTOCÉRIDÆ**

77. Abdomen with six sternites 78
Abdomen with seven or eight sternites. (MALACODÉRMATA, CANTHARÒIDEA) 90

78. Fifth segment of abdomen conical, as long as the three preceding segments together, the sixth minute. (See couplet 66). **SCAPHIDÌIDÆ**
Fifth segment not conical nor excessively lengthened..... 79

79. Hind coxæ grooved for the reception of the femora; tarsi with a prominent hairy pad between the claws. (See couplet 60). **RHIPICERÁTIDÆ**
Hind coxæ simple, not grooved..... 80

80. Hind coxæ flat, not prominent, covered by the femora in repose; first joint of posterior tarsi usually very short and indistinct. 81
Hind coxæ prominent, at least internally..... 82

81. Tarsi with the fourth joint of normal size; pronotum continuous with the propleura. (See couplet 68) ..... **CLÉRIDÆ**
Tarsi with the fourth joint very small, indistinct; pronotum separated from the pleura by a marginal line. (See couplet 65). **CORYNÉTIDÆ**

82. Hind coxæ widely separated..... 83
Hind coxæ approximated or contiguous 84

83. Eyes absent. (See couplet 84) ..... a few **SÍLPHIDÆ**
Eyes present, coarsely granulated; small, more or less ovate, brown beetles. (**Scydmænus**, cosmop.; **Eucónnus, Stenichnus**, widespr.; **Leptomástax, Cephànium, Neùraphes**, palæarc.) ..... **SCYDMÆNIDÆ**

84. Tibial spurs large; antennæ gradually thickened or clavate; hind tarsi slender, not widened. Carrion-beetles. (Figs. 773, 776, 803, 804, 806). (**Sílpha, Càtops, Ptomóphagus**, widespr.; **Bathýscia**, palæarc.; **Necróphorus**, nearc.; **Liòdes**, holarc.). (Including *CATÓPSIDÆ, LIÓDIDÆ, ANISOTÓMIDÆ*, pt.). **SÍLPHIDÆ**
Tibial spurs small or indistinct..... 85

85. Front coxæ with a distinct side piece (trochantin); rather small, usually soft-bodied species..... 86
Front coxæ without trochantin..... 87

86. Body with extensible vesicles. (**Malthòdes, Maláchius,** holarc.; **Cóllops,** nearc.) ..... **MALACHÌIDÆ**
Body without extensible vesicles. (**Mélyris,** widespr.; **Dásytes,** holarc., neotrop.; **Haplocnèmus,** palæarc.; **Rhádalus,** nearc.; **Astỳlus,** neotrop.). (Including *RHADÁLIDÆ, (MELÝRIDÆ)* ..... **DASÝTIDÆ**

87. Epimera of metasternum distinct; maxillary palpi simple; body more or less ovate. (**Brathînus,** nearc.) .... **BRATHÍNIDÆ**
Epimera of metasternum not visible; body elongate.....88

88. Elytra shortened, exposing several of the abdominal segments; very small species; maxillary palpi simple in both sexes. (**Micromálthus,** holarc.) ..... **MICROMÁLTHIDÆ**
Elytra entire; maxillary palpi of the male flabellate. (**Hylecœtus,** holarc., Austr.). (See couplet 71) .....Some **LYMEXỲLIDÆ**

89. Antennæ ten- or eleven-jointed, not abruptly capitate and not received in cavities; tarsi usually with more than three joints. (Fig. 820). (**Philónthus, Stènus, Aleóchara, Homalòta, Oxýtelus, Lathròbium, Tachýporus, Quèdius,** widespr.; **Staphylînus,** holarc., neotrop.) ..... **STAPHYLÍNIDÆ**

a. Antennæ inserted upon the front, near the inner margin of eyes.b
Antennæ inserted on the anterior margin of the head.....c
Antennæ inserted under the sides of the front.....d

b. Posterior coxæ large, contiguous; antennæ not terminated by a distinct club. ..... **ALEOCHARÎNÆ**
Posterior coxæ small, widely separated; antennæ terminated by a distinct club.....**STENÎNÆ**

c. Antennæ approximate; prosternum developed in front of the anterior coxæ..... **XANTHOLINÎNÆ**
Antennæ distant; prosternum not developed in front of the anterior coxæ..... **STAPHYLINÎNÆ**

d. Prothoracic spiracles conspicuous on removing the front coxæ..e
Prothoracic spiracles difficult to perceive on account of the prominence of the sides of the prothorax.....g

e. Posterior coxæ transverse.....f
Posterior coxæ triangular, prominent; antennæ capillary and verticillate-pilose..... **HABROCERÎNÆ**

f. Antennæ filiform, not verticillate-pilose.... **TACHYPORÎNÆ**
Antennæ capillary, verticillate-pilose..... **TRICHOPHYÎNÆ**

g. Anterior coxæ conical.....h
Anterior coxæ linear, transverse.....o

h. Anterior coxæ short.....i
Anterior coxæ large, prominent.....j

i. Tarsi two-jointed..... **LEPTOTYPHLÎNÆ**
Tarsi four-jointed..... **EVÆSTHETÎNÆ**
j. Vertex without ocelli.....k
Vertex with two ocelli..... **OMALIÎNÆ**
k. Last joint of labial palpi dilated, very large, crescent-shaped. **OXYPORÌNÆ**
Last joint of labial palpi not, or not strongly, dilated.....l
l. Posterior coxæ conical.....m
Posterior coxæ transverse.....n
m. Palpi with the last joint very small, subulate..... **PÆDERÌNÆ**
Palpi with the last joint equal to the preceding.. **PINOPHILÌNÆ**
n. Posterior trochanters small, one-fifth the length of the femora; head with a distinct neck..... **OXYTELÌNÆ**
Posterior trochanters large, one-third the length of the femora; head without a distinct neck..... **PHLŒOCHARÌNÆ**
o. Vertex without ocelli; elytra covering the greater part of the body. **PROTEINÌNÆ**
Vertex with one ocellus; elytra only slightly surpassing the metasternum..... **PHLŒOBIÎNÆ**
Antennæ nine-jointed, with a very abrupt club, received in cavities on the underside of the prothorax; tarsi three-jointed; body rather short, the elytra with several acutely elevated longitudinal ridges. (**Micropéplus, Kalíssus,** nearc.). **MICROPÉPLIDÆ**

90. Middle coxæ distant; epipleuræ wanting; elytra usually with a reticulate sculpture; no phosphorescent organs; usually flat beetles, widened behind and often with a bold color pattern. (Fig. 778) ..... **LŸCIDÆ**
Middle coxæ in contact; epipleuræ distinct; elytra not reticulate, rarely greatly reduced in size 91
91. Antennæ inserted at the sides of the front, before the eyes....92
Antennæ inserted on the upper part of the front or at the base of its anterior lobe; phosphorescent organs often present..94
92. Maxillary palpi flabellate; elytra very short; hind wings with a series of radiating veins; eyes almost meeting on the front. (**Atractócerus,** widespr.). ..... **ATRACTOCÉRIDÆ**
Maxillary and labial palpi simple, rarely greatly enlarged; elytra usually complete and the hind wings with normal venation..93
93. Maxillary and labial palpi enormously lengthened, the last joint nearly as long as the antennæ; slender, depressed species with the elytra extending to the middle of the abdomen (female). (**Telegeùsis,** N. Am.) ..... **TELEGEÙSIDÆ**

Maxillary and labial palpi normal; elytra usually complete. Female usually larviform. (**Drìlus, Halacogáster,** palæarc.; **Selàsius,** ethiop.; **Phrixothrix,** neotrop.; **Karùmia,** Persia; **Drilocéphalus,** neotrop.). (Including *KARUMÌIDÆ*).
DRÍLIDÆ

94. Head more or less completely covered by the prothorax; episterna of metathorax not sinuate on the inner side. (**Lucìola,** widespr.; **Lucidòta, Photìnus, Photùris,** Am.; **Lámpyris,** palæarc., ethiop.; **Lamprócera,** neotrop.; **Rhagophthálmus,** As.). (Including *RHAGOPHTHÁLMIDÆ*)... **LAMPÝRIDÆ**

Head not at all covered by the prothorax; episterna of metathorax sinuate on the inner side; antennæ of male sometimes flabellate. (**Cántharis** (=*Teléphorus*), widespr.; **Podàbrus,** holarc.; **Chauliógnathus,** Am.). (Including *PHENGÓDIDÆ*) (*TELEPHÓRIDÆ*) ..... **CANTHÁRIDÆ**

95. Tarsi four-jointed on all pairs of legs (front ones three-jointed in males of some Mycetophagidæ) 96

Tarsi with three joints or less 109

96. Wings fringed with long hairs; very small, highly convex beetles.. 97

Wings not fringed 99

97. Hind coxæ in contact, with plates at least partially covering the femora ..... **CLÁMBIDÆ**

Hind coxæ distant, transverse, not laminate 98

98. Third joint of tarsi small, concealed in the bilobed second joint. (**Sàcium,** cosmop.; **Corỳlophus, Orthóperus,** holarc.; **Árthrolips,** widespr.). (*CORYLÓPHIDÆ, CLYPEASTÉRIDÆ*)
ORTHOPÉRIDÆ

First three joints of tarsi subequal, each bilobed. (**Phænocéphalus,** Japan) ..... **PHÆNOCEPHÁLIDÆ**

99. Abdominal sternites all free and movable 100

Sternites one to four firmly united, immovable 107

100. First tarsal joint greatly dilated, overlapping the very minute second and third joints and a part of the long fourth joint; minute elongate beetles with costate elytra. (Fig. 836). (**Moncèdus** (=*Adimerus*), neotrop.). (*ADIMÉRIDÆ*).
MONŒDIDÆ

First tarsal joint not thus dilated 101

101. Front coxæ transverse; minute fungus-beetles (**Cybocéphalus,** widespr.). (See couplet 118).
Tribe CYBOCEPHALINI of the **NITIDÙLIDÆ**

Front coxæ not transverse 102

102. Front coxæ globose.....103
Front coxæ oval. (If conical, *cf.* Corynetidæ, couplet 81)...105

103. Tarsi slender, third joint distinct, but shorter than the second; very small species. (If the cheeks bear projections, see Silvanidæ, couplet 52; or Cucujidæ, couplet 52, if the body is greatly flattened). (Fig. 817). (**Mycetæa**, holarc., ethiop.; **Rhànis**, nearc.; **Liésthes**, palæarc.) ..... **MYCETÆIDÆ**
Tarsi more or less dilated and spongy beneath; more or less elongate beetles with hard body and strongly clubbed antennæ; usually moderate-sized or large species.....104

104. Front coxal cavities closed; metathoracic epimera separated by a distinct suture; body elongate oval. (**Tríplax**, widespr.; **Erótylus, Ægithus, Brachysphænus, Mycotrètus**, neotrop.; **Trítoma**, holarc.; **Cyrtomórphus**, Indomal.). **EROTÝLIDÆ**
Front coxal cavities open; metathoracic epimera not separated; body elongate, slender. (Fig. 834). (**Langùria, Acropteróxys**, Am.; **Adanástus**, palæarc., Indomal.; **Doubledàya**, Indomal.). **LANGURÌIDÆ**

105. Front coxæ almost in contact, prosternum more or less membranous, not visible between them; antennæ nine-jointed; small, convex, roughly sculptured beetles. (**Georýssus**, widespr.). **GEORÝSSIDÆ**
Front coxæ well separated by the horny prosternum..... 106

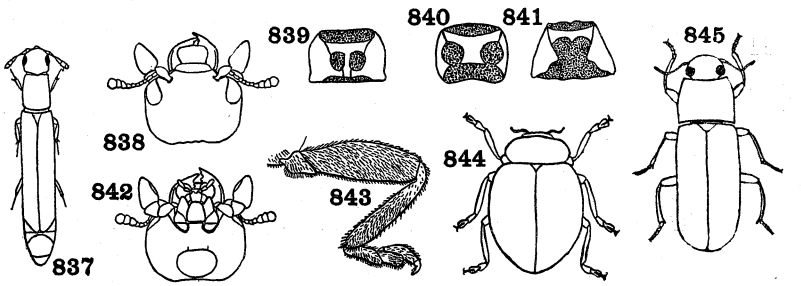
106. Head more or less concealed by the projecting prothorax; last joint of tarsi usually very long; body cylindrical. (**Cis**, cosmop.; **Enneárthron, Hendecátomus**, holarc.; **Rhopalodóntus**, palæarc.; **Oròphius**, palæarc., Austr.). (*CIÒIDÆ, CÍSIDÆ*). **CÌIDÆ**
Head free, not covered by the prothorax; body oval, depressed, pubescent. (**Litárgus**, widespr.; **Mycetóphagus**, holarc.). (*TRITÓMIDÆ*) ..... **MYCETOPHÂGIDÆ**

107. Antennæ thickened, with a two- or three-jointed club; tibiæ simple, not dilated or spinose; not aquatic.....108
Antennæ with a large serrate, seven-jointed club (Fig. 812); front and middle tibiæ dilated and armed with rows of spines; small, subaquatic beetles. (**Heterócerus**, cosmop.; **Litórimus, Micíllus**, palæarc.) ..... **HETEROCÉRIDÆ**

108. Antennæ inserted under a distinct frontal ridge; front coxæ distant from the mesosternum. (**Colýdium, Aulònium, Cérylon**, widespr.) ..... **COLYDÌIDÆ**

Antennæ inserted on the front; front coxæ inclosed behind by the mesosternum. (**Murmídius, Bothríderes, Mychócerus,** holarc.). (Including *BOTHRIDÉRIDÆ*) .. **MURMIDÌIDÆ**

109. Tarsi three-jointed 110
Tarsi with less than three joints.....119



Figs. 837–845. **Coleoptera**

837. **Cylindrosella** (Fouts).
838. **Epilachna,** head from above (Silvestri) Coccinellidæ.
839. Prosternum of beetle, showing coxal cavities separated and closed behind (Wickham).
840. Prosternum of beetle, showing coxal cavities separated and open behind (Wickham).
841. Prosternum of beetle, showing coxal cavities confluent and open behind (Wickham).
842. **Epilachna,** head from below (Silvestri) Coccinellidæ.
843. **Epilachna,** hind leg (Silvestri) Coccinellidæ.
844. **Coccinella.** Coccinellidæ.
845. **Tenebrio** (Girault) Tenebrionidæ.

110. Wings fringed with long hairs.....111
Wings not fringed, or at most with a short fringe.....113
111. Abdomen with only three sternites. Very small, highly convex beetles. (**Sphærius,** holarc.) ..... **SPHÆRÌIDÆ**
Abdomen with six or seven sternites.....112
112. Antennæ slender, nine- to eleven-jointed, with whorls of long hairs; very minute, shining beetles, usually found on foliage. (**Ptílium, Trichópteryx, Ptinélla, Acrótrichis,** palæarc.; Am.; **Limulòdes,** Am.). (*TRICHOPTERÝGIDÆ*).
PTILÌIDÆ

Antennæ short, eight-jointed, thickened apically; very small, ovate, aquatic beetles. (**Hydróscapha**, holarc.).
HYDROSCÁPHIDÆ

113. Second joint of tarsi dilated; the third joint consisting really of two joints, the small, true third joint being fused with the base of the last joint, which thus appears as the third.....114
Second tarsal joint not dilated.....115

114. Tarsal claws usually dilated or toothed at the base; first sternite with curved coxal lines; mesothoracic epimeron triangular; small, rounded, convex usually brightly spotted beetles. "Lady-birds." A large widespread family. (**Coccinélla, Chilócoris, Hippodamìa, Scýmnus, Adàlia, Hyperáspis, Megílla, Ánatis, Epiláchna**). (Figs. 838, 842, 843, 844). (Including *CERASOMMATIDÌIDÆ*) ..... **COCCINÉLLIDÆ**
Tarsal claws simple; first sternite without coxal lines; mesothoracic epimeron quadrangular; small oblong or oval beetles, often with a striking color pattern, usually living in fungi. (**Endómychus**, widespr.; **Lycoperdìna**, holarc.; **Aphorísta**, nearc.; **Epípocus, Rhýmbus**, Am.; **Ámphix**, neotrop.; **Sphærosòma**, palæarc.; **Amphistérnus**, Indomal.).
ENDOMÝCHIDÆ

115. Elytra entire 116
Elytra truncate, exposing the last abdominal segment.....118

116. Body broadly oval, convex; prothorax much widened behind; first three tergites more or less connate; very small beetles. (**Aphænocéphalus**, As.; **Discolòma** (= *Notióphygus*), neotrop., Afr.). (*APHÆNOCEPHÁLIDÆ, PSEUDOCORYLÓPHIDÆ, NOTIOPHÝGIDÆ*) ..... **DISCOLÓMIDÆ**
Body more elongate, the prothorax narrower, not widened behind 117

117. Abdominal sternites all free; wings with a short fringe of hairs (Fig. 808). (**Corticària**, widespr.; **Melanophthálma**, cosmop.; **Latrídius, Cartócere**, holarc.; **Enícmus**, holarc., Austr.).
LATHRIDÌIDÆ

a. Last three or four joints of the antennæ separately thickened, spindle-shaped, and set with long curved hairs. **DASYCERÌNÆ**
Antennæ without long hairs at apex.....b

b. Anterior coxal cavities closed behind.....c
Anterior coxal cavities open behind.. **HOLOPARAMECÌNÆ**

c. Anterior coxæ separate; head longer before the eyes; elytra often carinate ..... **LATHRIDIÌNÆ**

Anterior coxæ contiguous; head shorter before the eyes; elytra never carinate ..... **CORTICARIÏNÆ**

Basal three sternites connate. (See couplet 108).
A few **COLYDÏIDÆ**

118. Front coxæ subtransverse; maxillæ with a single lobe.
Tribe SMICRIPTINI of the **NITIDÙLIDÆ**

Front coxæ small, rounded; maxillæ bilobed; small flattened bark beetles ..... **MONOTÓMIDÆ**

119. Tarsi two-jointed; antennæ eleven-jointed; metasternum very long; very small, elongate beetles, with the elytra oval. (**Jacobsònium**, Sumatra) ..... **JACOBSONÏIDÆ**

Tarsi consisting of a single joint; antennæ four-jointed; metasternum not greatly elongated; very small, broad species. (**Cyathócerus**, neotrop.). (If both elytra and wings are wanting and body larviform, see couplet 198) .. **CYATHOCÉRIDÆ**

120. Frontal coxal cavities closed behind (Fig. 839) 121

Frontal coxal cavities open behind (Fig. 840) 130

121. Tarsal claws simple..... 122

Tarsal claws pectinate; usually elongate, convex, rather soft bodied and often thinly silky-pubescent beetles of small or moderate size; prothorax widened behind. (**Allécula**, cosmop.; **Hymenòrus**, palæarc., Am.; **Cistèla**, widespr.; **Ctenìopus**, palæarc.; **Lophópoda**, Am.). (*ALLECÙLIDÆ*) . **CISTÉLIDÆ**

122. Ventral segments (abdominal sternites) all freely movable. (If the mesosternum is carinate, compare some rare Silphidæ, couplet 84)..... 123

First two to four ventral segments more closely joined together, more or less fused or immovable 127

123. Antennæ 11-jointed 124

Antennæ 10-jointed..... 126

124. Prothorax cylindrical; small, soft-bodied beetles with long, slender antennæ and protruding eyes; elytra not completely covering the abdomen. (**Pètria**, palæarc.) .... **PETRÌIDÆ**

Prothorax not cylindrical..... 125

125. Prothorax quadrate, not wider than the head; narrow-bodied beetles. (If body is greatly flattened, compare males of some Cucujidæ, couplet 52, and Silvanidæ, couplet 52). (**Elácatis** (=*Óthnius*), widespr.; **Ábaba**, nearc.). (*OTHNÌIDÆ*).
ELACÁTIDÆ

Prothorax greatly expanded at the sides, much wider than the head. (**Nílio**, neotrop.) ..... **NILIÓNIDÆ**

126. Elytra entire; small convex beetles. (**Sphíndus,** holarc.). **SPHÍNDIDÆ**

Elytra truncate, exposing the pygidium; small, flattened beetles. (See couplet 36) ..... Males of **RHIZOPHÁGIDÆ**

127. Five ventral segments 128

Six ventral segments, the first two immovably united; small black beetles. (**Eurystèthus** (=*Ægialìtes*), nearc., Cali. to Alaska, Persia). (*ÆGIALÍTIDÆ*) ..... **EURYSTÉTHIDÆ**

128. Penultimate joint of tarsi spongy pubescent beneath; front coxæ prominent; slender, elongate, usually hairy, soft-bodied species, sometimes of metallic color. (**Làgria,** widespr.; **Arthromàcra,** holarc.; **Statìra,** Am.; **Nemostìra,** Afr., Indomal.). **LAGRÌIDÆ**

Penultimate joint of tarsi not spongy pubescent beneath; front coxæ short, not projecting from the cavities 129

129. Antennæ filiform or gradually clavate, the joints usually more or less bead-like, not concealed under the sides of the head; beetles of variable form, oval, elongate, or even pedunculate; usually hard-bodied, black or dark colored; moderate, large or small species. (Figs. 845, 846). A very large and widely distributed family. (**Tenèbrio, Strongýlium, Hèlops, Bláps, Ásida, Bolitóphagus, Diapèris, Eleòdes, Epítragus, Nyctóbates, Platýdema, Zópherus, Tentýria, Tribòlium, Meracántha**). (Including *HELÓPIDÆ, OPÁTRIDÆ, PIMELÌIDÆ, BLÁPIDÆ, DIAPÉRIDÆ*) ..... **TENEBRIÓNIDÆ**

Antennæ strongly clavate, more or less completely concealed beneath the sides of the head, with large two-jointed club, geniculate at the base, with the first joint very long; middle tarsi sometimes four-jointed, very small, oval, flattened beetles living in ants' nests. (**Cossyphòdes, Cossyphodìtes,** ethiop.; **Cossyphodìnus,** India) ..... **COSSYPHÓDIDÆ**

130. Antennæ geniculate; elytra truncate behind, exposing two abdominal tergites; small, oval, hard-bodied species. (**Acrìtus,** widespr.). (See couplet 46) ..... A few **HISTÉRIDÆ**

Antennæ not geniculate 131

131. Head not strongly or suddenly narrowed or constricted behind the eyes; tarsal claws simple or cleft 132

Head strongly and suddenly constricted behind the eyes; if more gradually narrowed, the tarsal claws are pectinate 138

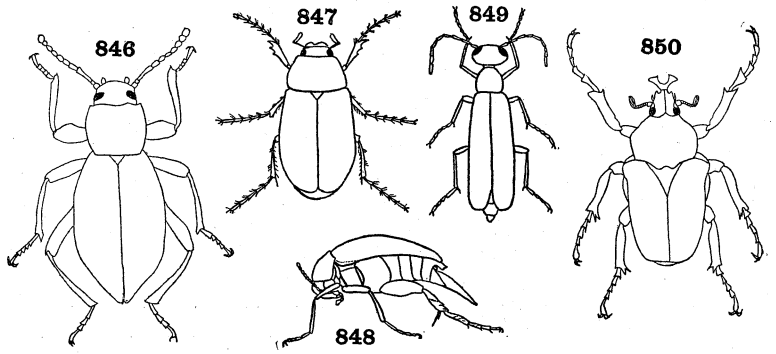
132. Middle coxæ not noticeably prominent 133

Middle coxæ very prominent, contiguous; prothorax without

lateral margin; penultimate joint of tarsi dilated and with a dense brush of hairs beneath; slender, soft-bodied species. (**Nacérda, Asclèra, Sessínia,** widespr.; **Cálopus, Xanthróchroa,** holarc.; **Óxacis,** Am.; **Œdémera,** palæarc.).

ŒDEMÉRIDÆ

133. Antennæ received in grooves on the underside of the prothorax; small, oval, flattened beetles with the head partly concealed



Figs. 846–853. **Coleoptera**

846. **Eleodes** (Hyslop) Tenebrionidæ.
847. **Phyllophaga** (Forbes) Melolonthidæ.
848. **Mordellistena.** Mordellidæ.
849. **Epicauta** (Bruner) Meloidæ.
850. **Goliathus** (Westwood) Cetoniidæ.

in the prothorax; legs retractile. (**Monómma,** widespr.). (*MONÓMMIDÆ*) ..... **MONOMMÁTIDÆ**

Antennæ free, not received in grooves.....134

134. Prothorax with a sharp lateral margin.....135

Prothorax not marginal laterally, narrowed behind, its disk without impressions. (**Myctèrus, Sphærístes** (=*Salpíngus*), **Lissodérma,** widespr.; **Pỳtho,** holarc.). (*SALPÍNGIDÆ*).

PÝTHIDÆ

135. Epimera of mesothorax not reaching the coxæ, the coxal cavities entirely surrounded by the sterna (males of a few genera). (See couplet 54) ..... **CRYPTOPHÁGIDÆ,** part

Epimera of mesothorax attaining the coxæ.....136

136. Metasternum long; epimera of metathorax visible.....137

Metasternum quadrate, epimera of metathorax covered. (Males of a number of genera (see couplet 52) .. **CUCÙJIDÆ**, part

137. Prothorax widened toward the base, its disk with basal impressions; tarsal claws sometimes cleft or appendiculate; elongate or broadly oval species. (**Orchèsia, Phlœotrỳia, Serropálpus**, widespr.; **Tetrâtoma, Hallómenus, Melándrya, Ósphya**, holarc.; **Pénthe**, palæarc., Indomal.). (*SERROPÁLPIDÆ*).
MELANDRỲIDÆ

Prothorax narrowed behind and in front, the sides rounded or toothed; without basal impressions; tarsal claws simple; mandibles very large and powerful, porrect. Very large, elongate beetles. (**Trictenótoma**, Ind., E. Ind.; **Autócrates**, So. As.).
TRICTENOTÓMIDÆ

138. Head prolonged behind and gradually narrowed; prothorax not margined at the sides, as wide as the elytra at base; tarsal claws pectinate, with a large appendage at base; medium-sized slender beetles. (**Cepháloon**, holarc.; **Typítium**, nearc.; **Sponídium**, palæarc.) ..... **CEPHALÒIDÆ**

Head suddenly narrowed behind.....139

139. Prothorax with a sharp lateral margin.....140

Prothorax rounded on the sides, without a sharp lateral margin 142

140. Antennæ filiform 141

Antennæ pectinate (male) or subserrate (female); tarsal claws serrate or toothed; elytra covering the abdomen. (**Evaniócera**, palæarc., Austr.; **Pelecótoma**, holarc.).
Tribe EVANIOCERINI of **RHIPIPHÓRIDÆ**

141. Hind coxæ moderate or large, flattened; front coxæ without trochantin; head placed vertically against the thorax; tarsal claws simple, or cleft and pectinate; body usually conically narrowed behind, the abdomen often prolonged and pointed at tip; small pubescent beetles. (Fig. 848). (**Mordélla, Mordellistèna, Anáspis**, cosmop.; **Tomóxia**, widespr.; **Tólida**, palæarc.) ..... **MORDÉLLIDÆ**

Hind coxæ transverse; front coxæ with trochantin; body not greatly narrowed behind; tarsal claws simple. (**Scráptia**, cosmop.; **Trotommídea, Trotómma**, palæarc.; **Evâlces**, neotrop.) ..... **SCRAPTÌIDÆ**

142. Base of prothorax narrower than the elytra.....143

Base of prothorax as wide as the elytra; body broad, much narrowed behind; elytra usually shortened and narrowed be-

hind; antennæ pectinate in the male, often serrate in the female. Females sometimes much degenerate or even larviform. (**Pelecotomòides, Rhipídius,** widespr.; **Macrosìagon,** cosmop.; **Rhipíphorus,** holarc.; **Myodìtes,** neotrop.).

RHIPIPHÓRIDÆ

143. Hind coxæ transverse, not prominent; tarsal claws usually simple 144

Hind coxæ large and prominent 146

144. Eyes more or less emarginate; hind coxæ contiguous or nearly so 145

Eyes elliptical, entire, rather coarsely granulated; hind coxæ usually well separated. (**Ánthicus, Tomóderus,** cosmop.; **Notóxus, Formicòmus, Endòmia,** widespr.; **Lemòdes,** Austr.) ..... **ANTHÍCIDÆ**

145. Head constricted far behind the finely granulated eyes. (**Macràtria,** cosmop.; **Pedìlus** (=*Corphyra*), **Stereopálpus,** holarc.) ..... **PEDÍLIDÆ**

Head constricted just behind the coarsely granulated eyes; tarsi apparently with 4, 4, 3 joints, as the penultimate joint is extremely minute; first two ventral segments immovably united. (**Hylóphilus** (=*Eùglenes,* =*Áderus*), cosmop.; **Sýzeton,** Austr.). (*XYLOPHÍLIDÆ, EUGLÉNIDÆ, ADÉRIDÆ*).

HYLOPHÍLIDÆ

146. Tarsal claws simple; head horizontal; antennæ serrate, often pectinate in the male (Fig. 797); body flattened; moderate-sized beetles. (**Dendròides, Schizòtus,** holarc.; **Pyróchroa,** palæarc.; **Pseudopyróchroa,** palæarc., Indomal.).

PYROCHRÒIDÆ

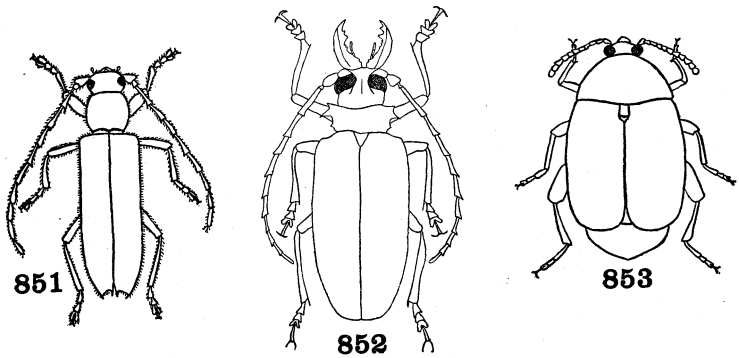
Tarsal claws toothed or cleft; head deflexed, with the front vertical; elytra sometimes shortened; body plump, usually more or less cylindrical; moderate or large beetles (Fig. 849). Blister beetles. (**Epicaùta, Lýtta** (=*Cántharis*), **Méloe, Nemógnatha, Cissìtes,** widespr.; **Zonìtes,** cosmop.; **Macróbasis,** Am.; **Hórnia,** nearc.). (*CANTHÁRIDÆ, LÝTTIDÆ*).

MELÒIDÆ

147. Submentum pedunculate; *i.e.* the mentum supported at its base by a narrow portion or peduncle; antennæ eleven-jointed, serrate, rarely pectinate; head prolonged into a broad muzzle; antennæ and body usually pubescent; elytra shortened, exposing the pygidium. (Fig. 853). Pea and bean weevils. (**Mylàbris** (=*Brùchus,* =*Lària*), cosmop.; **Spermóphagus, Pachýmerus,**

widespr.; **Pseudopachýmerus**, neotrop.). (*BRÚCHIDÆ, LARÌIDÆ*) ..... **MYLÁBRIDÆ**

Submentum not pedunculate; head not prolonged into a broad beak; antennæ rarely distinctly serrate, occasionally with more than eleven joints, usually filiform or moderately thickened toward apex 148



Figs. 851–853. **Coleoptera**

851. **Elaphidion** (Forbes) Cerambycidæ.
852. **Acanthophorus** (Gahan) Prionidæ.
853. **Mylabris** (Felt) Mylabridæ.

148. Antennæ usually long or greatly developed, frequently inserted on frontal prominences; front often vertical, large and quadrate; pronotum rarely margined; tibial spurs well developed; usually rather large, elongate or oblong beetles with parallel sides and pubescent upper surface. Longicorns 149

Antennæ moderate or short, not inserted on frontal prominences; front small, oblique, sometimes greatly inflexed; prothorax most frequently margined; tibial spurs usually wanting; small or of moderate size; body usually glabrous above and often very brightly colored or metallic; rather oval in form. Leaf-beetles 151

149. Prothorax sharply margined at the sides which commonly bear teeth or spines; labrum connate; front coxæ strongly transverse; inner lobe of maxillæ very small or obsolete; large or very large, considerably flattened, usually brown or black beetles. (Fig. 852). (**Priònus**, holarc.; **Macrótoma**, widespr.; **Mállo-**

don, Orthosòma, Am.; **Derancístrus, Pyròdes,** neotrop.).
PRIÓNIDÆ

Prothorax very rarely margined at the sides; labrum free; front coxæ rounded, rarely strongly transverse; inner lobe of maxillæ more or less well developed; antennæ never pubescent. .150

150. Front tibiæ obliquely grooved on the inner side; front coxæ never transverse; last joint of palpi usually pointed. (Fig. 791). (**Monóchamus, Obèrea,** widespr.; **Sapérda,** holarc.; **Dorcàdion,** palæarc.; **Oncíderes,** Am.; **Tetraòpes,** nearc.; **Batócera,** Afr., Austr.; **Tragocéphala,** Afr.; **Platyomópsis,** Austr.). (Including *BATOCÉRIDÆ*) ..... **LAMÌIDÆ**

Front tibiæ not grooved; last joint of palpi never acute at tip; antennæ pubescent. (Fig. 851). (**Leptùra, Callichròma, Xylótrechus,** widespr.; **Acmæops, Strangàlia, Phymatòdes, Rhàgium, Leptùra,** holarc.; **Ebùria, Elaphídion, Cyllène,** Am.) ..... **CERAMBÝCIDÆ**

151. Mouth placed anteriorly, the front normal; head porrect or vertical 152

Mouth inferior, the anterior part of the front prominent, so that the mouth is confined to the underside of the head and is small, hidden or nearly so 164

152. Antennæ widely separated at the base; elytra of hard texture. 153

Antennæ generally closely approximate at base, not widely separated; elytra more or less soft in texture 163

153. Intermediate abdominal sternites not narrowed medially, the pygidium not exposed behind the elytra 154

Intermediate abdominal sternites narrowed medially, the pygidium usually exposed, declivous 158

154. Prothorax rounded on the sides, without distinct lateral margin; head produced, the eyes prominent; prosternum very narrow. 155

Prothorax with a distinct lateral margin (if rarely not margined, the antennæ are usually short, with the terminal joints transverse and more or less serrate); head not produced, the eyes not prominent; prosternum broad. (If antennæ are strongly clavate, compare a few Erotylidæ, couplet 104) 161

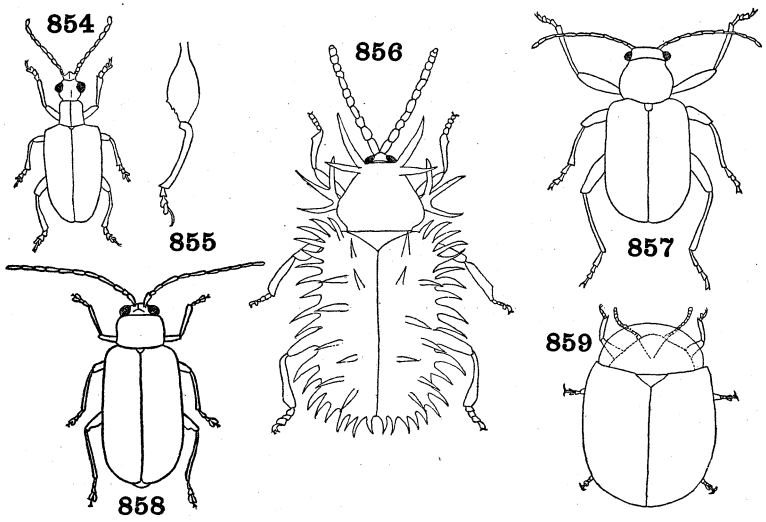
155. Antennæ not separated by the entire front of the head 156

Antennæ separated by the entire front of the head 157

156. Prosternum very narrow, not distinct; body beneath clothed with dense silvery pubescence; first sternite as long as the others united; elongate, more or less metallic, semiaquatic beetles. (**Donàcia,** widespr.; **Hæmònia, Plateùmaris,** holarc.).
DONACÌIDÆ

Prosternum distinct; body beneath not thus densely pubescent; first sternite shorter; less elongate beetles, not aquatic. (**Megáscelis, Atelédera,** neotrop.) ..... **MEGASCÉLIDÆ**

157. Hind femora greatly thickened, their tibiæ curved; brilliantly metallic species of moderately large size. (Fig. 855). (**Sàgra,** old world tropics) ..... **SÁGRIDÆ**



Figs. 854–859. **Coleoptera**

854. **Crioceris** (Jacoby) Crioceridæ.
855. **Sagra,** hind leg (Jacoby) Sagridæ.
856. **Hispella** (Fletcher) Hispidæ.
857. **Fidia** (Johnson and Hammar) Eumolpidæ.
858. **Diabrotica** (Chittenden) Galerucidæ.
859. **Cassida** (Jones) Cassididæ.

Hind femora only slightly incrassated; much smaller and less brilliant insects, rarely metallic. (Fig. 854). (**Criócerus, Lèma,** cosmop.; **Sigrísma,** ethiop.; **Orsodácne,** widespr.). (Including *ORSODÁCNIDÆ*) ..... **CRIOCÈRIDÆ**

158. Antennæ short, the joints serrate 159

Antennæ long and generally filiform, never serrate, although sometimes shorter with the terminal joints thickened; small, cy-

lindrical beetles of compact shape, with the head flat, perpendicular and invisible from above. (**Cryptocéphalus**, cosmop.; **Pachýbrachys**, cosmop., mainly Am.; **Diorýctus**, Indomal.; **Cœnòbius**, As., Afr.; **Mónachus**, neotrop.; **Bassàreus**, nearc.) ..... **CRYPTOCEPHÁLIDÆ**

159. Prothorax without grooves for the reception of the antennæ; elytra not tuberculate 160

Prothorax with grooves on the flanks for the reception of the antennæ; elytra tuberculate; body subquadrate or somewhat elongate; head flat, deeply inserted in the prothorax, invisible from above. (**Chlàmys, Éxema**, widespr.). (*FULCIDÁCIDÆ*) **CHLAMÝDIDÆ**

160. Apical joint of maxillary palpi pointed; hind femora with one or two teeth; last joint of tarsi and claws very long; body elongate, the head not concealed. (**Megálopus**, neotrop.; **Mastostèthus**, neotrop.; **Temnáspis, Colobáspis**, Afr., Indomal.) ..... **MEGALOPÓDIDÆ**

Apical joint of maxillary palpi more or less truncate; hind femora without teeth; claw joint normal; elongate, more or less cylindrical species with the head deflexed or perpendicular; elytra generally covering the pygidium. (**Clỳtra**, Euras., Afr.; **Gynandrophthálma**, widespr.; **Cyanìris**, widespr.; **Æthomórpha**, Afr., Indo-Austr.; **Aspidólopha**, Indomal.; **Coscinóptera**, nearc.; **Bàbia**, Am.) ..... **CLÝTRIDÆ**

161. Third joint of tarsi deeply bilobed; front coxæ usually rounded 162

Third tarsal joint entire, not bilobed; front coxæ transverse; body oval, convex; antennæ moderately thickened toward apex. (Fig. 790). (**Chrysomèla, Plagiódera**, widespr.; **Phytodécta, Phyllodécta**, holarc.; **Leptinotársa** (*L. decemlineàta*, Colorado potato-beetle), **Polyspìla**, Am.; **Timárcha**, palæarc.; **Pýrgo**, Austr.) ..... **CHRYSOMÉLIDÆ**

162. Prothorax as wide as the elytra at base; legs compressed; femora with grooves into which the tibiæ can be placed; metasternum and abdomen grooved for the reception of the femora; short, very convex beetles, often brilliantly metallic. (**Lamprosòma**, neotrop., As.; **Lycnóphanes**, neotrop., ethiop.). **LAMPROSOMÁTIDÆ**

Prothorax generally narrower than the elytra; legs not compressed; abdomen not grooved for the reception of the femora; more or less oblong, convex beetles. (Fig. 857). (**Fídia, Co-**

láspis, Am.; **Chrýsochus, Adóxus**, holarc.; **Chrysolámpra**, As.; **Nodóstoma**, Indomal.; **Colasposòma**, Afr., Indomal.; **Tricliòna**, Indomal.; **Corynòdes**, Afr., Indomal.; **Pària**, Am., As.; **Nodonòta**, Am., Austr.) ..... **EUMÓLPIDÆ**

163. Hind femora slender, adapted for walking; tibiæ usually subcylindrical; tarsi slender, not retractile. (Fig. 858). (**Lupèrus, Galerucélla**, cosmop.; **Galerùca**, holarc.; **Monóxia, Cerótoma, Diabròtica, Trirhábda**, Am.) ..... **GALERÙCIDÆ**

Hind femora greatly thickened, adapted for leaping; tibiæ frequently sulcate externally, the tarsi retractile. (**Áltica** (= *Háltica*)). (*HALTÍCIDÆ*) ..... **ALTÍCIDÆ**

164. Head free, not retracted beneath the prothorax; body usually spinose, narrowed in front, broad and truncate behind. (Fig. 856). (**Híspa**, Afr., As.; **Châlepus**, Am.; **Cephalòlia**, neotrop.; **Cephalodónta**, neotrop.; **Gonóphora, Callíspa, Dactylíspa**, Afr., As.) ..... **HÍSPIDÆ**

Head concealed under the prothorax, which with the elytra, is widely margined; body oval or nearly circular in outline. (Fig. 859). (**Cássida, Coptocỳcla**, widespr.; **Chelymórpha**, Am.; **Hoplionòta**, ethiop., Indo-Austr.; **Pseudomesophàlia**, neotrop.; **Aspidomórpha**, Afr., Indo-Austr.) ..... **CASSÍDIDÆ**

165. Tarsi apparently three-jointed, with the second joint lobed. (Fig. 877). (AGLYCYDERÒIDEA) 166

Tarsi apparently four-jointed, with the third joint lobed. ... 167

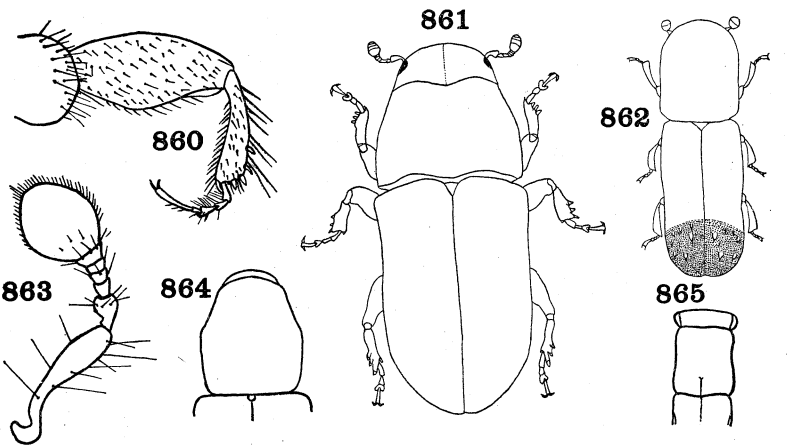
166. Head without a distinct beak in either sex, wider than the anterior part of the pronotum; prothorax subquadrate, the sides straight and the pleuræ clearly separated from the notum. (Fig. 877). (**Aglycýderes**, Canary Isl., New Zealand, New Caledonia) ..... **AGLYCYDÉRIDÆ**

Beak in female well developed; in male rarely attaining a length greater than its width; head narrower than the anterior part of the pronotum; prothorax oval, the sides bulging outwards and the pleuræ indistinctly separated from the notum. (Fig. 872). (**Proterhìnus**, Hawaii) ..... **PROTERHÍNIDÆ**

167. Rostrum or beak extremely short and broad, scarcely developed; tibiæ with a series of teeth externally or the front ones produced into a stout curved process at tip; antennæ short with a broad club; small oval or cylindrical beetles. (SCOLYTÒIDEA) .. 168

Beak of variable length, usually at least broader than long; tibiæ simple, without teeth externally or process at tip; antennæ clubbed or not. (CURCULIONÒIDEA) 172

168. First joint of anterior tarsi shorter than the second, third and fourth together (Fig. 871); eyes oval, emarginate or divided; head narrower than the prothorax. (Fig. 864).....170
First joint of anterior tarsi very long (Fig. 875), longer than the second, third and fourth together; head broader than prothorax; eyes rounded (Fig. 865) 169



Figs. 860–865. **Coleoptera**

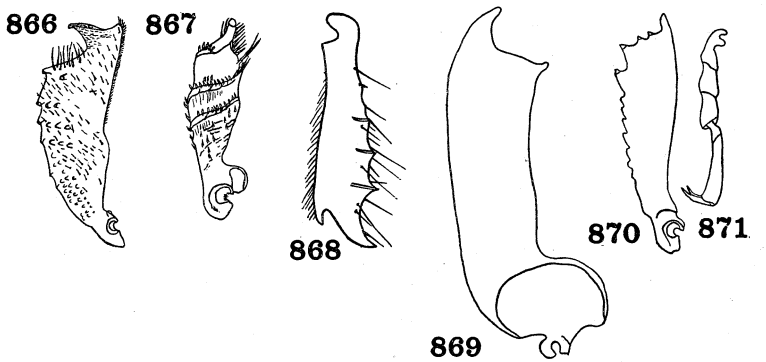
860. **Pityogenes,** front leg (Felt) Ipidæ.
861. **Dendroctonus** (Hopkins) Ipidæ.
862. **Xyleborus** (Hubbard) Ipidæ.
863. **Ips,** antenna (Felt) Ipidæ.
864. **Hylastes,** dorsal outline of head and prothorax (Felt) Scolytidæ.
865. **Platypus,** dorsal outline of head and prothorax (Felt) Platypodidæ.

169. Third joint of front tarsi not lobed; anterior tibiæ with a prominent apical process and with rugosities on the ventral area. (Figs. 865, 867, 875). (**Plátypus,** tropicopol.; **Tesserócerus,** neotrop.; **Crossotársus,** Afr., Indo-Austr.; **Periómmatus,** Afr.) ..... **PLATYPÓDIDÆ**
Third joint of front tarsi deeply lobed; anterior tibiæ more slender. (**Chapuisia,** neotrop.) ..... **CHAPUISÌIDÆ**
170. Front tibiæ without a prominent process on the outer apical angle. (Figs. 810, 861, 863, 864, 868, 870, 871). (**Íps, Pityóphthorus, Hylesìnus, Hylástes,** cosmop.; **Dendróctonus,**

Cryptúrgus, holarc.; **Mìcracis**, Am.). Including *HYLESÍNIDÆ*, part) ..... **ÍPIDÆ**

Front tibiæ with a prominent process on the outer apical angle 171

171. Front tibiæ without prominent rugosities on ventral area. (Figs. 788, 869). (**Scólytus** (=*Eccoptogáster*), widespr.; **Scolytópsis, Camptócerus**, neotrop.). (Including *HYLESÍNIDÆ*, pt.) ..... **SCOLÝTIDÆ**



Figs. 866–871. **Coleoptera**

866. **Scolytoplatypus**, front tibia (Hopkins) Scolytoplatypodidæ.
867. **Platypus**, front tibia (Platypodidæ).
868. **Erineophilus**, front tibia (Felt) Ipidæ.
869. **Camptocerus**, front tibia (Hopkins) Scolytidæ.
870. **Ips**, front tibia (Hopkins) Ipidæ.
871. **Ips**, tarsus (Hopkins) Ipidæ.

Front tibiæ with prominent rugosities on ventral area. (Fig. 866). (**Scolytoplátypus**) .... **SCOLYTOPLATYPÓDIDÆ**

172. Antennæ not elbowed, without a distinct club although sometimes stouter toward tip; first joint not lengthened 173

Antennæ straight or elbowed, always with a distinct club, the first joint much elongated 174

173. Antennæ 10-jointed, the last joint very elongate. (**Cỳlas** (*C. formicàrius*, Sweet-potato weevil), widespr.; **Myrmacícelus**, Austr.) ..... **CYLÁDIDÆ**

Antennæ 11-jointed; body very elongate; beak well developed at least in the female and often remarkably long and thin. (Fig.

874). (**Eùpsalis, Trachelìzus,** widespr.; **Bréntus, Rhaphidorrhýnchus,** neotrop.). (*BRÉNTHIDÆ*).... **BRÉNTIDÆ**

174. Palpi flexible; labrum present 175
Palpi rigid; labrum wanting ..... **CURCULIÓNIDÆ**[1]

a. Prothorax with a distinct acute or carinate lateral margin; antennæ straight, not geniculate.....b
Prothorax without a distinct lateral margin, rarely with the weak indication of one c

b. Elytra short, exposing three dorsal abdominal segments; short, stout species. (**Pterócolus,** Am.) ..... **PTEROCOLÌNÆ**
Elytra completely covering the abdomen. (**Oxycórynus,** neotrop.) ..... **OXYCORYNÌNÆ**

c. Antennæ straight, not received in grooves; club frequently with separated joints .....d
Antennæ geniculate, more or less completely elbowed; the beak with grooves for the reception of the scape; club compact....j

d. Antennal club composed of completely separated joints.....e
Antennæ with the joints closely united into a compact, oval club.f

e. Mandibles flat, toothed on inner and outer sides, tibiæ with short terminal spurs; tarsal claws free, bifid or acutely toothed. **RHYNCHITÌNÆ**
Mandibles stout, pincers-shaped; tibial spurs forming two strong hooks; tarsal claws connate at base..... **ATTELABÌNÆ**

f. Trochanters elongate, the femora attached to their apices and thus separated from the coxæ; elytra completely covering the abdomen, concealing the pygidium; beak porrect, usually long; small species. (**Àpion,** cosmop.) ..... **APIONÌNÆ**
Trochanters triangular, the femora contiguous with the coxæ..g

g. Tips of elytra leaving the pygidium exposed.....h
Tips of elytra completely covering the abdomen. (**Brachýcerus,** palæarc., ethiop.; **Micrócerus, Bròtheus,** ethiop.). **BRACHYCERÌNÆ**

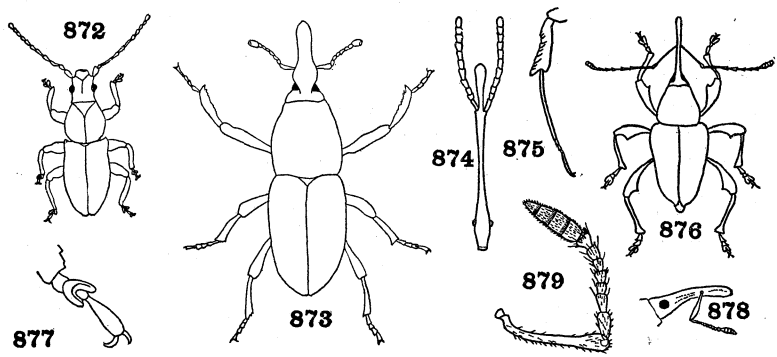
h. First joint of antennæ no longer than the second; beak short, broad; middle and hind coxæ widely separated; hind legs very long, fitted for grasping; broad, short species. (**Tachýgonus,** Am.) ..... **TACHYGONÌNÆ**
First joint of antennæ longer than the second.....i

i. Hind femora short, very broad, their outer margin crenulate and strongly curved; small species with long, curved beak; joints of antennal club less closely compacted than usual. (**Allocórynus,** Am.) ..... **ALLOCORYNÌNÆ**

[1] This very extensive family has been divided into a long series of subfamilies, the limits of which are not agreed upon by different workers. Those generally recognized may be distinguished by the above key.

Hind femora of the usual elongate, clavate form; beak short, broad; large species. (**Ithýcerus,** nearc.). (*BÉLIDÆ,* Leng). **ITHYCERÎNÆ**

j. Abdomen of male with an apparent extra segment at tip; the pygidium and anal segment separated by a suture; club of antennæ usually annulated, sensitive and not shining; third joint of tarsi usually deeply bilobed, with a brush beneath (rarely with narrow setose tarsi in some subaquatic species). . k



Figs. 872–879. **Coleoptera**

872. **Proterhinus** (Perkins) Proterhinidæ.
873. **Sitophilus** (Back and Cotton) Curculionidæ.
864. **Brentus,** head from above (Berlese) Brentidæ
875. **Platypus,** tibia and tarsus of front leg (Felt) Platypodidæ.
876. **Balaninus** (Chittenden) Curculionidæ.
877. **Aglycyderes,** hind tarsus (Tillyard) Aglycyderidæ.
878. Curculionid Weevil, side of head.
879. **Sitones,** antenna (Silvestri) Curculionidæ.

Abdomen similar in both sexes, the pygidium not divided by a suture as the anal segment of the male is at least partly free and retractile; club of antennæ usually with its basal joint enlarged or shining, or both, without or with indistinct sutures. . . . . o

k. Mandibles with a deciduous cusp or projection which leaves an oval scar when it falls off; beak never long and slender, not received in the breast in repose. (*BRACHYRHÍNIDÆ, PSALIDÌIDÆ*) . . . . . **OTIORHYNCHÎNÆ**

Mandibles without scar or deciduous cusp; beak elongate, or if slender, received by the breast in repose. l

l. Prosternum not forming a triangular plate in front of the coxæ; simple or grooved to receive the beak..... .....m

Prosternum forming a triangular plate in front of the coxæ; beak received in the prosternum when in repose; tarsi usually narrow and bristly. (**Thecestérnus**, holarc.; **Býrsops**, palæarc.). (*BRYSÓPIDÆ*) ..... **THECESTERNÌNÆ**

m. Trochanters elongated, completely separating the base of the femora from the coxæ .... **NANOPHYÌNÆ**

Trochanters short, triangular; base of femora contiguous with the coxæ .....n

n. Beak short and stout, received between the front legs in repose; jumping species with short thickened hind femora. **ORCHESTÌNÆ**

Beak usually elongate, slender and porrect, rarely concealed; hind femora not thickened for jumping.. **CURCULIONÌNÆ**

o. Pygidium covered by the elytra; mentum attached to a short quadrate gular peduncle..... **COSSONÌNÆ**

Pygidium exposed; peduncle of mentum long and narrow, the buccal cavity elongate. (**Caléndra** (=*Sphenóphorus*)). (*CALÁNDRIDÆ, RHYNCÓPHÓRIDÆ*) ..... **CALENDRÌNÆ**

175. Beak long, well developed, prothorax without lateral carinate margin or transverse ridge; elytra completely covering the pygidium; anterior coxæ conical. (**Rhinómacer**, holarc.; **Nemònyx**, palæarc.). (*DOYDIRHÝNCHIDÆ, NEMONÝCHIDÆ*) ..... **RHINOMACÉRIDÆ**

Beak very short; prothorax trapezoidal, with carinate lateral margin and usually a transverse raised line or ridge; pygidium exposed; anterior coxæ globose. (*BRUCHÉLIDÆ, CHORÁGIDÆ, PLATYRRHÍNIDÆ, PLATYSTÓMIDÆ*). **ANTHRÍBIDÆ**

176. Lamellæ of antennal club not capable of closing together, usually not flattened, but forming a more or less comb-like mass (Fig. 814); only five abdominal sternites 177

Lamellæ of antennal club movable, flattened and capable of close apposition to form a solid club; six, or more rarely five, abdominal sternites 179

177. Mentum entire, ligula behind, or at the apex of the mentum; antennæ not curled in repose 178

Mentum deeply emarginate, the ligula large, corneous, filling the emargination; labrum free; antennæ straight, curled in repose; large elongate, somewhat flattened, shining beetles with deeply lined elytra ..... **PASSÁLIDÆ**

178. Ligula and maxillæ covered by the mentum; antennæ usually elbowed. (Fig. 814). Stag-beetles. (**Dórcus, Platýcerus, Cerùchus, Lucànus,** holarc.; **Nicàgus,** nearc.; **Odontólabis,** As., Indomal.; **Lámprima,** Austr.) ..... **LUCÁNIDÆ**

Ligula and maxillæ not covered; antennæ straight. (**Sinodéndron,** holarc.) ..... **SINODÉNDRIDÆ**

179. Side pieces of metasternum attaining the coxæ; abdomen usually with six tergites 180

Side pieces of mesosternum not attaining the coxæ; abdomen with five tergites; body heavily sculptured, the elytra usually with distinct rows of tubercles; pygidium covered by the elytra; small or moderate, rarely large beetles. Skin-beetles. (**Tróx,** cosmop.; **Gláresis,** holarc.; **Cryptogènius,** neotrop.). **TRÓGIDÆ**

180. Abdominal spiracles placed in a line, each one in the membrane between the sternite and tergite and all of them covered by the elytra; mentum and ligula separated by a suture. 181

At least some of the apical abdominal spiracles located on the sternites, below the connecting membrane; the last one usually not covered by the elytra; mentum and ligula usually connate. 191

181. Hind tibiæ with a single apical spur; scutellum usually invisible; middle legs widely separated by their coxæ; clypeus expanded so as to cover the mandibles and mouthparts; pygidium partly exposed; antennæ eight- or nine-jointed. (**Onthóphagus,** cosmop.; **Scarabæus,** palæarc., ethiop. (*S. sàcer,* Sacred scarabæus); **Gymnopleùrus,** Afr., As.; **Cánthon,** Tumble-bugs, **Deltochìlum,** Am.; **Chœrídium,** Am.; **Pinôtus,** neotrop.; **Cõpris,** widespr.; **Phanæus,** Am.). (*CÓPRIDÆ*). **SCARABÆIDÆ**

Hind tibiæ with two apical spurs; scutellum well developed; middle legs more approximated; clypeus of variable size, either concealing or exposing the mouthparts 182

182. Six abdominal sternites 183

Five abdominal sternites, or with the sutures between the sternites effaced 190

183. Antennæ with eleven joints 184

Antennæ with ten joints or less 185

184. Antennal club with three leaves; mandibles and labrum prominent; moderate-sized beetles usually with strongly striate elytra. (Fig. 815). (**Bolbóceras,** cosmop.; **Athýreus,** neotrop., As.; **Geotrùpes,** widespr.; **Lèthrus,** holarc.) .. **GEOTRÙPIDÆ**

Antennal club with many (5–7) leaves; moderately large, black, hairy beetles. (**Pleócoma, Ácoma,** nearc.) . **PLEOCÓMIDÆ**

185. Antennæ ten-jointed; body more or less hairy.....186
Antennæ nine-jointed.....189

186. Antennal club bare and shining, sparsely hairy; epimera of metathorax large; conspicuously hairy beetles. (**Amphícoma,** holarc.; **Toxócerus, Gláphyrus,** palæarc.) . **GLAPHÝRIDÆ**
Antennal club, at least on the apical two joints, pubescent and dull or opaque.....187

187. Epimera of metathorax covered; abdominal sternites free; antennal club simple, lamellate.....188
Epimera of metathorax visible; abdominal sternites connate; antennal club telescopic, the joints cupuliform. (**Hybósorus,** holarc., ethiop.; **Liparòchrus,** Austr.; **Phæòchrous,** widespr.) ..... **HYBOSÓRIDÆ**

188. Eyes divided in front. (**Hýbalus,** palæarc.; **Órphnus,** ethiop., Ind.; **Ægídium,** neotrop.) ..... **ÓRPHNIDÆ**
Eyes entire. (**Ochodæus,** widespr.) ..... **OCHODÆIDÆ**

189. Mandibles concealed beneath the clypeus. (**Aphòdius, Atæ-nius, Psammòbius, Saprosìtes, Oxyòmus,** cosmop.; **Eupària,** widespr.; **Lorditomæus,** Afr.) ..... **APHODÌIDÆ**
Mandibles not covered by the clypeus. (**Ægiàlia,** holarc.; **Eremàzus,** palæarc.) ..... **ÆGIALÌIDÆ**

190. Abdomen retractile, whole body together with the legs capable of being contracted into a ball; small shining, more or less metallic species. (**Acanthócerus, Cleonòtus,** Am.; **Philharmóstes,** Afr.; **Pterorthochætes,** Indo-Austr.). . **ACANTHOCÉRIDÆ**
Body not retractile. Tribe ONCERINI of the **MELOLÓNTHIDÆ**

191. Abdominal spiracles forming two rows which diverge only slightly behind, each row forming a nearly straight line; tarsal claws at least of hind legs usually of equal size and with a tooth, generally immovable; rarely with only one claw; epistoma transverse, separated from the front by a suture. (Figs. 816, 847). A large, widely distributed group. (**Melolóntha** (Cockchafers), **Oncócerus, Sérica, Diplotáxis, Phyllóphaga** (=*Lachnostérna*) (May-beetles, June-bugs), **Polyphýlla** and many others) ..... **MELOLÓNTHIDÆ**
Abdominal spiracles forming two rows which diverge strongly behind, each row forming two lines.....192

192. Front legs greatly lengthened, especially in the male; sides of prothorax dentate; tarsal claws equal; distal leaves of antennal

club inclosing the proximal ones. (**Euchìrus**, Indomal.; **Cheirótonus**, **Propomàcrus**, As.) ..... **EUCHÍRIDÆ**

Of a different conformation 193

193. Tarsal claws, at least of the hind legs, of equal length 194

Tarsal claws unequal, freely movable, the shorter one not bifid; pygidium exposed; usually large, often brightly colored beetles, usually no strong dimorphism between the sexes. (**Anómala**, cosmop.; **Popíllia**, widespr.; **Adorètus**, Old World; **Anisòplia**, palæarc.; **Cotálpa**, **Plusiòtis**, **Pelidnòta**, nearc.). **RUTÉLIDÆ**

194. Hind legs of male with the femora greatly swollen, the antennæ nine-jointed; female without elytra or wings. (**Páchypus**, palæarc.) ..... **PACHYPÓDIDÆ**

Femora normal; female with elytra 195

195. Mandibles visible from above, more or less widened and blade-like; anterior coxæ transverse; large or very large beetles; highly dimorphic, the males often with large horns on the head and prothorax. Rhinoceros beetles. (**Dynástes**). **DYNÁSTIDÆ**

Mandibles not visible from above, not widened or expanded; anterior coxæ usually strongly conical 196

196. Clypeus emarginate at the sides in front of the eyes, so that the base of the antenna is visible from above; antennæ ten-jointed 197

Clypeus not thus emarginate at the sides; antennæ nine-jointed. (**Phænómeris**, **Oxychìris**, Afr.) ..... **PHÆNOMÉRIDÆ**

197. Epimera of metathorax visible from above between the hind angle of the prothorax and the humeral callus; lateral edge of elytra bent inwards near the base. (Fig. 850). Moderate-sized, or often large, frequently brightly colored beetles. (**Cetònia**, palæarc.; **Cremastochìlus**, nearc.; **Euphòria**, **Allorhìna**, **Cótinus**, Am.; **Goliathus** (Goliath beetle), ethiop.; and many others) ..... **CETONÌIDÆ**

Epimera of metathorax not visible from above, elytra not sinuate; prothorax behind much narrower than the base of the elytra. (**Trích̀ius**, holarc.; **Válgus**, widespr.; **Osmodérma**, holarc.; **Gnórimus**, palæarc.) ..... **TRICHÌIDÆ**

198. Head more or less completely retracted within the prothorax; legs larviform, bearing a single claw 199

Head prominent, not retracted; legs of normal form with two tarsal claws. (See couplet 142).

A few female **RHIPIPHÓRIDÆ**

199. Body elongate, more or less uniformly cylindrical; thorax no broader than the abdomen; females of PHENGODINI (See couplet 94) ..... Some **CANTHÁRIDÆ**

Body strongly flattened; prothorax triangularly narrowed in front, meso- and metathorax expanded laterally and much wider than the abdomen, the latter with processes extending from the sides of the segments. (**Dulitícola**, Borneo). "Trilobite larvæ." (See couplet 93) ..... Some females of **DRÍLIDÆ**

LITERATURE ON COLEOPTERA

GENERAL

ALLUAUD, C. Catalogue of Coleoptera of Madagascar. In Grandidier, Hist. Madagascar, **21** (1900).

BLATCHLEY, W. S. Coleoptera or Beetles of Indiana. Nature Publishing Co., Indianapolis (1910).

BÖVING, A. G. Classification of beetles according to larval characters. Bull. Brooklyn Entom. Soc., **24**, pp. 55–80 (1929).

BRADLEY, J. C. Manual of the genera of beetles of America North of Mexico. Ithaca, Daw, Illston & Co., 360 pp. (1930).

BROUN, T. Manual of New Zealand Coleoptera. 1566 pp. Wellington (1880–93).

BRUCH, C. Catálogo de los Coleópteros de Argentina. Rev. Mus. la Plata, **19** (several parts) (1915).

CALWER, C. G. Käferbuch. 6th edition, 1390 pp., Stuttgart (1916).

CASEY, T. L. Memoirs on the Coleoptera, 1–11 (1910–24). (Some parts are listed separately). (Deals with various groups of North American Coleoptera).

FORBES, W. T. M. The wing-venation of Coleoptera. Ann. Entom. Soc. America, **15**, pp. 328–352 (1922).

The wing-folding patterns of the Coleoptera. Journ. New York Entom. Soc., **34**, pp. 42–68; 91–138 (1926).

FOWLER, W. W. British Coleoptera. 6 vols. London (1887–1913).

Coleoptera, general introduction and Cicindelidæ and Paussidæ. Fauna of British India (1912).

GAHAN, C. J. and others. Coleoptera of India. Fauna of British India, 4 vols. (1906–1912). (An extensive work, covering a part of the coleopterous fauna of this region).

GANGLBAUER, L. Die Käfer von Mitteleuropa. Vienna, 4 vols. (1892–1904). (Adephaga, Staphyliniformia and Clavicornia).

GEMMINGER, M. and B. HAROLD. Catalogus Coleopterorum. 12 vols., 3986 pp. Monaco (1868–76).

HATCH, M. H. Systematic index to keys for the determination of Nearctic Coleoptera. Journ. New York Entom. Soc., **35**, pp. 279–306. (Supplementary to the bibliography in Leng's catalogue).

HAYWARD, R. Classification of the families of Coleoptera of North America. American Entom. Soc., 37 pp. (1909).

HENSHAW, S. Bibliography, in "Synopsis of North American Coleoptera." Appendix to Leconte and Horn, 1883, pp. 535–552 (1883).

HORN, G. H. Coleoptera of Baja California. Proc. California Acad. Sci. (2), **4**, pp. 302–449 (1895); **5**, pp. 225–295 (1896); **6**, pp. 367–381 (1897).

HOULEBERT, C. Encyclopédie Scientifique. Les Coléoptères d'Europe, France et Régions voisins. Paris (1922). (A continuing series).

LACORDAIRE, J. T. Genera des Coléoptères. 13 vols., Paris (1854–76).

LAMEERE, A. Classification des Coléoptères. Ann. Soc. Entom. Belgique, **44**, pp. 355–377 (1900).

LECONTE, J. L. and G. H. HORN. Classification of the Coleoptera of North America. Smithsonian Misc. Coll., No. 507 (1883). (With an extensive list of literature on North American Coleoptera).

LENG, C. W. Catalogue of the Coleoptera of America North of Mexico. Mount Vernon, N. Y. J. D. Sherman (1920). (With a complete bibliography of the North American Coleoptera).

LENG, C. W. and A. J. MUTCHLER. Water Beetles (Dytiscidæ, Hydrophilidæ and Parnidæ) of Florida. Bull. American Mus. Nat. Hist., **38**, pp. 73–116 (1918).

LUCAS, R. Catalogus generum et subgenerum Coleopterorum. (Catalogue of such genera and subgenera as have been treated in the Genera Insectorum and the Catalogus Coleopterorum, Junk). Pt. 1, 696 pp., Berlin (1920).

REITTER, E. Fauna Germanica. Käfer. 5 vols., Stuttgart (1908–16).

REITTER, E. and others. Bestimmungs-Tabellen der europäischen Coleopteren. (About one hundred parts of this series have appeared in various journals. We are unable to cite them here, but references are contained in the Zoological Record and the Tierwelt Mitteleuropas.)

SCHEERPELTZ, O. and A. WINKLER. Coleoptera. In Tierwelt Mitteleuropas, **5**, Lief. 2, pp. XII 1–272 (1930).

SCHENKLING, S. and W. JUNK. Coleopterorum Catalogus. W. Junk, Berlin, (1910). (A complete synonymic catalogue of the Coleoptera of the World being published in parts by various authors. It is as yet incomplete and we have listed the parts separately).

SCHULTZE, W. A Catalogue of Philippine Coleoptera. Philippine Journ. Sci., **11D**, pp. 1–194 (1916).

SHARP, D., G. C. CHAMPION and others. Coleoptera. In Biologia centrali-Americana. 7 vols. (1887–1909).

SHARP, D. and PERKINS, R. C. L. Coleoptera. In Fauna Hawaiiensis, **2**, pt. 3 (1900).

WINKLER, A. Catalogus Coleopterorum regionis palæarcticæ, pts. 1–8. Vienna, Winkler and Wagner, 752 pp. (1924–28).

YAKOBSON, G. G. Key to Beetles of Russia (in Russian). Moscow and Leningrad Govt. Pub., 522 pp. (1927).

ADEPHAGA

AHLWARTH, K. Gyrinidæ. Coleop. Cat. Junk, pt. 21 (1910).

ANDREWES, H. E. Carabinæ. Fauna of British India, Carabidæ, **1** (1929).

ATKINSON, E. T. Catalogue of Oriental Carabidæ. Journ. Roy. Asiatic Soc., **58**, pp. 1–126 (1889).

BARBER, G. W. and W. O. ELLIS. Cupedidæ of North America. Journ. New York Entom. Soc., **28**, pp. 197–208 (1920).

BERTRAND, H. Les larves et nymphes des Dytiscides, Hygrobiides et Haliplides. Encycl. Entom., part 10, 366 pp. (1928).

CSIKI, E. Carabidæ, Carabinæ. Coleop. Cat. Junk, pts. 91 and 92 (1927).

Carabidæ, Mormolycinæ. Coleop. Cat. Junk, pt. 97 (1928).

Carabidæ, Harpalinæ. Coleop. Cat. Junk, pts. 97, 98, 104 (1928–29).

DESNEUX, J. Paussidæ. Gen. Insectorum, fasc. 35, 34 pp. (1905).

DUPIUS, P. Carabidæ, Metriinæ and Mystropominæ. Gen. Insectorum, fasc. 116, 4 pp. (1911).

Carabidæ, Apotominæ. Gen. Insectorum, fasc. 117, 4 pp. (1911).

Carabidæ, Psydrinæ. Gen. Insectorum, fasc. 123, 2 pp. (1911).

Carabidæ, Opisthiinæ. Gen. Insectorum, fasc. 126, 2 pp. (1912).

Carabidæ, Notiphilinæ. Gen. Insectorum, fasc. 134, 7 pp. (1912).

Carabidæ, Pentagonicinæ. Gen. Insectorum, fasc. 145, 4 pp. (1913).

Carabidæ, Peleciinæ. Gen. Insectorum, fasc. 146, 4 pp. (1913).

Carabidæ, Hexagoniinæ. Gen. Insectorum, fasc. 147, 4 pp. (1913).

GESTRO, R. Rhysodidæ. Coleop. Cat. Junk, pt. 1 (1910).

Cupedidæ, Paussidæ. Coleop. Cat. Junk, pt. 5 (1910).

GROUVELLE, A. Synopsis des Rhysodides. Rev. Entom., **22**, pp. 85–145 (1903).

HAYWARD, R. Revision of Bembidium of North America. Trans. American Entom. Soc., **24**, pp. 32–143 (1897).

Revision of North American Species of Tachys. Trans. American Entom. Soc., **26**, pp. 191–238 (1900).

HELLER, K. M. Fauna Sumatrensis. Jacobsoniidæ. Suppl. Entom., **15**, pp. 111–112 (1927); and ibid., **14**, p. 127 (1926).

HEYNES-WOOD, M. and C. DOVER. Cicindelidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 13 (1927).

HORN, W. Cicindelidæ. Coleop. Cat. Junk, pt. 86 (1926).

JEANNEL, R. Monographie der Bathysciinæ. Arch. Zool., **63**, pp. 1–436 (1924).

Monographie des Trechinæ. Abeille, **33**, pp. 1–592 (1926).

KOLBE, H. Die Paussiden Südamerikas. Entom. Mitteil., **9**, pp. 131–141; 145–156 (1920).

LA PONGE, G. V. Carabidæ, Carabinæ. Gen. Insectorum, fasc. 192, 289 pp. (1929–30).

LENG, C. W. Revision of Cicindelidæ of Boreal America. Trans. American Entom. Soc., **28**, pp. 93–186 (1902).

LENG, C. W. and W. BEUTENMÜLLER. Handbook of Cicindelidæ and Carabidæ of Northeastern America. Journ. New York Entom. Soc., **2**, **4** (1894–96). (Several parts).

MATHESON, R. The Haliplidæ of North America, North of Mexico. Journ. New York Entom. Soc., **20**, pp. 156–193 (1912).

NOTMAN, H. Review of Pseudomorphidæ and rearrangement of the Adephaga. Proc. U. S. Nat. Mus., **67**, art. 14, 34 pp. (1925).

OCHS, G. Gyrinidæ of the Philippine Islands. Philippine Journ. Sci., **24**, pp. pp. 81–86 (1924).

PERINGUEY, L. Revision of South African Carabidæ. Ann. South African Mus., **23**, pp. 579–659 (1926).

PESCHET, R. Dytiscidæ et Gyrinidæ des îles mascareignes. Ann. Soc. Entom. France, **86**, pp. 1–56 (1917).

RÉGIMBART, M. Monographie des Gyrinides. Ann. Soc. Entom. France (1882–83).

Gyrinidæ. Gen. Insectorum, fasc. 1, 12 pp. (1902).

ROESCHKE, H. Monographie der Tribus Cychrini (Carabidæ). Ann. Mus. Hist. Nat. Hungarici, **5**, pp. 9–277 (1907).

ROUSSEAU, E. Carabidæ, Anthiinæ. Gen. Insectorum, fasc. 39, 19 pp. (1906).

Carabidæ, Mormolycinæ. Gen. Insectorum, fasc. 40, 5 pp. (1906).

Omophronidæ. Gen. Insectorum, fasc. 83, 5 pp. (1908).

Carabidæ, Promecognathinæ. Gen. Insectorum, fasc. 84, 4 pp. (1908).

Carabidæ, Pamborinæ. Gen. Insectorum, fasc. 85, 3 pp. (1908).

Carabidæ, Lorocerinæ. Gen. Insectorum, fasc. 86, 4 pp. (1908).

SHARP, D. On aquatic Coleoptera or Dytiscidæ. Sci. Trans. Roy. Dublin Soc., (2), **2**, pp. 179–1003 (1882).

SLOANE, T. G. The Classification of the Family Carabidæ. Trans. London Entom. Soc., 1923, pp. 234–250 (1923).

VAN DORSSELAER, R. Dytiscidæ and Haliplidæ of Belgium. Bull. Soc. Entom. Belgique, **1**, pp. 68–119 (1919).

ZIMMERMANN, A. Die Schwimmkäfer des Deutschen entomologischen Museums, Berlin. Arch. f. Naturg., Jahrg. 83, pp. 68–249 (1917).

Amphizoidæ, Dytiscidæ, Haliplidæ and Hygrobiidæ. Coleop. Cat. Junk, pt. 71 (1920).

Die Halipliden der Welt. Entom. Blätt., **20**, pp. 1–16 et seq. (several parts) (1924).

HYDROPHILOIDEA

KNISCH, A. Die exotischen Hydrophiliden des Deutschen Entomologischen Museums. Arch. f. Naturg., Jahrg. 85A, Heft 8, pp. 55–88 (1923).

Hydrophilidæ. Coleop. Cat. Junk, pt. 79 (1924).

D'ORCHYMONT, A. Classification des Palpicornia. Ann. Soc. Entom. France, **88**, pp. 105–168 (1919) and Rev. Zool. Africaine, **6**, pp. 163–168 (1919).

Palpicornia. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 14 (1927).

RÉGIMBART, M. Revision des Grands Hydrophiles. Ann. Soc. Entom. France, 1902, pp. 188–232 (1902).

STAPHYLINOIDEA

BERNHAUER, M. and SCHUBERT, K. Staphylinidæ. Cat. Coleop. Junk, pts. 19, 29, 40, 57, 67, 82 (1910–26).

CAMERON, M. Indomalayan Staphylinidæ. (New Species of Staphylinidæ from Singapore with Catalogue). Trans. Entom. Soc. London, 1920, pp. 347–413 (1921).

Staphylinidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 6 (1925).

CASEY, T. L. Synopsis of Scaphidiidæ. Ann. New York Acad. Sci., **7**, pp. 281–606 (1893).

Synopsis of Scydmænidæ. Ann. New York Acad. Sci., **9**, pp. 285–548 (1897).

Synopsis (partial) of North American Pselaphidæ. Ann. New York Acad. Sci., **9**, pp. 550–630 (1897).

Revision of Pæderini (Staphylinidæ). Trans. Acad. Sci. St. Louis, **15**, pp. 17–248 (1905).

Partial Revision of Aleocharinæ and Xantholinini (Staphylinidæ). Trans. Acad. Sci., St. Louis, **16**, pp. 125–434 (1906).

CSIKI, E. Scaphidiidæ. Coleop. Cat. Junk, pt. 13 (1910).

Platypsyllidæ. Coleop. Cat. Junk, pt. 18 (1910).

Scydmænidæ. Coleop. Cat. Junk, pt. 70 (1919).

DESNEUX, J. Platypsyllidæ. Gen. Insectorum, fasc. 41, 9 pp. (1906).

FENYES, A. Staphylinidæ, Aleocharinæ. Gen. Insectorum, fasc. 173, 453 pp. (1918–1921).

HATCH, M. H. Studies on the Silphinæ. Journ. New York Entom. Soc., **35**, pp. 331–370 (1927).

Liodidæ, Clambidæ. Coleop. Cat. Junk, pt. 105 (1929).

HETSCHKO, A. Thorictidæ. Coleop. Cat. Junk, pt. 83 (1926).

HORN, G. H. Synopsis of the Silphidæ of the United States. Trans. American Entom. Soc., **8**, pp. 219–322 (1880).

Synopsis of the Dascyllidæ of the United States. Trans. American Entom. Soc., **8**, pp. 73–114 (1880).

JEANNEL, R. and M. H. HATCH. Silphidæ. Coleop. Cat. Junk, pts. 60 and 95 (1914).

JOHANSEN, J. P. Danish Staphylinidæ (in Danish). 600 pp. Copenhagen (1914).

Olsufier, G. Synopsis of Leptinidæ. Rev. Russe Entom., **18**, pp. 81–90 (1923).

Portevin, G. Revision des Necrophorini du Globe. Bull. Mus. Hist. Nat. Paris (1923–25). (Various parts).

Les grands Nécrophages du Globe. Encycl. Entom., pt. 6, 270 pp. (1926).

Raffray, A. Australian Pselaphidæ. Proc. Linn. Soc. New South Wales, **25**, pp. 131–249 (1900).

Pselaphidæ. Gen. Insectorum, fasc. 64, 487 pp. (1908).

Pselaphidæ. Coleop. Cat. Junk, pt. 27 (1911).

CUCUJOIDEA

Böving, A. G. Remarks on taxonomy of Cucujidæ. Zoologica, New York, **3**, pp. 197–221 (1921).

Casey, T. L. Revision of Cucujidæ of North America. Trans. American Entom. Soc., **11**, pp. 69–112 (1884).

Classification of Cucujidæ. Mem. Coleop., pt. 7, pp. 111 et seq. (1915).

Ritsema, C. Helotidæ. Coleop. Cat. Junk, pt. 34 (1911).

CANTHAROIDEA

Champion, G. C. Revision of Mexican and Central American Malachiidæ. Trans. London Entom. Soc., 1914, pp. 13–127 (1914).

Revision of Mexican and Central American Chauliognathinæ. Trans. London Entom. Soc., 1914, pp. 126–168 (1914).

Revision of the Mexican and Central American Telephoridæ. Trans. London Entom. Soc., 1915, pp. 16–146 (1915).

Chapin, E. A. Classification of the Philippine components of the Coleopterous Family Cleridæ. Philippine Journ. Sci., **24**, pp. 159–286 (1924).

Kleine, R. Die Lyciden der Philippinen-Inseln. Philippine Journ. Sci., **31**, pp. 33–109 (1926).

Coleoptera, Lycidæ. Nova Guinea, Leiden, **15**, pp. 91–195 (1926).

Leconte, J. L. Synopsis of Lampyridæ of the United States. Trans. American Entom. Soc., **9**, pp. 15–72 (1881).

Leng, C. W. and A. J. Mutchler. The Lycidæ, Lampyridæ and Cantharidæ of the West Indies. Bull. American Mus., **46**, pp. 413–499 (1922).

Olivier, E. Lampyridæ. Gen. Insectorum, fasc. 53, 74 pp. (1907).

Lampyridæ and Drilidæ. Coleop. Cat. Junk, pts. 9 and 10 (1910).

Pic, M. Étude des Malacodermes de l'Indochine. Fauna Indochine Français, fasc. 6, pp. 7–63 (1923).

Lampyridæ, Phengodinæ. Coleop. Cat. Junk, pt. 94 (1927).

Drilidæ (Karumiidæ). Coleop. Cat. Junk, pt. 94 (1927).

Dasytidæ, Melyrinæ. Coleop. Cat. Junk, pt. 103 (1929).

SCHENKLING, S. Cleridæ. Gen. Insectorum, fasc. 13, 124 pp. (1903).
Cleridæ. Coleop. Cat. Junk, pt. 23 (1910).
Lymexylidæ, Telegeusidæ and Micromalthidæ. Cat. Coleop. Junk, pt. 64 (1915).

MORDELLOIDEA

BLAIR, K. G. A Revision of the Pyrochroidæ. Ann. Mag. Nat. Hist., **13**, pp. 310–326 (1914).
South African Œdemeridæ. Ann. South African Mus., **23**, pp. 353–375 (1926).
Pythidæ and Pyrochroidæ. Coleop. Cat. Junk, pt. 99 (1928).
BORCHMANN, F. Eurystethidæ. Coleop. Cat. Junk, pt. 2 (1910).
Meloidæ and Cephaloidæ. Coleop. Cat. Junk, pt. 69 (1917).
CASEY, T. Synopsis of Anthicidæ of United States. Ann. New York Acad. Sci., **8**, pp. 624–838 (1895).
North American Cephaloidæ. Entom. News, **9**, pp. 193–195 (1898).
CSIKI, E. Rhipiphoridæ. Cat. Coleop. Junk, pt. 54 (1913).
Mordellidæ. Coleop. Cat. Junk, pt. 63 (1915).
HORN, G. H. Œdemeridæ of Boreal America. Proc. California Acad. Sci., (2), **6**, pp. 382–421 (1896).
MUTCHLER, A. J. and H. B. WEISS. Meloidæ of New Jersey. Circ. New Jersey State Dept. Agric., No. 76, 19 pp. (1924).
PIC, M. Euglenidæ. Gen. Insectorum, fasc. 8, 14 pp. (1902).
Euglenidæ. Coleop. Cat. Junk, pt. 14 (1910).
Pedilidæ. Coleop. Cat. Junk, pt. 26 (1911).
Anthicidæ. Coleop. Cat. Junk, pt. 36 (1911).
SCHENKLING, S. Œdemeridæ. Coleop. Cat. Junk, pt. 65 (1915).
SMITH, J. B. Synopsis of Mordellidæ of the United States. Trans. American Entom. Soc., **10**, pp. 73–100 (1882).
VAN DYKE, E. C. Genera of North American Meloidæ. Univ. California Publ. Entom., **4**, pp. 395–474 (1928).

ELATEROIDEA

BLANCHARD, F. Revision of North American Throscidæ. Trans. American Entom. Soc., **43**, pp. 1–26 (1917).
BONVOULOIR, H. Monographie des Eucnémides. Ann. Soc. Entom. France, (4), **10**, supplement, 907 pp. (1871–75).
BUYSSON, H. DU. Tableaux des Elateridæ de la faune francorhénane. Misc. Ent. Castanet-Tolosan, pp. 1–208 (1910–26).
CANDÈZE, E. DE. Monographie des Élatérides. 4 vols. and 3 suppl. Liège (1857–81).
CHAMBERLIN, W. J. Catalogue of the Buprestidæ of North America, North of Mexico. Corvallis, Oreg. 289 pp. (1926).

DALLA TORRE, K. W. Cebrionidæ. Coleop. Cat. Junk, pt. 25 (1911).
Cebrionidæ. Gen. Insectorum, fasc. 127, 17 pp. (1912).
FISHER, W. S. Revision of West Indian Buprestidæ. Proc. U. S. Nat. Mus., **65**, art. 9, pp. 1–207 (1925).
FLEUTHIAUX, E. Études sur les Mélasidæ. Ann. Soc. Entom. Belgique, **60**, pp. 93–104 (1920); **61**, p. 23, etc. (1921).
Catalogue raisonné des Mélasidæ des Îles Philippines. Ann. Soc. Entom. France, **95**, pp. 29–90 (1926).
HORN, G. H. Synopsis of Throscidæ of the United States. Trans. American Entom. Soc., **12**, pp. 198–208 (1885).
Monograph of Eucneminæ and Cerophytinæ of the United States. Trans. American Entom. Soc., **13**, pp. 5–38 (1886).
KERREMANS, C. Buprestidæ. Gen. Insectorum, fasc. 12, 338 pp. (1903).
Monographie des Buprestidæ. 7 vols. Brussels (1906–14).
KNULL, J. N. The Buprestidæ of Pennsylvania. Ohio Univ. Studies, **2**, No. 2, 71 pp. (1927).
OBENBERGER, J. Buprestidæ. Coleop. Cat. Junk, pt. 84 (1926).
Revision of Pachyseloides Trachides (Buprestidæ) of America. Sbornik Entom. Odd. Narod. Praze, **13** (20), pp. 3–149 (1925).
PIC, M. Rhipiceratidæ. Coleop. Cat. Junk, pt. 81 (1925).
SCHENKLING, S. Elateridæ. Coleop. Cat. Junk, pts. 80 and 88 (1925–27).
Plastoceridæ. Coleop. Cat. Junk, pt. 93 (1927).
Melasidæ. Coleop. Cat. Junk, pt. 96 (1928).
Cerophytidæ. Coleop. Cat. Junk, pt. 101 (1928).
SCHWARZ, O. Elateridæ. Gen. Insectorum, fasc. 46, 370 pp. (1906).
Plastoceridæ. Gen. Insectorum, fasc. 50, 10 pp. (1907).
Elateridæ, pt. Gen. Insectorum, fasc. 51, 4 pp. (1907).

DRYOPOIDEA

BARTHE, E. Dryopidæ. Misc. Entom., **30**, pp. 211–274 (1928).
CARTER, H. J. and E. H. ZECK. A Monograph of the Australian Dryopidæ. Australian Zool., **6**, pp. 50–72 (1929).
HORN, G. H. Synopsis of Heteroceridæ of the United States. Trans. American Entom. Soc., **17**, pp. 1–17 (1890).
ZAITZEV, P. Dryopidæ, Georyssidæ and Heteroceridæ. Coleop. Cat. Junk, pt. 17 (1910).

DASCYLLOIDEA

BORCHMANN, F. Alleculidæ. Coleop. Cat. Junk, pt. 3 (1910).
CARTER, H. J. Revision of the Australian Cistelidæ. Proc. Roy. Soc. Victoria, **28**, pp. 52–104 (1915).
CASEY, T. L. Synopsis of North American Cistelidæ. Ann. New York Acad. Sci., **6**, pp. 9–214 (1892).

Descriptive catalogue of American Byrrhidæ. Memoirs on the Coleoptera, No. 3, pp. 1–69 (1912).

DALLA TORRE, K. W. Byrrhidæ, Dermestidæ and Nosodendridæ. Coleop. Cat. Junk, pt. 33 (1911).

FALL, H. C. Revision of Ptinidæ of Boreal America. Trans. American Entom. Soc., **31**, pp. 97–296 (1905).

GROUVELLE, A. Byturidæ. Coleop. Cat. Junk, pt. 56 (1913).

JAYNE, H. F. Revision of Dermestidæ of the United States. Proc. American Philos. Soc., **20**, pp. 343–377 (1882).

MUTCHLER, A. J. and H. B. WEISS. New Jersey Dermestidæ. Circ. New Jersey Dept. Agric., No. 108, 31 pp. (1927).

PIC, M. Ptinidæ. Coleop. Cat. Junk, pt. 41 (1912).

Dascillidæ and Helodidæ. Coleop. Cat. Junk, pt. 58 (1914).

WESTWOOD, J. O. Description of a new genus of Coleopterous insects. (Gnostidæ). Trans. Entom. Soc. London (n.s.) **3**, pp. 90–94 (1854).

HISTEROIDEA

BICKHARDT, H. Histeridæ. Coleop. Cat. Junk, pt. 24 (1910).

Histeridæ, part. Gen. Insectorum, fasc. 166a, 112 pp. (1916).

HETSCHKO, A. Synteliidæ. Coleop. Cat. Junk, pt. 83, (1926).

HORN, G. H, Synopsis of Histeridæ of the United States. Proc. American Philos. Soc., **13**, pp. 237–360 (1873).

PORTEVIN, G. Les Liodides de l'Inde. Encycl. Entom., Ser. B, Coleoptera, **1**, pp. 75–83 (1926).

COLYDIOIDEA

ARROW, G. J. Contribution to classification of the Coleopterous family Endomychidæ. Trans. Entom. Soc. London, 1920, pp. 1–83 (1920).

BELON, R. P. Classification des Lathridiidæ. Rev. Entom. 1897, pp. 105–221 (1897).

Récapitulation des Lathridiidæ de l'Amérique méridionale. Ann. Soc. Lyon, **46**, pp. 137–192 (1900).

Lathridiidæ. Gen. Insectorum, fasc. 3, pp. 40 (1902).

BRÈTHES, J. Coccinellides du British Museum, avec une nouvelle famille (Cerasommatidiidæ). An. Mus. Hist. Nat. Buenos Aires, **33**, pp. 195–214 (1925).

CASEY, T. L. Synopsis of Phalacridæ. Ann. New York Acad. Sci., **5**, pp. 39–185 (1891).

Revision of American Coccinellidæ. Journ. New York Entom. Soc., **7**, pp. 71–163 (1899).

Review of American Corylophidæ, Cryptophagidæ, Tritomidæ and Dermestidæ. Journ. New York Entom. Soc., **8**, pp. 51–172 (1900).

CHATTERJEE, S. N. Nitidulidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 5 (1924).

CSIKI, E. Endomychidæ. Coleop. Cat. Junk, pt. 12 (1910).

Discolomidæ, Orthoperidæ, Phænocephalidæ and Sphæriidæ. Coleop. Cat. Junk, pt. 18 (1910).

Hydroscaphidæ and Ptiliidæ. Coleop. Cat. Junk, pt. 32 (1911).

DALLA TORRE, K. W. Ciidæ. Coleop. Cat. Junk, pt. 30 (1911).

FALL, H. C. Revision of the Lathridiidæ of Boreal America. Trans. American Entom. Soc., **25**, pp. 101–190 (1899).

FOWLER, W. W. Languriidæ. Gen. Insectorum, fasc. 78, 45 pp. (1908).

GROUVELLE, A. Nitidulidæ. Coleop. Cat. Junk, pt. 56 (1913).

GUI, H. L. Coccinellidæ of Kansas. Proc. Kansas Entom. Soc., **1**, pp. 26–37 (1928).

HELLER, K. M. Erotyliden der indo-australischen Region. Arch. Naturg., Jahrg. 84A, Heft 8, pp. 1–121 (1920).

HETSCHKO, A. Catapochrotidæ and Monœdidæ. Coleop. Cat. Junk, pt. 83 (1926).

Lathridiidæ. Coleop. Cat. Junk, pt. 85 (1926).

HORN, G. H. Revision of Bostrychidæ and Colydiidæ of the United States. Proc. American Philos. Soc., **17**, pp. 555–592 (1878).

Synopsis of the Monotomidæ of the United States. Trans. American Entom. Soc., **7**, pp. 257–267 (1879).

Revision of Nitidulidæ of the United States. Trans. American Entom. Soc., **7**, pp. 267–336 (1879).

KRAUS, E. J. and A. D. HOPKINS. Revision of Holarctic Lyctidæ. Bull. U. S. Dept. Agric., Bur. Entom., Tech. Ser. No. 20, pp. 111–138 (1911).

KUHNT, P. Erotylidæ. Gen. Insectorum, fasc. 88, 139 pp. (1909).

Erotylidæ. Coleop. Cat. Junk, pt. 34 (1911).

LESNE, P. Revision des Bostrychides. Ann. Soc. Entom. France, 1896, pp. 95–127 and several later parts (1896–1906).

Les Bostrychides de l'Afrique tropicale française. Encycl. Entom. pt. 3, 301 pp. (1924).

LEVEILLE, A. Temnochilidæ. Coleop. Cat. Junk, pt. 11 (1910).

MATTHEWS, A. Monograph of Trichopterygidæ, 188 pp. London (1872).

Synopsis of North American Trichopterygidæ. Trans. American Entom. Soc., **11**, pp. 113–156 (1884).

Monograph of Corylophidæ and Sphæriidæ. London (1899).

MEQUIGON, A. Rhizophagidæ. Coleop. Cat. Junk, pt. 61 (1914).

PIC, M. Anobiidæ. Coleop. Cat. Junk, pt. 48 (1912).

SCHENKLING, S. Derodontidæ. Coleop. Cat. Junk, pt. 64 (1915).

Cryptophagidæ. Coleop. Cat. Junk, pt. 76 (1923).

Languriidæ. Coleop. Cat. Junk, pt. 100 (1928).

Throscidæ. Coleop. Cat. Junk, pt. 10 (1928).

ZAITZEV, P. Cyathoceridæ. Coleop. Cat. Junk, pt. 17 (1910).

TENEBRIONOIDEA

BLAISDELL, F. E. Revision of the Tribe Eleodini of U. S., Lower California and Adjacent Islands. Bull. 63, U. S. Nat. Mus., 524 pp. (1909).

BORCHMANN, F. Elactidæ, Lagriidæ, Nilionidæ, and Petriidæ. Coleop. Cat. Junk, pt. 2 (1910).

Die Lagriinæ. Arch. Naturg., Jahrg. 81A, Heft 6, pp. 46–186 (1916).

Die Amerikanischen Gattungen und Arten der Statirinæ (Lagriidæ). Arch. Naturg., Jahrg. 87A, Heft 1, pp. 216–357 (1921).

CARTER, H. J. Catalogue of Australian Tenebrionidæ. Australian Zoölogist, **4**, pp. 117–163; 280; 294 (1926).

CASEY, T. L. Revision of American Tentyrinæ (Tenebrionidæ). Proc. Washington Acad. Sci., **9**, pp. 275–522 (1907).

Revision of American Coniontinæ (Tenebrionidæ). Proc. Washington Acad. Sci., **10**, pp. 51–166 (1908).

CHATANAY, J. Tenebrionidæ, Zophosinæ. Gen. Insectorum, fasc. 176, 50 pp. (1921).

CSIKI, E. Melandryidæ. Coleop. Cat. Junk, pt. 77 (1924).

GEBIEN, H. Tenebrionidæ and Trictenotomidæ. Coleop. Cat. Junk, pts. 15, 22, 28, 37 (1910–11).

Monographie der südamerikanischen Camarien (Tenebrionidæ). Arch. f. Naturg. Jahrg. 83A, pt. 3, pp. 25–167 (1919).

Tenebrionidæ of Southwest Africa. Abh. Hamburg Univ., **5**, pp. 1–168 (1920).

Ueber einige Gruppen amerikanischen Tenebrioniden. Stettiner Entom. Zeitg., **89**, pp. 169–170 (1928).

HETSCHKO, A. Cossyphodidæ. Coleop. Cat. Junk, pt. 83 (1926).

HORN, G. H. Revision of the Tenebrionidæ of North America. Trans. American Philos. Soc., **14**, pp. 253–404 (1870).

Synopsis of North American Lagriidæ. Trans. American Entom. Soc., **15**, pp. 26–48 (1888).

PIC, M. Scraptiidæ. Coleop. Cat. Junk, pt. 26 (1911).

POUILLADE, J. Revision of Trictenotomidæ. Insecta, Rennes, **4**, pp. 243–251 (1914).

REITTER, E. Subfamilies and tribes of palæarctic Tenebrionidæ. Wiener Entom. Zeitg., **36**, pp. 53–66 (1917).

SEMENOV, A. Synopsis of Platyopinæ (Tenebrionidæ). Horæ Soc. Entom. Rossicæ, **38**, pp. 175–184 (1907).

CERAMBYCOIDEA

ACHARD, J. Lamprosomatidæ. Gen. Insectorum, fasc. 159, 13 pp. (1914).

Chrysomelidæ, Chlamydinæ and Sphærocarinæ. Gen. Insectorum, fasc. 160, 25 pp. (1914).

AURIVILLIUS, C. and A. LAMEERE. Cerambycidæ (*s. lat*). Coleop. Cat. Junk, pts. 39, 73, 74 (1912–1923).

BOPPE, P. Cerambycidæ *s. lat.*, part; Disteniinæ and Lepturiinæ. Gen. Insectorum, fasc. 178, 121 pp. (1921).

CLAVAREAU, H. Chrysomelidæ *s. lat.* Coleop. Cat. Junk, pt. 59 (1914).

CRAIGHEAD, F. C. Larvæ of the Prioninæ. Rept. No. 107, Office of Secretary, U. S. Dept. Agric., 24 pp. (1915).

Classification of Larvæ of North American Cerambycidæ. Bull. Canada Dept. Agric. Entom., No. 23, 238 pp. (1923).

HANSEN, V. Chrysomelidæ and Lariidæ. Danmarks Fauna, **31**, pp. 1–279, Copenhagen (1927).

HORN, G. H. Revision of the Bruchidæ of the United States. Trans. American Entom. Soc., **4**, pp. 311–342 (1873).

Synopsis of the Halticinæ of North America. Trans. American Entom. Soc., **16**, pp. 163–320 (1889).

The Eumolpinæ of Boreal America. Trans. American Entom. Soc., **19**, pp. 195–234 (1892).

The Galerucinæ of Boreal America. Trans. American Entom. Soc., **20**, pp. 57–136 (1893).

JACOBY, M. Sagridæ. Gen. Insectorum, fasc. 14, 11 pp. (1903).

Chrysomelidæ. Fauna of British India, Coleoptera, 534 pp. (1908).

JACOBY, M. and H. CLAVAREAU. Donaciidæ. Gen. Insectorum, fasc. 21 (1904).

Crioceridæ. Gen. Insectorum, fasc. 23, 40 pp. (1904).

Megascelidæ. Gen. Insectorum, fasc. 32, 6 pp. (1905).

Megalopodidæ. Gen. Insectorum, fasc. 33, 20 pp. (1905).

Clytridæ. Gen. Insectorum, fasc. 49, 88 pp. (1907).

LAMEERE, A. Prionidæ. Coleop. Cat. Junk, pt. 52 (1913). Gen. Insectorum, fasc. 172, 189 pp. (1919).

LENG, C. W. Synopsis of Nearctic Cerambycidæ. Bull. Brooklyn Entom. Soc., **7**, and Entomologica Americana, **1–6** (1884–1900) (various parts).

Revision of Donaciidæ of Boreal America. Trans. American Entom. Soc., **18**, pp. 159–176 (1891).

LENG, C. W. and J. HAMILTON. The Lamiidæ of North America. Trans. American Entom. Soc., **23**, pp. 101–178 (1896).

MAULIK, S. Hispidæ and Cassididæ. Fauna of British India, Coleoptera, Chrysomelidæ (1919).

Chrysomelidæ and Halticidæ. Fauna of British India, 442 pp. (1926).

PIC, M. Bruchidæ. Coleop. Cat. Junk, pt. 55 (1913).

PLANET, L. M. Histoire naturelle des Longicornes de France. Encycl. Entom. Sér. A, 2. 386 pp. (1924), also suppl. 53 pp. (1927).

SCHAEFFER, C. Revision of the New World Donaciini. Brooklyn Mus. Sci. Bull., **3**, 165 pp. (1925).

SPAETH, F. Cassididæ. Coleop. Cat. Junk, pt. 62 (1914).

Fauna sumatrensis, Cassidinæ. Supplementa Entom., **13**, pp. 1–108 (1926).

SWAINE, J. S. and R. HOPPING. Lepturini of North America. Pt. I. Bull. Nat. Mus. Canada, No. 52, 79 pp. (1928).

WEBB, J. L. A Preliminary Synopsis of Cerambycoid Larvæ. Tech. Ser., 20, pt. 5, Bur. Entom. U. S. Dept. Agric. (1912).

WEISE, J. Hispidæ. Coleop. Cat. Junk, pt. 15 (1911).

Chrysomelidæ. Coleop. Cat. Junk, pt. 68 (1916).

Galerucidæ. Coleop. Cat. Junk, pt. 78 (1924).

Hispidæ. Gen. Insectorum, fasc. 125, 124 pp. (1911).

CURCULIONOIDEA AND SCOLYTOIDEA

BLACKMAN, M. W. North American Scolytidæ, Subfamily Micracinæ. Bull. Mississippi Agric. Expt. Sta., Tech. Ser. No. 10 (1921).

Revision of Pityophthori of North America. Bull. New York Coll. Forestry, Syracuse, Tech. Pub. No. 25 (1928).

BLATCHLEY, W. S. and C. W. LENG. The Rhyncophora or Weevils of Northeastern America. Nature Pub. Co. (1916).

BOVIE, A. Curculionidæ, Entiminæ. Gen. Insectorum, fasc. 69, 7 pp. (1908).

Curculionidæ, Cryptoderminæ. Gen. Insectorum, fasc. 70, 3 pp. (1908).

Curculionidæ, Alcidinæ. Gen. Insectorum, fasc. 71, 11 pp. (1908).

Curculionidæ, Læmosaccinæ. Gen. Insectorum, fasc. 89, 6 pp. (1909).

Curculionidæ, Gymnetrinæ. Gen. Insectorum, fasc. 92, 19 pp. (1909).

Curculionidæ, Nanophyinæ. Gen. Insectorum, fasc. 98, 11 pp. (1910).

Curculionidæ, Brachycerinæ. Gen. Insectorum, fasc. 99, 38 pp. (1910).

CHITTENDEN, F. H. Classification of Nut Curculios of North America. Entom. Americana, **7**, pp. 129–207 (1926).

DALLA TORRE, K. W. Aglycyderidæ and Proterhinidæ. Coleop. Cat. Junk, pt. 31 (1911).

DIETZ, W. G. Revision of North American Anthonomini. Trans. American Entom. Soc., **18**, pp. 177–276 (1891).

Revision of Ceutorhynchini of North America. Trans. American Entom. Soc., **23**, pp. 387–480 (1896).

FALL, H. C. Revision of North American Species of Apion. Trans. American Entom. Soc., **25**, pp. 105–184 (1898).

HAGEDORN, M. Ipidæ. Gen. Insectorum, fasc. 111, 178 pp. (1910). Coleop. Cat. Junk, pt. 4 (1910).

HOPKINS, A. D. Monograph of Pissodes. Bull. U. S. Dept. Agric. Tech. Ser., No. 20, 68 pp. (1911).

Monograph of Scolytidæ. Bull. U. S. Dept. Agric., Tech. Ser. No. 17, pt. 1 (1909); pt. 2 (1915).

Classification of Cryphalinæ. Rept. 99, U. S. Dept. Agric. (1915).

HUSTACHE, A. Curculionides de Madagascar. Bull. Acad. Malgache, Tananarive, **7**, pp. 1–582 (1924).

JORDAN, K. Les Anthribides de l'Indochine. Faune Entom. Indochine française, fasc. 6, pp. 71–113 (1923).

KLEINE, R. Die Brenthiden der Nederländischen Ost-Indischen Kolonien. Capita Zool., **2**, pt. 4, 86 pp. (1926).

Brenthidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 11 (1926).

Die Brenthiden. Nova Guinea, Leiden, **15**, pp. 214–274 (1926).

Brenthidæ. Coleop. Cat. Junk, pt. 89 (1927).

Bestimmungstabelle der Brenthidæ. Ent. Zeit. Frankfort-am-M., **40-42** (1927–28). (In several parts).

LEA, A. M. and A. BOVIE. Curculionidæ, Belinæ. Gen. Insectorum, fasc. 91, 13 pp. (1909).

MARSHALL, G. A. K. Curculionidæ. Fauna of British India, Coleoptera (1916).

MURAYAMA, J. On the Platypodidæ of Formosa. Journ. Coll. Agric., Hokkaido Imp. Univ., **15**, pp. 197–236 (1925).

PAPE, P. Curculionidæ, Brachycerinæ. Coleop. Cat. Junk, pt. 16 (1910).

PETRI, K. Monograph of Palæarctic Hyperini. 208 pp., Berlin (1901).

PIERCE, W. D. Weevils of the Superfamily Curculionoidea. Proc. Entom. Soc. Washington, **21**, pp. 21–36 (1919).

SCHENKLING, S. and G. A. K. MARSHALL. Curculionidæ, part. Coleop. Cat. Junk, pt. 106 (1929).

SCHÖNFELDT, H. Brenthidæ. Gen. Insectorum, fasc. 65, 88 pp. (1908); Coleop. Cat. Junk, pt. 7 (1910).

SMITH, J. B. Synopsis of Apioninæ of North America. Trans. American Entom. Soc., **11**, pp. 41–68 (1884).

STROHMEYER, H. Platypodidæ. Coleop. Cat. Junk, pt. 44 (1912).

Chapuisiidæ. Gen. Insectorum, fasc. 162, 6 pp. (1914).

Platypodidæ. Gen. Insectorum, fasc. 163, 55 pp. (1914).

SWAINE, J. W. Catalogue of North American Scolytidæ. Rept. New York State Entom., No. 24, pp. 76–159 (1909).

Classification of Canadian Bark-beetles. Bull. Canada Dept. Agric. Entom., No. 14, pp. 7–143 (1918).

VOSS, E. Die Unterfamilien Attelabinæ und Apoderinæ. Stettiner Entom. Zeitg., **85**, pp. 1–78; 191–304 (1925).

WAGNER, H. Curculionidæ, Apioninæ. Gen. Insectorum, fasc. 130, 109 pp. (1912).

Curculionidæ, Apioninæ. Coleop. Cat. Junk, pt. 6 (1910).

WOLFRUM, P. Anthribidæ. Coleop. Cat. Junk, pt. 102 (1929).

SCARABÆOIDEA

ARROW, G. J. Fauna of British India. Lamellicornia (Cetoniidæ, Dynastidæ, Rutelinæ, in Fauna British India, **1** (1910–17).

Acanthoceridæ, Glaphyridæ, Hybosoridæ, Ochodæidæ, Orphnidæ, Pleocomidæ and Trogidæ. Coleop. Cat. Junk, pt. 43 (1912).

Notes on the Coleopterous Families Hybosoridæ and Trogidæ. Ann. Mag. Nat. Hist. (9) **15**, pp. 328–331 (1925).

BOUCOMOUT, A. Geotrupidæ. Gen. Insectorum, fasc. 7, 20 pp. (1902).
Geotrupidæ. Coleop. Cat. Junk, pt. 46 (1912).
BROWN, W. J. Revision of North American Ægialiidæ. Canadian Entom., **63**, pp. 9–19 (1931).
DALLA TORRE, K. W. Melolonthidæ. Coleop. Cat. Junk, pts. 45, 47, 49, 50 (1912–13).
DAWSON, R. W. Scarabæidæ of Nebraska. Univ. of Nebraska Studies, **22**, pp. 1–82 (1922).
FALL, H. C. Synopsis of Ochodæidæ of the United States. Journ. New York Entom. Soc., **17**, pp. 30–38 (1909).
FUCHS, C. Synopsis of Lucanidæ of United States. Bull. Brooklyn Entom. Soc., **5**, pp. 49–52; 57–60 (1882).
GILLET, J. J. E. Scarabæidæ, *s. str.* Coleop. Cat. Junk, pt. 38 (1911).
GRAVELY, F. H. Passalidæ. Mem. Indian Mus., **7**, pp. 1–144 (1918).
HORN, G. H. Monograph of Aphodiinæ of the United States. Trans. American Entom. Soc., **14**, pp. 1–110 (1887).
HOULEBERT, C. and E. MONNOT. Faune entomologique amoricaine, Coléoptères. Lamellicornes. Trav. Sci. Univ. Rennes, **13**, pp. 1–171 (1915).
LEA, A. M. Australian Scarabæidæ, *s. str.* Rec. South Australian Mus., **2**, pp. 353–396 (1923).
MOREIRA, C. Insectos Coleópteros Passalideos do Brazil. Fauna brasiliense, N. S. No. 1, 52 pp. (1925).
OHAUS, J. Euchiridæ, Rutelidæ and Phænomeridæ. Coleop. Cat. Junk, pt. 66 (1918).
OLSONFIEFF, G. Les Phanæides. Insecta, **13**, pp. 5–202 (1924).
PIC, M. Eucinetidæ. Coleop. Cat. Junk, pt. 58 (1914).
ROON, G. VAN. Lucanidæ. Coleop. Cat. Junk, pt. 8 (1910).
SCHENKLING, A. Cetoniidæ. Coleop. Cat. Junk, pt. 72 (1921).
Trichiidæ. Coleop. Cat. Junk, pt. 75 (1922).
SCHMIDT, A. Aphodiidæ. Gen. Insectorum, fasc. 110, 155 pp. (1910).
Aphodiidæ. Coleop. Cat. Junk, pt. 20 (1910).
Ægialiidæ. Coleop. Cat. Junk, pt. 42 (1912).
Scarabæidæ (*s. lat.* part) Ægialiinæ, Chironinæ, Dynamopinæ, Hybosorinæ, Idiostominæ, Ochodæinæ, Orphninæ. Gen. Insectorum, fasc. 150, 87 pp. (1913).
Aphodiidæ. Das Tierreich. Lief. 45, 333 pp. (1922).

ORDER **STREPSÍPTERA**

(*RHIPÍPTERA*)

Small species parasitic on other insects, the adult males winged and free-living, but the larviform females never leaving the body of their host. Male with the head free. Eyes well developed, sphæroidal, provided with large, highly convex; separated facets. Antennæ with three

to seven joints, one or several of the joints prolonged into a long, lateral process (flabellum). Mouthparts reduced; mandibles often soft or minute; maxillæ fleshy; labium not developed. Prothorax greatly reduced in size, usually ring-like; mesothorax small, strongly transverse; metathorax very large. Fore wings reduced to small club-shaped appendages; hind wings very large and delicate, with a few, fine radiating veins, but without crossveins. Legs rather weak; the coxæ, especially of the front and middle legs very minute; tarsi with from five to two joints; often with the claws absent. Female with the mouthparts and antennæ vestigial; legs and wings absent; head and thorax fused into one strongly flattened piece; sexual openings in the form of segmental, usually unpaired canals opening on several of the abdominal segments. Metamorphosis complete; larvæ undergoing hypermetamorphosis with an active long-legged first stage larva or triungulin; female remaining larviform in the reproductive stage.

1. Tarsi of male five-jointed, with two claws; pro- and mesothorax short, transverse; female unknown. (Superfamily MENGEÒIDEA) 2

   Tarsi of male with four joints or less and without claws 3

2. Antennæ seven-jointed, the third and fourth joints prolonged laterally; metathoracic præscutum transverse, reaching the humeri and lying entirely in front of the other dorsal plates of the metathorax; scutellum broadly rounded in front, longer than the præscutum. (Fig. 886). (**Triozócera**, nearc., neotrop.; **Méngea**, oligocene (fossil)) ..... **MENGÈIDÆ**

   Antennæ six-jointed, third, fourth and fifth joints prolonged laterally; sixth elongate; metathoracic præscutum transverse-quadrate, not reaching the humeri, depressed and forming a sort of neck; lateral lobes of scutum reaching the metathorax; scutellum very long, narrowed and rounded in front. (**Mengenílla**, palæarc.; **Austrostỳlops**, austr.; **Tetrozócera**, palæarc.) ..... **MENGENÍLLIDÆ**

3. Thoracic spiracles of female more or less distinct, usually prominent; tarsi of male with four joints (so far as known); species parasitic on Orthoptera, Hymenoptera, Hemiptera and Homopætera 4

   Thoracic spiracles of female not usually discernible, never prominent; tarsi of male with two or three joints; parasites of Homoptera 9

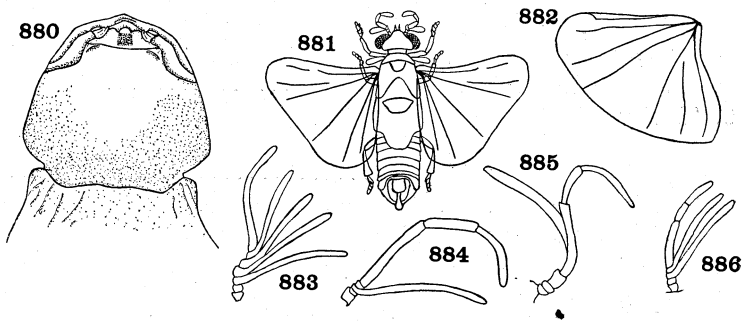
4. Female with three longitudinal rows of genital tubes entering the brood canal; males unknown; parasites of Orthoptera.

(Superfamily STICHOTREMATÒIDEA). (**Stichótrema,** austr.) ..... **STICHOTREMÁTIDÆ**

Female with a single median series of four or five genital tubes entering the brood canal; tarsi of male four-jointed; pro- and mesothorax short, transverse; parasites of Hymenoptera and Hemiptera. (Superfamily XENÒIDEA) 5

5. Cephalothorax of female narrow, elongate, with two pairs of spiracles; five genital tubes. Males unknown; parasites of Hemiptera. (**Callipharíxenos, Chrysochoríxenos,** indomal.) **CALLIPHARIXÉNIDÆ**

Cephalothorax of female broader, with only one pair of spiracles; parasites of Hymenoptera 6



Figs. 880–886. **Strepsiptera**

880. **Xenos,** head of female (Brues) Xenidæ.
881. **Stylops,** male (Pierce) Stylopidæ.
882. **Xenos,** wing of male (Kirby) Xenidæ.
883. **Anthericomma,** antenna of male (Pierce) Halictophagidæ.
884. **Cænocholax,** antenna of male (Pierce) Myrmecolacidæ.
885. **Parastylops,** antenna of male (Pierce) Stylopidæ.
886. **Triozocera,** antenna of male (Pierce) Mengeidæ.

6. Scutellum broadly rounded in front 7

Scutellum more or less broadly truncate, pedunculate in front ... 8

7. Scutellum shorter than the præscutum; antennæ seven-jointed, the third joint prolonged laterally, fourth short, fifth to seventh elongate. Female unknown; parasitic on ants. (Fig. 884). (**Myrmécolax,** ind.; **Cænócolax,** neotrop.) **MYRMECOLÁCIDÆ**

Scutellum longer than the præscutum; antennæ six-jointed, the third joint prolonged laterally. Cephalothorax of female

broadly truncate or rounded at apex; head almost half as wide as the metathorax at spiracles; five genital tubes. (Figs. 881, 885). Parasites of bees. (**Stỳlops, Neostỳlops,** holarc.; **Katastỳlops,** nearc.; **Parastỳlops,** ind.) ..... **STYLÔPIDÆ**

8. Præscutum as broad as the mesothorax at base; antennæ five-jointed, the third joint prolonged laterally; fourth very short; fifth long. Cephalothorax of female with the head not more than half as wide as the metathorax at spiracles. Parasites of bees. (**Hylêcthrus,** palæarc.) ..... **HYLÉCHTHRIDÆ**

Præscutum not as broad as the mesothorax at base; antennæ four-jointed, the third joint prolonged laterally; fourth joint elongate. Cephalothorax of female variable in shape; four or five genital tubes. Parasites of wasps and bees. (Figs. 880, 882). (**Xènos,** palæarc., Am.; **Pseudóxenos, Eupathócera,** holarc.; **Vespáxenos,** indoaustr.; **Halictóphilus,** ind.; **Belonogastéchthrus,** ethiop.; **Hómilops,** Am.). ..... **XÉNIDÆ**

9. Tarsi of male three-jointed; head of female lobed apically; only two genital tubes entering the brood canal. (Superfamily HALICTOPHAGÒIDEA) 10

Tarsi of male two-jointed; head of female with the tubercles ventral, more or less obsolete; three genital tubes entering the brood canal. (Superfamily ELENCHÒIDEA). (**Elénchus,** neotrop., ethiop., austr.; **Dinelénchus,** austr.; **Liburnelénchus, Elenchòides, Pentagrammáphila,** nearc.). **ELÉNCHIDÆ**

10. Antennæ of male four-jointed, the flagellum of the third and the fourth joint elongate, subequal. (**Diozócera,** palæarc.). **DIOZOCERÁTIDÆ**

Antennæ of male seven-jointed, the third, fourth, fifth and sixth joints prolonged laterally and the seventh elongate. (Fig. 883). (**Anthericómma, Agalliáphagus,** nearc.; **Pentozócera,** neotrop.; **Halictóphagus, Delphacíxenos,** palæarc., **Tettigóxenos,** ethiop.; **Muiríxenos,** indomal.; **Pentacladócera,** austr.) ..... **HALICTOPHÁGIDÆ**

LITERATURE ON STREPSIPTERA

LENG, C. W. Catalogue of N. American Strepsiptera. See Leng, Cat. Coleop., pp. 343–345 (1920).

PIERCE, W. D. A Monographic Revision of the Twisted-Winged Insects Comprising the Order Strepsiptera. Bull. U. S. Nat. Mus., No. 66 (1909). Strepsiptera. Gen. Insectorum, fasc. 121, 54 pp. (1911).

The Comparative Morphology of the Order Strepsiptera, together with Records and Descriptions of Insects. Proc. U. S. Nat. Mus., **54**, pp. 391–501 (1918).

ULRICH, W. Strepsiptera, In Tierwelt Mitteleuropas, **5**, Lief. 1, pp. XIII 1–26 (1930).

ORDER **HYMENÓPTERA**

Moderate-sized, small or minute, rarely very large; four membranous wings, the fore pair larger and more completely veined; venation rather complete but not complex, sometimes greatly reduced; head free, mandibulate, but the mouthparts usually adapted for lapping liquid food; antennæ variable, sometimes with very many or very few joints, in the higher forms usually with twelve or thirteen joints; eyes usually moderately large; ocelli nearly always present; prothorax not free; legs similar; tarsi nearly always five-jointed; abdomen usually with six or seven visible segments, the first segment fused with the thorax and not forming a part of the apparent abdomen; no cerci; ovipositor usually sting-like, sometimes saw-like, occasionally greatly elongate.

Metamorphosis complete; larvæ caterpillar-like in the more primitive families, legless in the higher forms; pupæ free, sometimes enclosed in a cocoon. Habits varied, phytophagous, predatory, or parasitic. Saw-flies, Wood-wasps, Ichneumon-flies, Ants, Wasps and Bees.

There is no close agreement concerning the family divisions in the Chalastogastra, especially in the higher forms and it is probable that the future will see changes in the grouping of the Diprionidæ and Tenthredinidæ. Among the Terebrantia there is less difference of opinion. The Ichneumonidæ and Braconidæ include many diverse types and are of greater rank than most of the other families, but attempts to divide them have not been satisfactory. The wasps and bees on the other hand have been separated into families on far less important characters. Among the more primitive wasps, some of the family divisions are undoubtedly artificial and must be regarded as tentative only.

Adults

1. Abdomen broadly sessile, attached over a large area (Fig. 887); trochanters two-jointed (Fig. 896); hind wing with three basal cells. Suborder CHALASTOGÁSTRA (*SÝMPHYTA, SESSILIVÉNTRES, PHYTÓPHAGA, BOMBÓPTERA*) 2

   Abdomen petiolate or subpetiolate, sharply constricted at the base,

never broadly sessile (Figs. 891, 916, 935); trochanters one- or two-jointed; hind wing with less than three basal cells. Suborder CLISTOGÁSTRA (*APÓCRITA, PETIOLÀTA*) 15

2. Fore wings with three radial cells, *i.e.* two radial crossveins present; antennæ many-jointed, but with the three basal joints strongly developed, the third very long. (**Xyèla**, holarc.; **Odontóphyes, Macroxyèla**, nearc.) (Fig. 892).. **XYÉLIDÆ**

Fore wings with only one or two radial cells; third antennal joint only rarely lengthened 3

3. Costal cell divided by a distinct longitudinal vein (the subcosta); antennæ slender, becoming very thin apically, many-jointed; radial cell with one crossvein. (**Pamphílius** (=*Lýda*), **Neurótoma, Bactróceros**, holarc.). (*LÝDIDÆ*)... **PAMPHILÌIDÆ**

Costal cell not divided by a longitudinal vein 4

4. Anterior tibiæ with a single apical spur. (Wood-wasps). Superfamily SIRICÒIDEA 5

Anterior tibiæ with two apical spurs. (Saw-flies). (Superfamily TENTHREDINÒIDEA) 8

5. Fore wings with only one closed cubital cell and one recurrent nervure; antennæ ten- or eleven-jointed, inserted much below the lower margin of the eyes, beneath a frontal ridge; vertex strongly tuberculate. (**Orýssus** (=*Orússus*), Eur., N. Am., Austr.; **Ophrynòpus**, Austr., S. Am.). (*IDIOGÁSTRA, ORYSSÒIDEA, ORÚSSIDÆ*) ..... **ORÝSSIDÆ**

Fore wings with two or three closed cubital cells; antennæ inserted above the lower margin of the eyes; two recurrent nervures; antennæ variable. (Figs. 888, 890) 6

6. Pronotum nearly truncate or weakly emarginate behind, its anterior portion not forming a vertical surface; abdomen more or less compressed. (Fig. 888). (**Cèphus**, holarc. (*C. pygmæus*, Wheat-stem Saw-fly); **Jànus**, holarc.) ..... **CÉPHIDÆ**

Pronotum deeply incurved or emarginate behind, its anterior part forming a more or less vertical surface; abdomen cylindrical 7

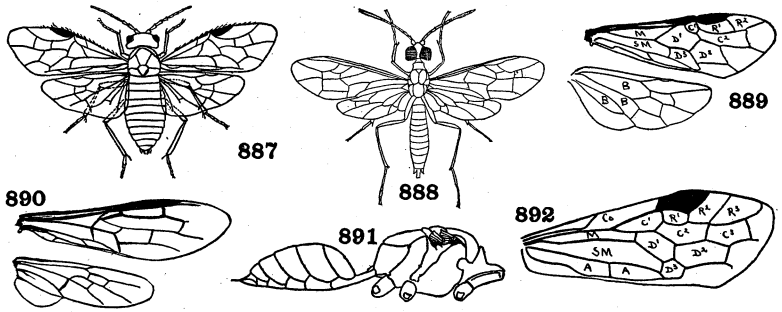
7. Parapsidal furrows present; fore wings with a crossvein (Sc) in the costal cell; no triangular plate at the apex of the abdomen; prothorax conical, the pronotum a narrow collar. (**Xiphýdria**, widespr.) ..... **XIPHYDRÌIDÆ**

Parapsidal furrows absent; fore wings without a crossvein in the costal cell; apex of the abdomen with a triangular or spear-shaped plate; prothorax subquadrate, the pronotum longer.

Horntails. (**Trèmex,** cosmop.; **Sìrex, Urócerus, Xèris,** holarc.). (Fig. 890). (*UROCÉRIDÆ*) ..... **SIRÍCIDÆ**

8. Posterior margin of the pronotum straight or nearly so; mesonotum very short, never extending much behind the anterior margins of the tegulæ. (**Megalodóntes,** palæarc.). **MEGALODÓNTIDÆ**

Posterior margin of the pronotum strongly curved, mesonotum longer, extending well behind the anterior margin of the tegulæ 9



Figs. 887–892. **Hymenoptera**

887. **Cladius** (Chittenden) Tenthredinidæ.
888. **Cephus** (Marlatt) Cephidæ.
889. **Dolerus,** wings: M, median cell; R1, R2, marginal or radial cells; C1, C2, cubital or submarginal cells; D1, D2, D3, first, second and third discoidal cells; SM, submedian cell; B1, B2, B3, basal cells. Tenthredinidæ.
890. **Tremex,** wings. Uroceridæ.
891. **Chlorion,** lateral view of thorax and abdomen (Fernald) Sphecidæ.
892. **Xyela,** fore wing. Lettering as in fig. 889; Co, costal cell; A, A, anal cells (MacGillivray) Xyelidæ.

9. Antennæ clavate; transverse median and basal veins interstitial; abdomen more or less swollen or globose 10

Antennæ not clavate; filiform, serrate, or pectinate 11

10. Radial cell divided by a crossvein (Fig. 889); abdomen angled laterally so that the tergites are sharply divided into a dorsal and ventral surface; abdomen of female strongly globose. (**Címbex, Trichiosòma,** holarc.) ..... **CIMBÍCIDÆ**

Radial cell not divided; abdomen rounded laterally, not angled

or carinate; abdomen not greatly swollen. (**Pérga, Xylopérga,** Austr.) ..... **PÉRGIDÆ**

11. Antennæ with only three joints, the third very long, sometimes split in the male. (**Árge** (= *Hylótoma*), widespr.; **Labidárge,** S. Am.; **Schizócera,** Eur., Am.). (*HYLOTÓMIDÆ*). **ÁRGIDÆ**

Antennæ with four or more joints 12

12. First discoidal cell petiolate above, *i.e.* the cubitus arising from the basal vein; antennæ four-jointed, the third joint very long. (**Blasticótoma,** one European species). **BLASTICOTÓMIDÆ**

First discoidal cell almost never petiolate above, the cubitus arising beyond the basal vein; antennæ with at least six joints 13

13. Radial cell simple, without a crossvein 14

Radial cell divided by a crossvein (Fig. 889); antennæ commonly filiform, rarely with some of the joints toothed or with projections, with at least seven and usually with nine joints. Cosmopolitan but scarce in the tropics. (**Monophadnòides** (*M. rùbi,* Raspberry sawfly); **Eriocampòides** (*E. limacìna*; *E. ceràsi,* Pear-slugs); **Ametastègia** (*A. glabràta,* Dock sawfly); **Hoplocámpa** (*H. cooki,* Cherry fruit sawfly); **Tenthrèdo, Tenthredélla, Dólerus, Macròphya, Selándria, Émphytus, Fenùsa,** holarc.) ..... **TENTHREDÍNIDÆ**

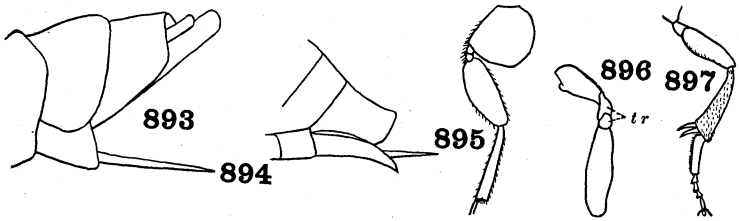
14. Antennæ filiform, nine-jointed. (**Pachynématus, Pteronídea** (= *Ptéronus*), holarc., (*P. ribèsi,* Currant sawfly), **Pontània** (Willow gall sawflies); **Nématus** (*N. erichsònii,* Larch sawfly); **Diphádnus** (*D. appendiculàtus,* Gooseberry sawfly). (*NEMATÌNÆ*) ..... Some **TENTHREDÍNIDÆ**

Antennæ of a different conformation; usually many-jointed, frequently serrate or pectinate, rarely six-jointed. (**Diprìon,** (=*Lophyrus*) (Pine sawflies)), holarc.; **Perreyia,** neotrop.; **Pterygóphorus,** Austr.; **Acordulécera,** Am.). (Including *PERREYIDÆ, PTERYGOPHÓRIDÆ, LOBOCERÁTIDÆ*). (*LOPHÝRIDÆ*) ..... **DIPRIÓNIDÆ**

15. Last abdominal sternite divided longitudinally, the ovipositor issuing some distance before the tip of the abdomen (Fig. 893) and provided with a pair of narrow sheaths which equal it in length. Trochanter divided into two distinct joints, except in some forms without stigma; fore wing either with or without a costal cell. (TEREBRÁNTIA) 16

Last abdominal sternite not divided longitudinally, the ovipositor issuing from the tip of the abdomen as a sting (rarely absent) without a pair of exserted sheaths (Fig. 894). Trochanter consisting of a single joint (Fig. 897), or if rarely divided, the second part is very closely attached to and not distinctly separated from the femur (except Trigonalidæ); fore wing always (except Rhopalosomatidæ) with a costal cell. Ants, Wasps and Bees. (ACULEATA) 63

16. Winged 17
Wingless or with the wings greatly reduced in size 49



Figs. 893–897. **Hymenoptera**

893. **Ichneumon,** apex of abdomen, with ovipositor. Ichneumonidæ.
894. **Epeolus,** apex of abdomen, with ovipositor. Melectidæ.
895. **Elasmus,** basal segments of leg (Silvestri) Elasmidæ.
896. **Ichneumon,** basal segments of leg; tr. two-jointed trochanter (Sharp) Ichneumonidæ.
897. Hind leg of a bee (Riley).

17. Fore wings with a stigma which is usually triangular or rarely very slender or linear (Fig. 900); costal vein well developed as far as the stigma; abdomen usually with the sternites membranous and with a median fold; antennæ usually with more than sixteen joints; wing venation ordinarily well developed. Ichneumon-flies. (ICHNEUMONÒIDEA) (*TRÍSTEGA*) 18
Fore wings without a stigma, the marginal vein if present linear, not swollen to form a stigma; costal vein much thinner than the subcostal (Sc + R) (Figs. 906, 907); abdomen with the ventral surface hard and chitinous, without a median fold; antennæ with never more than eighteen joints and rarely more than thirteen; wings with very incomplete venation 30
18. Costal and subcostal (Sc + R) veins separated, enclosing a narrow costal cell; abdominal sternites chitinized (Figs. 904, 905) .. 19
Costal and subcostal veins confluent, no costal cell (Fig. 900) .. 26

19. Mesonotum with a sharp median groove or linear furrow; notauli absent; abdomen elongate oval; body more or less cylindrical; ovipositor prominent, usually extremely long. (**Megályra,** Austr.; **Dinápsis,** S. Afr.). (Including *DINÁPSIDÆ*).
MEGALÝRIDÆ

Mesonotum without median groove; or if with a median impressed area, also with notauli 20

20. Abdomen inserted on the thorax, far above the hind coxæ, commonly on a nipple-shaped protuberance; antennæ with 13 or 14 joints 21

Abdomen inserted normally, low down, at the apex of the thorax, and quite close to the hind coxæ 23

21. Fore wing with two recurrent nervures; two more or less completely closed cubital cells, the second one sometimes partly open, due to a partial loss of the apical intercubitus. (Fig. 904). (**Aùlacus, Pristaùlacus,** cosmop.; **Pammegíschia,** N. Am.).
AULÁCIDÆ

Fore wing with one or no recurrent nervure; only one distinctly closed cubital cell, or none 22

22. Prothorax long, forming an elongate neck; abdomen long, gradually clavate; radial cell of fore wing long, pointed. (Fig. 905). (**Gasterúption,** cosmop.; **Pseudofœnus, Hemifœnus,** Austr.)
GASTERUPTIÓNIDÆ

Prothorax short; body of abdomen short, orbicular, borne on a narrow cylindrical pedicel; radial cell short and broad, or absent. (**Evània,** cosmop.; **Brachygáster,** Eur., **Hýptia,** Am.).
EVANÌIDÆ

23. Two or three closed cubital cells 24

Only one closed cubital cell, or none 25

24. Antennæ with 18 joints or more; head large, quadrate. (See couplet 83) ..... **TRIGONÁLIDÆ**

Antennæ with 12 or 13 joints. (See couplet 89).
RHOPALOSOMÁTIDÆ

25. Antennæ setaceous, multiarticulate, with 30 joints or more; abdomen long and slender; ovipositor long; hind femora swollen and toothed before the apex; head tuberculate above. (**Stéphanus,** cosmop.; **Hemistéphanus,** S. A., Austr.; **Diastéphanus,** As., Afr., Austr.) ..... **STEPHÁNIDÆ**

Antennæ 14-jointed; abdomen long and slender; ovipositor very short; hind femora without teeth; head not tuberculate above. (If the body of the abdomen is compressed, rounded (♀) or

broadly ovate (♂), borne on a slender cylindrical petiole, compare Roproniidæ, couplet 73.) (**Monómachus**, S. Am., Austr.; **Tetracònus**, S. Am.) ..... **MONOMÁCHIDÆ**

26. Mandibles widely separated, not meeting when closed, the tips concave, the teeth curving outward instead of inward. (**Dacnûsa, Phænocárpa, Aphæreta, Alýsia,** cosmop.; **Lysiógnatha**, N. Am.). (Including *LYSIOGNÁTHIDÆ*). **ALYSÌIDÆ**

Mandibles attached normally, their tips opposed and meeting when closed 27

27. Ventral abdominal segments soft and membranous, with a median fold 28

Ventral abdominal segments hard, heavily chitinized; scutellum armed with a sharp spiniform process. (**Agriótypus**, holarc.). **AGRIOTÝPIDÆ**

28. Fore wing with two recurrent nervures (except *Ophionellus* and *Hymenopharsalia*); first cubital and first discoidal cells not separated; all the abdominal segments freely movable, except in very rare cases. (Figs. 893, 896, 898, 902). A very large cosmopolitan family. (Including *OPHIONÉLLIDÆ, MYERSÌIDÆ*). This family is commonly divided into a number of subfamilies, but as the current classification involves many exceptions and appears to be highly artificial, a key to these would serve no useful purpose, and be of little practical value. **ICHNEUMÓNIDÆ**

Fore wing with only one, or without any recurrent nervure (Fig. 900); usually with the second and third abdominal segments immovably united above 29

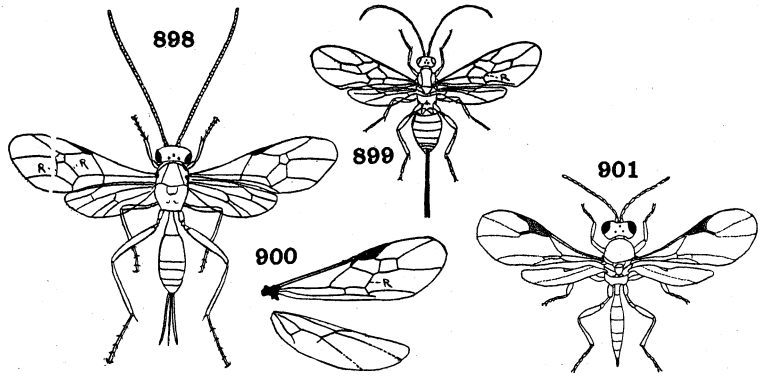
29. Abdomen extremely slender, three times as long as the head and thorax together, the segments freely movable; tip of propodeum prolonged beyond the hind coxæ. (**Hymenopharsàlia, Ophionéllus**, Am.). (See couplet 28). A few **ICHNEUMÓNIDÆ**

Abdomen shorter; propodeum not thus prolonged; venation sometimes considerably reduced. A large cosmopolitan family. (Including *APHIDÌIDÆ, CAPITONÌIDÆ, PACHYLOMÁTIDÆ, NEORHACÓDIDÆ*) ..... **BRACÓNIDÆ**

a. Clypeus semicircularly emarginate below and forming with the mandibles a more or less circular opening or cavity ..... b

Clypeus not emarginate below, or at most with a broad, shallow emargination, not forming with the mandibles such an opening i

b. Abdomen sessile, sometimes with the base considerably narrowed, but the first segment not forming a distinct petiole.....c
Abdomen petiolate, the first segment greatly lengthened, at least three times as long as broad at apex, and often very long and slender with the remainder of the abdomen suddenly much wider; antennæ usually very slender. (**Spàthius,** widespr.; **Stephaníscus, Ogmophásmus,** ethiop.; **Psenóbolus,** neotrop.; **Cantharóctonus,** nearc.). (Including *STEPHANISCÌNÆ*) ..... **SPATHIÌNÆ**



Figs. 898–901. **Hymenoptera**

898. **Cryptus,** R, R, recurrent nervures. Ichneumonidæ.
899. **Microbracon** (Hunter and Hinds) Braconidæ.
900. **Rhogas,** wings, R, recurrent nervure. Braconidæ.
901. **Lysiphlebus.** Braconidæ.

c. Head behind with the occiput, temples and cheeks rounded, without marginal line.....d
Head behind with a distinct carinate, raised marginal line which is always distinct on the sides although sometimes more or less obsolete either above or below.....e

d. Nervulus (transverse median nervure) originating just basal to the basal vein or at the same point, rarely slightly further toward the apex of the wing; usually large species, often with colored wings. (Fig. 899). (**Vípio, Microbràcon** (including **Habrobràcon**), **Iphiaulax, Glyptomórpha,** cosmop.; **Cheloneogástra,** ethiop., indomal.; **Platybràcon,** indomal.; **Gastrothèca,** ethiop.). (Including *APHRASTOBRACONÌNÆ*) (*BRACONÌNÆ,* auctt.) ..... **VIPIÌNÆ**

Nervulus originating well beyond the lower end of the basal vein. (**Exothècus**, widespr.; **Spinària**, ethiop., indomal.; **Mesobràcon**, ethiop.) ..... **EXOTHECÌNÆ**

e. Fore wings with three submarginal cells, all completely formed; very rarely without wings ..... f

Fore wings with only two submarginal cells, the first sometimes incompletely formed; females occasionally wingless ..... h

f. Head cubical, large, and bulging behind the eyes, rarely slightly transverse. (**Dorýctes, Dendrosòter, Odontobràcon**, widespr.) ..... **DORYCTÌNÆ**

Head clearly transverse, usually much wider than long; not widened or bulging behind the eyes ..... g

g. Subdiscoidal vein arising at the upper corner of the second discoidal cell, forming a continuous line with the upper edge of this cell. (**Hormìus, Hormiópterus**, widespr.; **Chrémylus**, palæarc.) ..... **HORMIÌNÆ**

Subdiscoidal vein originating from the outer side of the second discoidal cell which is angulate at the point of origin, this vein lying below the level of the upper side of the cell. (Fig. 900). (**Rhògas**, cosmop.; **Rhýssalus, Clinocéntrus; Gyroneùron**, ethiop., indomal.) ..... **RHOGADÌNÆ**

h. Head, when seen from above, large, cubical; abdominal tergites almost always very clearly separated; female always winged; hind wing of male often with a stigma-like thickening on the costal margin. (**Hecábolus, Ēcphylus**, holarc.; **Heterospìlus**, widespr.) ..... **HECABOLÌNÆ**

Head, when seen from above, strongly transverse, much wider than long; sutures of abdomen obsolete above except at the base; female commonly wingless; hind wing of male without false stigma. (**Pámbolus**, widespr.) ..... **PAMBOLÌNÆ**

i. Abdomen with the tergites separated by distinct sutures, all the tergites beyond the third freely movable; if rarely all are fused, the abdomen is strongly clavate ..... j

Abdomen with the tergites fused to form a rigid dorsal shell or carapace which is either entirely without sutures or with these indicated only as fine grooves ..... w

j. Abdomen sessile or subsessile; if the first segment is rarely elongate its lateral margins are straight; venation of wings not reduced . k

Abdomen petiolate, wing venation often much reduced in the smaller species x

k. Marginal cell either very narrow, or incompletely formed with the radial vein weak or wanting apically; second submarginal cell usually small or imperfectly formed l

Marginal cell never much narrowed, second submarginal cell large and fully formed ..... p

l. Marginal cell very narrow, the radial vein almost always distinct to the tip ..... m
Marginal cell not narrow, more or less incompletely formed apically ..... n

m. Palpi very short; tarsi long, slender, with minute or very indistinct claws. Minute species parasitic on ants. **Neoneùrus, Elasmosòma,** holarc.) ..... **NEONEURÌNÆ**
Palpi long, well developed; tarsi not unusually lengthened, with large, often toothed or pectinate claws. (**Bràcon** (=*Crémnops*), **Disòphrys, Ágathis, Mícrodus, Órgilus,** cosmop.; **Braunsia.** ethiop., indomal.; **Eárinus,** widespr.). (*AGATHIDÌNÆ, AGATHÌNÆ*) ..... **BRACONÌNÆ**

n. Second submarginal cell minute or incompletely formed; marginal cell wanting except at extreme base. ..... o
Second submarginal cell large, although more or less weakly defined apically; apical part of marginal cell weakly defined, but the cell is clearly marked by a strongly curved and very delicately chitinized vein. (**Cardiochìles,** widespr.; **Toxoneùron,** Am.; **Laminitársus,** malay.) ..... **CARDIOCHILÌNÆ**

o. Radial vein consisting of two nearly equal sections with the stub of a third. (**Neorhacòdes,** palæarc.). This group is by some placed in the Ichneumonidæ ..... **NEORHACODÌNÆ**
Radial vein composed of only a single basal section. (**Microgáster, Apantèles, Microplìtis,** cosmop.; **Mìrax,** widespr.; **Oligoneùrus,** neotrop.) ..... **MICROGASTRÌNÆ**

p. Fore wings with three submarginal cells. ..... q
Fore wings with only two submarginal cells. ..... u

q. Legs long and slender, the spurs of the hind tibiæ often very long; body usually slender with the abdomen elongate; head strongly transverse. (**Macrocéntrus,** cosmop.; **Zèle,** palæarc., Am.; **Aulacocéntrum, Austrozèle,** Australas.; **Amicrocéntrum,** ethiop.; **Neozèle,** neotrop.) ..... **MACROCENTRÌNÆ**
Legs not long and slender, femora stout; abdomen usually stout and short, rarely elongate; tibial spurs not elongate; head large and thick in all forms with elongate abdomen ..... r

r. Abdomen inserted low down on the propodeum, between the hind coxæ; usually small or minute species ..... s
Abdomen inserted distinctly above the hind coxæ; abdomen often elongate; head large, cubical, often with the vertex deeply impressed; rather large or moderate-sized species. (**Hélcon, Gymnóscelus, Aspicólpus,** widespr.; **Eumacrocéntrus,** nearc.; **Austrohélcon, Schauinslándia,** Austr.; **Cenocœlius,** widespr.). (Including *CENOCŒLIÌNÆ*) ..... **HELCONÌNÆ**

s. Marginal cell very short, its upper margin no longer than the

stigma. (**Ichneùtes**, holarc.; **Próterops**, widespr.; **Ichneutídea, Proteropòides**, nearc.) ..... **ICHNEUTÌNÆ**

Marginal cell long, much longer than the stigma.....t

t. Head above not margined; anal cell of fore wing without trace of a crossvein; clypeus often shallowly emarginate, leaving an elliptical opening between the mandibles when closed; second submarginal cell often much shorter above than below. (**Òpius**, cosmop.; **Biósteres, Diachásma, Eurýtenes**, widespr.; **Rhinòplus**, ethiop.) ..... **OPIÌNÆ**

Head margined above; anal cell of fore wing often with an incomplete crossvein; clypeus not emarginate, fitting close to the mandibles when closed; second submarginal cell rarely noticeably shortened above. (**Diospìlus**, widespr.; **Dyscolètes**, holarc.; **Eudiospìlus, Neodiospìlus**, ethiop.). **DIOSPILÌNÆ**

u. Second discoidal cell not completely closed below at apex, the posterior part of its outer side without the usual vein. (**Brachístes** (=*Calýptus*), **Eubádizon**, widespr.). (*CALYPTÌNÆ*). **BRACHISTÌNÆ**

Second discoidal cell completely closed below at apex by a vein..v

v. Last section of radial vein curved, marginal cell very short, not nearly extending to the wing tip. (**Leìophron, Centístes**, holarc.; **Centistìna**, ethiop.) ..... **LEIOPHRONÌNÆ**

Last section of radial vein straight, the marginal cell long, extending almost to the tip of the wing. (**Blàcus**, widespr.; **Pygóstolus**, holarc.) ..... **BLACÌNÆ**

w. Fore wings with three cubital cells. (**Chelònus, Chelonélla, Phanerótoma, Ascogáster**, cosmop.; **Sphæropyx**, palæarc.; **Minánga, Pachychelònus**, ethiop.) ..... **CHELONÌNÆ**

Fore wings with two closed cubital cells. (**Triáspis** (=*Sigálphus*), cosmop.). (*SIGALPHINÆ*)..... **TRIASPIDÌNÆ**

x. Hind wings with two closed basal cells, the second sometimes incomplete.....y

Hind wings with only one, or without any closed basal cell....aa

y. Fore wings with three submarginal cells, the second one always completely closed, their venation not reduced.....z

Fore wings with only two submarginal cells; venation usually much reduced, the radial cell usually short. (**Eùphorus**, holarc.; **Perilìtus, Dinocámpus**, widespr.; **Eustalócerus, Cosmóphorus**, holarc.) ..... **EUPHORÌNÆ**

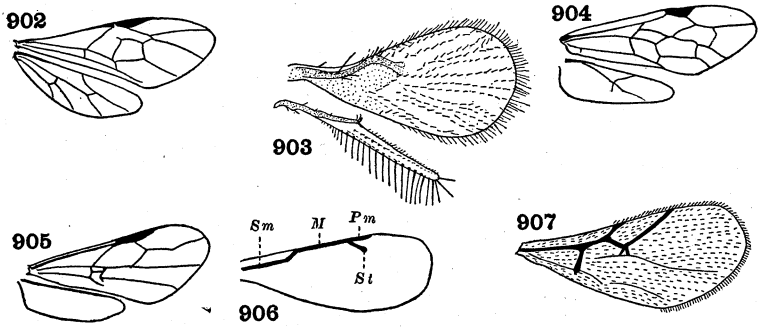
z. Second submarginal cell about as long as high; antennæ long and slender, filiform; abdominal tergites separated by sutures. (**Meteòrus**, cosmop.) ..... **METEORÌNÆ**

Second submarginal cell much longer than high; antennæ 18-jointed, the joints toward the apex bead-like; second tergite

covering the whole abdomen beyond the petiole. (**Helorimórpha,** widespr.) ..... **HELORIMORPHÌNÆ**

aa. Abdomen inserted low down on the propodeum, between the hind coxæ; fore wings with one, two, or rarely three submarginal cells, the cubitus if present, not arising from the marginal cell. (Fig. 901). (**Aphídius** (=*Íncubus*), **Pràon, Éphedrus, Trióxys,** widespr.; **Lysíphlebus,** holarc.). (*INCUBÌNÆ*). **APHIDIÌNÆ**

Abdomen inserted high up on the propodeum, above the level of the hind coxæ; fore wings with two submarginal cells, the cubitus arising from the narrow, triangular marginal cell. (**Paxylómma** (=*Pachylómma*) ..... **PAXYLOMMATÌNÆ**



Figs. 902–907. **Hymenoptera**

902. **Ophion,** wings. Ichneumonidæ.
903. **Trichogramma,** wings (Girault) Trichogrammatidæ.
904. **Aulacus,** wings. Aulacidæ.
905. **Gasteruption,** wings. Gasteruptionidæ.
906. Chalcid fly, fore wing, diagrammatic. *Sm*, submarginal vein; *M*, marginal vein; *Pm*, postmarginal vein; *St*, stigmal vein.
907. Gall wasp, fore wing, diagrammatic (Kieffer).

30. Sides of the pronotum extending back to the tegulæ; antennæ not elbowed; marginal cell present, more or less complete. (Fig. 907). Gall wasps. (*CYNIPÒIDEA*) 31

Pronotum not extending back to the tegulæ (Fig. 910); antennæ more or less distinctly elbowed, often enlarged apically, the basal joint usually much elongated. (Fig. 906). Chalcis-flies. (CHALCIDÒIDEA) 33

31. Dorsal abdominal plates meeting along the venter and completely enclosing all the ventral plates, except sometimes a part of the

hypopygium. Parasitic species, cosmopolitan. (**Eucòila, Allótria**) ..... **FIGÍTIDÆ**

Dorsal abdominal plates usually extending well down on the sides of the abdomen, but not meeting along the venter; all, or nearly all of the ventral plates visible.....32

32. Basal joint of the hind tarsi twice as long as the others united, second joint with a long process externally which reaches to the tip of the fourth joint; abdomen greatly compressed, curved like a pruning knife, much longer than the remainder of the body. Parasitic species. (**Ibàlia,** Eur., N. Am.). **IBALÏIDÆ**

Basal joint of hind tarsi much shorter; second joint simple, without process. Mostly gall-making species, almost entirely holarc. (**Aulacídea, Diástrophus, Rhodìtes, Disholcáspis, Amphíbolips**)..... **CYNÍPIDÆ**

33. Hind wings exceedingly narrow, linear, the base forming a long stalk; ovipositor issuing barely before the tip of the abdomen; antennæ with the scape not greatly elongated, usually swollen and compressed and without ring joint; very minute species with long wing fringe; widespread in distribution. (**Polynèma, Gonatócerus, Aláptus, Ánaphes**) ..... **MYMÁRIDÆ**

Hind wings never very narrow, not linear nor with a long stalk at the base; ovipositor issuing decidedly before the tip of the abdomen; antennæ elbowed (Figs. 909, 912, 913) with long scape and usually with from one to three minute ring joints; wing fringe almost always much shorter.....34

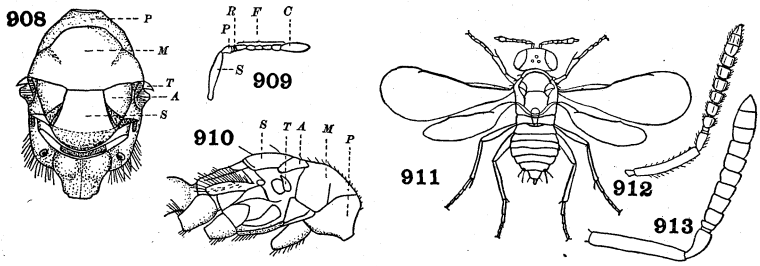
34. Tarsi five-jointed (rarely four-jointed or less in certain wingless males); axillæ with their anterior margins forming a more or less straight line, their sides not extended in front of the tegulæ (Fig. 908); spur of front tibia strong, curved.....35

Tarsi three- or four-jointed (five-jointed or heteromerous only in the females of one or two genera); axillæ extended strongly and obliquely forward at the sides, well in advance of the tegulæ (Fig. 910); spur of front tibia usually weak.....47

35. Head of female long, oblong, with a deep longitudinal groove above; front and hind legs very stout, the middle ones very much more slender; males almost always wingless, with stout, short, three- to nine-jointed antennæ. (Fig. 917). Tropicopolitan. Fig-insects. (**Blastóphaga** (*B. psènes* = *grossòrum*, Fig caprifier), tropicopolitan; **Ágaon, Ceratosòlen,** Old World; **Tétrapus,** neotrop.; **Pleistodóntes,** Austr.). . **AGAÓNTIDÆ**

Of a different conformation.....36

36. Mesopleura rarely large, with an oblique femoral groove or impression; spur of middle tibia normal, not enlarged.....37
Mesopleura large, entire; flat, without femoral groove in the female and usually in the male; spur of middle tibia usually very large and stout, often fringed with minute spines internally. An extremely varied, abundant, cosmopolitan group. (**Eupélmus, Anástatus, Metapélma, Encýrtus, Ageniáspis, Copidosòma, Signíphora**). (Including *EUPÉLMIDÆ, SIGNIPHÓRIDÆ,* and *TANAOSTIGMÁTIDÆ*).
ENCÝRTIDÆ



Figs. 908–913. **Hymenoptera**

908. **Pteromalus,** thorax from above. *P*, pronotum; *M*, mesonotum; T, tegula; *A*, axilla; *S*, scutellum. Pteromalidæ.
909. Chalcid fly, diagram of antenna. *P*, pedicel; *R*, ring-joints; *F*, funicle; *C*, club; *S*. scape.
910. **Eulophus,** thorax seen from side. Lettering as in Fig 908. Eulophidæ.
911. **Coccophagus** (Howard) Eulophidæ.
912. **Dibrachys,** antenna of female. Pteromalidæ.
913. **Dibrachys,** antenna of male. Pteromalidæ.

37. Hind tibiæ with two apical spurs.....38
Hind tibiæ with a single apical spur; ovipositor rarely long; mandibles with three or four teeth at apex; small black, bronzed, or metallic species. (Figs. 908, 912, 913). A large cosmopolitan family. (**Pterómalus, Díbrachys, Nasònia, Diglòchis, Pachyneùron, Spalángia**). (Including *SPALANGÌIDÆ*).
PTEROMÁLIDÆ

38. Mandibles sickle-shaped, usually with one or two teeth within; thorax greatly elevated; scutellum usually much enlarged and produced behind; abdomen compressed, usually on a long,

slender pedicel, the second segment very large. (Fig. 920). Cosmopolitan, but almost entirely tropical. (**Kápala, Orasèma, Schizaspídia, Thoracántha, Stílbula**).

EUCHARÍDIDÆ

Mandibles strong and stout, generally with three or four teeth at apex; thorax not or very slightly elevated; axillæ separated from the mesonotum 39

39. Hind coxæ very large, long, five or six times larger than the front ones 40

Hind coxæ never very large, not conspicuously larger than the front ones 44

40. Hind coxæ more or less triangular in cross-section, sharply ridged above; hind femora usually simple, rarely swollen and with a tooth beneath; if denticulate beneath, the ovipositor is long. . 41

Hind coxæ cylindrical, long 42

41. Notauli present, ovipositor exserted, usually very long; abdomen not coarsely pitted or punctured. Cosmopolitan. (**Callimòme** (=*Tórymus*), **Diámorus, Monodontomèrus, Podágrion, Megastígmus** (Seed chalcids), **Idárnes**). (*TORÝMIDÆ*).

CALLIMÓMIDÆ

Notauli absent or obsolete; ovipositor hidden; abdomen of female conical, elongate, usually with rows of deep pits or large punctures. Mainly Eur. and N. Am. (**Ormyrus, Tribæus**).

ORMÝRIDÆ

42. Hind femora greatly swollen, and toothed or denticulate beneath, their tibiæ curved and oblique at apex; prothorax not elongate or narrowed 43

Hind femora not swollen, simple; all the legs very long and slender; abdomen extremely long and slender; prothorax much elongated, forming a narrow neck; ovipositor very long. S. Am. and Austr. (**Leptofœnus** (=*Pelecinélla*)). (*PELECINÉLLIDÆ*).

LEPTOFŒNIDÆ

43. Fore wings folded longitudinally in repose; ovipositor long, curving upwards and forward over the dorsum of the abdomen. (**Leucóspis**, cosmop.; **Polistomórpha**, S. Am.; **Epexochlænòides**, Ind.-Austr.) ..... **LEUCOSPÍDIDÆ**

Fore wings not folded; ovipositor only very rarely long, and then not thus upcurved; tip of abdomen sometimes drawn out as a slender stiff process. (Fig. 914). Cosmopolitan, more abundant in the tropics. (**Chálcis, Phasgonóphora, Spilochálcis, Smìcra, Haltichélla, Dirrhìnus**) ..... **CHALCÍDIDÆ**

44. Pronotum wide, quadrate, not or scarcely narrower than the mesonotum; mesonotum usually very coarsely sculptured. . . 45
Pronotum narrower, usually much narrowed in front or transverse linear, rarely as wide as the mesonotum; mesonotum usually finely sculptured 46

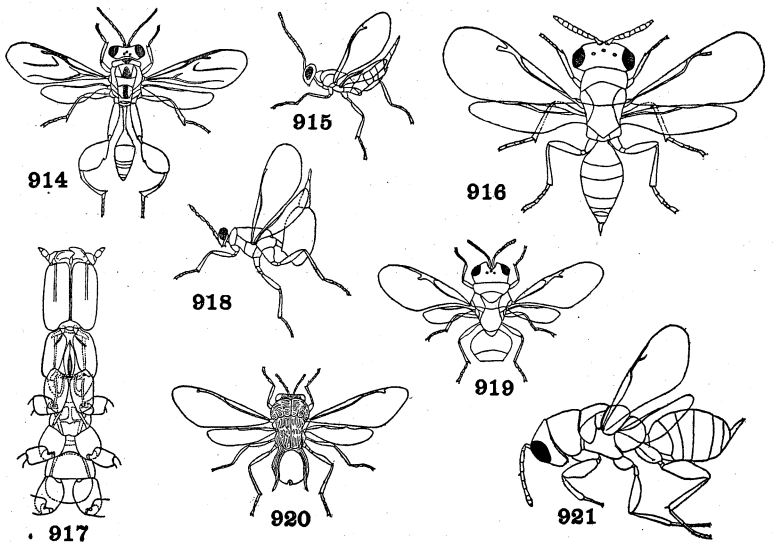
45. Abdomen rounded or ovate, more or less compressed, second tergite never very large; the hypopygium usually produced in the female; black or yellowish species. Cosmopolitan. (**Harmolìta** (=*Isosòma*) (Joint-worms), **Eurýtoma, Decátoma, Áxima, Bruchóphagus, Rìleyia**). (Figs. 916, 921).
EURYTÓMIDÆ
Abdomen small, subtriangular, the second, or fused second and third tergite covering most of its surface; thorax very large; short, metallic or submetallic species. (Fig. 919). (**Perilámpus**, cosmop.; **Trichilogáster**, Austr.; **Chrysolámpus**, N. Am., Eur.) . . . . . **PERILÁMPIDÆ**

46. Mesepisternum not large and triangular; none of the femora noticeably swollen; small bronzed or green species. (**Semiotéllus, Lamprótatus, Miscogáster**, cosmop.; **Lèlaps**, Am.). (Including *TRIDÝMIDÆ*) . . . . . **MISCOGÁSTRIDÆ**
Mesepisternum large and triangular; either the front or hind femora more or less swollen, and sometimes serrate; usually of metallic color. (Fig. 915). (**Chalcodéctus**, Am.; **Epistènia**, cosmop.; **Cleónymus, Cheirópachys**, Eur., N. Am.; **Ptinòbius**, N. Am.) . . . . . **CLEONÝMIDÆ**

47. Hind coxæ normal, not enlarged; mesopleura with a groove or impression 48
Hind coxæ much enlarged and dilated (Fig. 895), their femora compressed; marginal vein greatly elongated; very small, usually black species. (**Elásmus**, cosmop.; **Euryíschia**, Austr.).
ELÁSMIDÆ

48. Tarsi four-jointed (five-jointed or heteromerous in the females of one or two genera); wing hairs not placed in rows or lines; wings usually narrow. A very extensive but poorly known cosmopolitan family. (Figs. 910, 911, 918). (**Tetrástichus, Aphelìnus, Melittòbia, Ablèrus, Ootetrástichus, Eupléctrus, Eùlophus**). (Including *TETRASTÍCHIDÆ, APHELÍNIDÆ, ELACHÉRTIDÆ* and *ENTEDÓNTIDÆ*) . . . **EULÓPHIDÆ**
Tarsi three-jointed; wings broad, with the wing hairs usually arranged in bands or lines; marginal and stigmal veins united to form a strongly recurved stem (Fig. 903). (**Trichográmma** (=*Pentárthron, Oóphthora*)). . . . . **TRICHOGRAMMÁTIDÆ**

49. Antennæ distinctly elbowed, the scape long and the flagellum generally swollen toward the tip (Figs. 909, 912, 913).....50
Antennæ not elbowed, usually filiform or tapering toward the tip 59



Figs. 914–921. **Hymenoptera**

914. **Xanthomelanus** (Ashmead) Chalcididæ.
915. **Trigonoderus** (Ashmead) Cleonymidæ.
916. **Bruchophagus** (Urbahns) Eurytomidæ.
917. **Sycophaga,** underside of head and thorax (Grandi) Agaontidæ.
918. **Paracrias** (Ashmead) Eulophidæ.
919. **Perilampus** (Ashmead) Perilampidæ.
920. **Kapala** (Ashmead) Eucharididæ.
921. **Bephratoides** (Brues) Eurytomidæ.

50. Head with a deep triangular impression anteriorly.....51
Head normal, without such impression.....52
51. Abdomen short, of normal form, not pointed or enlarged apically. (Wingless males of Idarnini). (See couplet 41).
Some **CALLIMÓMIDÆ**
Abdomen broadly sessile, much drawn out into a point apically, or broadened at tip. (Wingless males). (See couplet 35).
AGAÓNTIDÆ

52. Pronotum as long as the mesonotum and scutellum together; abdomen with only four visible segments. (A single species, **Aliènus**, S. Afr.) ..... **ALIÉNIDÆ**
Of different conformation 53
53. Tarsi five-jointed 54
Tarsi four-jointed (see couplet 48)..... A few **EULÓPHIDÆ**
54. Mesopleura large, entire, without a femoral groove. (See couplet 36) ..... A few **ENCÝRTIDÆ**
Mesopleura with an oblique femoral groove or impression.....55
55. Hind coxæ large, more or less triangular in cross-section, ridged above. (See couplet 41) .....A few **CALLIMÓMIDÆ**
Hind coxæ small, not ridged above.....56
56. Femora of normal size, not greatly swollen on the front or hind legs; mesopleura small 57
Femora of either the front or hind legs greatly swollen, mesopleura large, triangular. (See couplet 46) . . A few **CLEONÝMIDÆ**
57. Hind tibiæ with a single apical spur. (See couplet 37). A few **PTEROMÁLIDÆ**
Hind tibiæ with two apical spurs 58
58. Pronotum wide, quadrate. (See couplet 45). A few **EURYTÓMIDÆ**
Pronotum narrow, usually narrowed in front or transversely linear. (See couplet 46) .....A few **MISCOGÁSTRIDÆ**
59. Abdominal petiole cylindrical, rarely very short; abdomen much compressed; antennæ frequently swollen apically or clavate..60
Abdominal petiole, if well developed, arcuate, or curved toward the tip, rarely compressed; antennæ never enlarged apically.61
60. Tergites meeting along the venter and completely enclosing the sternites. (See couplet 32) ..... Some **CYNÍPIDÆ**
Tergites not meeting along the venter; all, or nearly all the sternites visible. (See couplet 31) ..... A few **FIGÍTIDÆ**
61. Second and third tergites immovably united; antennæ with more than twenty-four joints. (See couplet 29). A few **BRACÓNIDÆ**
Second and third tergites freely movable like the other segments; very rarely indistinctly separated.....62
62. Abdominal petiole rather suddenly broadened and bent downward near the tip, its spiracles placed well beyond the middle. (See couplet 28) ..... A few **ICHNEUMÓNIDÆ**
Abdominal petiole very short or not of this conformation; very small black species. (Some apterous Aphidiinæ). (See couplet 29) ..... A few **BRACÓNIDÆ**

63. Pronotum extending entirely or almost back to the tegulæ, its hind angles usually not lobed, or the tegulæ absent; trochanters occasionally two-jointed 64

Pronotum shortened (rarely extended in front as a neck), more or less collar-shaped (Figs. 891, 925), not extending back on the sides to the tegulæ, although each posterior angle is produced to form a lobe; trochanters always one-jointed..... 116

64. First segment of abdomen forming a scale or node (Figs. 922, 923, 924, 926) or the first and second nodiform, and clearly separated both above and below from the gaster, or remainder of the abdomen 65

First segment of abdomen not scale-like; if nodiform and separated from the gaster by a constriction, the second segment forms a part of the gaster and is not separated from it both above and below. 66

65. Hypopygium of male with an upturned spine; female wingless, but not dimorphic, without sterile worker caste; female with suture between mesonotum and pronotum, but without suture or impression between mesonotum and metanotum or propodeum. Insects not living in colonies. (**Apterógyna**, Afr., As.).

APTEROGŸNIDÆ

Hypopygium of male without an upturned spine; female dimorphic, the sterile form (worker) wingless, with the thoracic sutures lost or much reduced; the fertile form with the thoracic sutures all present. Insects living in colonies. Ants. (FORMICÒIDEA, HETERÓGYNA) ..... **FORMÍCIDÆ**[1]

a. Cloacal orifice slit-shaped.....b

Cloacal orifice round, terminal, surrounded by a fringe of hairs; sting not functional; abdominal pedicel consisting of a single segment; no constriction between the second and third abdominal segments; male genitalia not retractile. (Fig. 923). (**Prenólepis**, cosmop.; **Làsius**, **Formìca**, holarc.; **Polýrhachis**, Old World tropics; **Camponòtus** (Wood-ants), cosmop.).

FORMICÎNÆ

b. Sting vestigial (except *Aneuretus*); abdominal pedicel consisting of a single segment; no constriction between the second and third abdominal segments; species producing a secretion of aromatic rancid odor. (**Dolichodèrus**, cosmop.; **Dorymŷrmex**, **Iridomŷrmex** (*I. hùmilis*, Argentine ant), widespread).

DOLICHODERÎNÆ

[1] The ants form a very extensive, widespread, and dominant family divisible into a number of well-marked subfamilies, several of which are undoubtedly of equal rank with many of the families recognized in other groups. A table for their separation is given below, adapted from a recent key by Wheeler.

Sting developed, sometimes very small, but capable of being exserted. Petiole of abdomen (pedicel) either consisting of two joints, or with the first segment forming a node and the second and third separated by a strong (very rarely weaker) constriction c

c. Pedicel of two segments, the petiole and postpetiole (Fig. 922); frontal carinæ usually separated from each other; copulatory organs of male almost always exserted ..... d

Pedicel consisting of a single segment, more rarely of two, but in this case the frontal carinæ are very close to each other and do not cover the insertions of the antennæ (Dorylinæ) or the mandibles are linear and denticulate (*Myrmecia*) ..... e

d. Antennæ 12-jointed in worker, female and male; clypeus not prolonged back between the frontal carinæ, its posterior margin rounded; fore wings almost always with two closed cubital cells; one of the tibial spurs on the middle and hind legs pectinate; ocelli almost always present in the worker. (**Pseudomýrma,** neotrop.; **Pachysìma, Viticícola,** Afr.).

PSEUDOMYRMÎNÆ

Clypeus almost always prolonged between the frontal carinæ; if not, the spurs of the middle and hind tibiæ are simple or absent, or the antennæ are 11-jointed in the worker and female, 12-jointed in the male, and the fore wings have one closed cubital cell. (**Pogonomýrmex** (Agricultural ants), Am.; **Myrmìca,** holarc., Indo-Mal.; **Pheidòle, Monomòrium,** tropicopolitan; **Solenópsis** (*S. geminàta,* Fire ant), cosmop.; **Átta** (Leaf-cutter ants), neotrop.) ..... **MYRMICÎNÆ**

e. Frontal carinæ very close to each other; almost vertical, not at all covering the antennal insertions; abdominal pedicel of one or two segments; genitalia of male almost always completely retractile. Legionary and Driver ants (Fig. 927). (**Dórylus, Æníctus,** Old World tropics; **Éciton,** neotrop.) **DORYLÎNÆ**

Frontal carinæ separated or close together, in the latter case being dilated anteriorly to form an oblique or horizontal lamina, which covers in part the insertion of the antennæ; abdominal pedicel almost always of a single segment. Genitalia of male incompletely retractile. (Fig. 924). (**Pachycóndyla,** neotrop.; **Myrmècia** (Bull-dog ants), Austr.; **Stigmatómma,** widespr.; **Ponèra,** cosmop.; **Cerápachys; Odontómachus,** tropicopolitan). (Including *CERAPACHYÌNÆ*) .... **PONERÎNÆ**

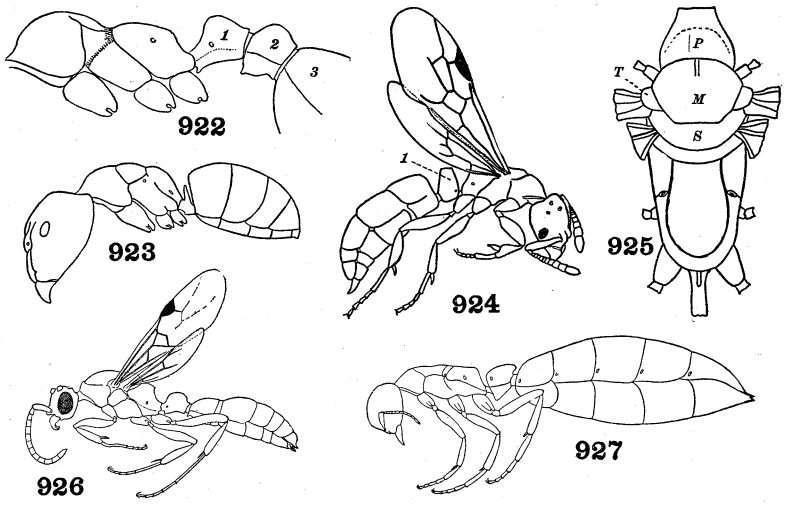
66. Winged 67

Wingless, or with the wings much reduced in size 98

67. Hind wings without distinct venation and with no closed cells; usually small or minute insects. (See couplet 134) 68

Hind wings with a distinct venation and with at least one closed cell 82

68. Antennæ inserted far above the clypeus on a frontal shelf or strong prominence; small or minute, never large species..... 69



Figs. 922–927. **Hymenoptera**

922. **Myrmica,** profile view of thorax and base of abdomen; 1, 2, basal nodes of abdomen (first and second segments); 3, third abdominal segment. Formicidæ.
923. **Camponotus,** lateral outline of body (Wheeler) Formicidæ.
924. **Ponera,** female. 1, node or basal segment of abdomen (Wheeler) Formicidæ.
925. **Chlorion,** thorax from above. *P*, pronotum; *M*, mesonotum; *S*, scutellum; *T*, tegula (Fernald) Sphecidæ.
926. **Phryacaces,** male (Wheeler) Formicidæ.
927. **Eciton,** female (Emery) Formicidæ.

Antennæ not inserted on a frontal shelf or strong prominence, arising just above the clypeus or near the middle of the face..70

69. Wing venation very incomplete; radial cell if indicated very small, cubital vein ($R_4+R_5+M_1$) entirely wanting; antennæ 11- to 14-jointed, usually strongly clavate in the female. (Fig. 932). (**Paramèsius, Spilómicrus, Gálesus, Phænòpria, Trichòpria,** cosmop.; **Hoplòpria,** Am.) ..... **DIAPRÌIDÆ**

Wing venation more complete; radial cell large, but not always completely closed; cubital vein well developed except at apex; antennæ of males 10-jointed, of females 13-jointed. (**Embólemus**, Eur.; **Myrmecomórphus** (= *Pedinómma*), Eur., N. Am.; **Ampulicimórpha**, N. Am.) ..... **EMBOLÉMIDÆ**

70. Antennæ composed of fourteen joints or more.....71
Antennæ composed of thirteen joints or less.....74

71. Basal joint of hind tarsi much shorter than the following joint; first abdominal segment as long as the head and thorax together; abdomen very long, filiform and composed of equal segments in the female; clavate in the male; large insects. (Fig. 930). (**Pelecìnus**, Am.) ..... **PELECÍNIDÆ**
Basal joint of hind tarsi longer than the second joint; abdominal petiole very much shorter.....72

72. Head elongate; antennæ 22- to 40-jointed, inserted at the anterior margin of the head; females wingless. A small, widespread group of rare insects. (**Sclerogíbba, Mystrocnèmis, Cryptobéthylus**) ..... **SCLEROGÍBBIDÆ**
Head short, broader than long; antennæ 14- or 15-jointed, inserted at the middle of the face, far above the clypeus.....73

73. Basal vein complete; antennæ 14-jointed; abdomen strongly compressed. (**Roprònia**, N. Am.) ..... **ROPRONÌIDÆ**
Basal vein incomplete, its anterior portion wanting; antennæ 15-jointed; abdomen not compressed. (**Helòrus**, Eur., N. Am.). **HELÓRIDÆ**

74. Mandibles very short, with three large teeth, widely separated and not meeting when closed; when open, the tips are directed laterally; abdomen with only two (female) or four (male) visible tergites, the first covering most of the abdomen; sting very long, extended forward beneath the body. (Fig. 928). A single species. (**Vanhórnia**, N. Am.) ..... **VANHORNÌIDÆ**
Mandibles in normal position, their tips opposing when closed..75

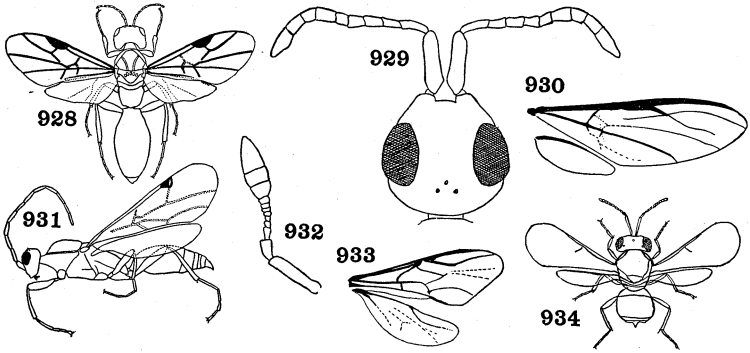
75. Antennæ inserted at the middle of the face, 13-jointed in both sexes; fore wings with a broad stigma and a closed, usually very small, radial cell; abdomen with a short cylindrical petiole, the second segment much longer than the others. (Fig. 931). (**Sérphus** (= *Proctotrypes*), **Phænosérphus**, widespr.; **Exallònyx**, Eur., N. Am.). (*PROCTOTRÝPIDÆ*).... **SÉRPHIDÆ**
Antennæ inserted near the mouth, close to the margin of the clypeus 76

76. Hind wing with a lobe at the anal angle, separated by a deep, slit-

shaped notch; if the lobe and notch are inconspicuous, the body is metallic in color 77

Hind wing very narrow without anal lobe or slit-shaped notch. 80

77. Abdomen with two to four, rarely five dorsal segments; venter concave; propodeum laterally with sharp keels or teeth; prothorax large, its posterior corners often distinctly separated from the tegulæ; ovipositor tubular, extensile, several-jointed;



Figs. 928–934. **Hymenoptera**

928. **Vanhornia** (Crawford) Vanhorniidæ.
929. **Calliceras,** head and antennæ. Calliceratidæ.
930. **Pelecinus,** wings. Pelecinidæ.
931. **Serphus** (Brues) Serphidæ.
932. **Loxotropa,** antenna. Diapriidæ.
933. **Chrysis,** wings. Chrysididæ.
934. **Telenomus.** Scelionidæ.

last large tergite frequently dentate; antennæ 13-jointed; body usually with coarse sculpture and of metallic color. Cuckoo-wasps. (Fig. 933). (**Chrỳsis,** cosmop.; **Parnòpes, Ellámpus, Hédychrum,** widespr.; **Allocèlia,** S. Afr.). **CHRYSÍDIDÆ**

Abdomen with six to eight visible segments, very rarely with only four or five; venter convex; body rarely with any coarse sculpture 78

78. Antennæ 10-jointed in both sexes; front tarsi of female usually pincers-shaped (Fig. 937); head broad, transverse, or subquadrate; female frequently apterous with the thorax nodose. (Figs. 937, 938). (**Drỳinus, Gonátopus, Ánteon,** cosmop.; **Aphélopus,** Eur., N. Am.; **Bócchus,** N. Am.; **Paradrỳinus,** Austr.) **DRYÍNIDÆ**

Antennæ 12 to 13-jointed; front tarsi simple; head elongate or rounded 79

79. Anal lobe of hind wing conspicuous; abdomen with seven or eight visible dorsal segments; head usually elongate, oblong; small, usually black or bronzed species, the females sometimes wingless. (**Béthylus, Mesítius, Perisiérola,** widespr.; **Sièrola,** Hawaii; **Pristócera, Épyris** (*s. lat.*), **Sclerodérma, Goniòzus,** cosmop.) ..... **BETHÝLIDÆ**

Anal lobe of hind wing not conspicuous, separated by a minute notch; abdomen with at most six segments visible from above. (**Cléptes,** Eur., Am.) ..... **CLÉPTIDÆ**

80. Abdomen acute, or sharply margined along the sides..... 81

Abdomen rounded on the sides; wings, when present, with the radial vein developed, but not complete, leaving the radial cell open; no postmarginal vein. (Fig. 929). (**Lygócerus, Conostígmus, Callíceras,** cosmop.; **Megaspìlus,** holarc.). (*CERAPHRÓNIDÆ*) ..... **CALLICERÁTIDÆ**

81. Antennæ ten-jointed, rarely with fewer joints, but never more; front wings without marginal or stigmal vein and usually without a subcostal vein also. (**Platygáster** (including **Polygnòtus**), cosmop.; **Inostémma, Léptacis, Amblyáspis,** Eur., Am.)..... **PLATYGÁSTRIDÆ**

Antennæ twelve- or eleven-jointed (if rarely seven- or eight-jointed, the club is unjointed, or if ten-jointed, the stigmal vein is present); marginal and stigmal veins usually present. (Fig. 934). (**Phanùrus, Telénomus, Calotelèia, Scèlio,** cosmop.; **Tèleas, Prosacántha, Hadronòtus,** widespr.; **Gryon,** Eur., Am.) ..... **SCELIÓNIDÆ**

82. Antennæ composed of fourteen or more joints 83

Antennæ with never more than thirteen joints; twelve-jointed in the female and thirteen-jointed in the male, except in rare instances when the number may be reduced. (VESPÒIDEA)..85

83. Mandibles with four teeth, head large, quadrate; antennæ with at least 16 joints, usually more; hind wing with two large closed cells; moderate-sized, often brilliantly colored species. (Fig. 935). (**Trigónalys,** palæarc.; **Lycogáster,** Am., E. Ind.; **Tapinógalos,** N. Am., S. Afr.; **Seminòta,** neotrop.; **Bareogónalos,** N. Am.) ..... **TRIGONÁLIDÆ**

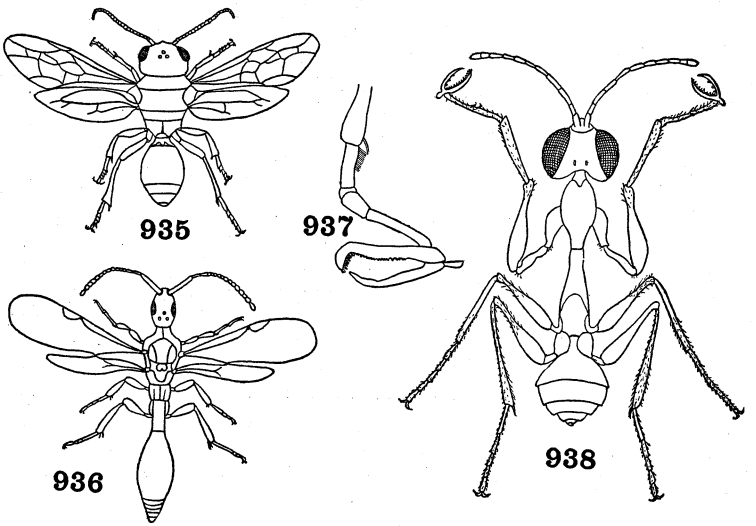
Mandibles with not more than three teeth; antennæ 14- or 15-jointed 84

84. Fore wing with a closed discoidal cell; apex of propodeum extend-

ing back beyond the insertion of the hind coxæ; antennæ not inserted on a large frontal prominence. (See couplet 25).

MONOMÁCHIDÆ

Fore wing always without a closed discoidal cell; propodeum not extended back beyond the insertion of the hind coxæ; antennæ inserted on a conspicuous frontal shelf or prominence; small black or brownish species. (Fig. 936). (**Bélyta, Oxýlabis,**



Figs. 935–938. **Hymenoptera**

935. **Seminota** (Schultz) Trigonalidæ.
936. **Belyta** (Fouts) Belytidæ.
937. **Gonatopus**, front tarsus of female. Dryinidæ.
938. **Gonatopus** (Misra) Dryinidæ.

Aclísta, widespr.; **Pántoclis**, cosmop.; **Leptorháptus**, holarc.) ..... **BELÝTIDÆ**

85. First discoidal cell shorter than the submedian cell (usually very much so); fore wings very rarely folded; solitary species, never living in colonies 86

First discoidal cell very long, as a rule much longer than the submedian cell; fore wing almost always folded longitudinally when

in repose; frequently social species, living in colonies. (Figs. 940, 941, 944, 946) ..... **VÉSPIDÆ** [1]

a. Transverse median vein in hind wing straight or curved, not angulate; fore wing with two or three cubital cells, the marginal cell always truncate at apex; antennæ usually strongly clavate. b

Transverse median vein angulate; antennæ not noticeably swollen apically ..... d

b. Anal lobe of hind wing elongate, more than half as long as the submedian cell. (**Euparàgia**, N. Am.) .... **EUPARAGIÌNÆ**

Anal lobe of hind wing small, circular or oval, much less than half as long as the submedian cell..... c

c. Discoidal vein in hind wing obsolete or entirely absent. (**Másaris**, palæarc.; **Pseudomásaris**, N. Am.; **Trimèria** neotrop.; **Masariélla, Ceràmius, Ceramiòides**, Afr.; **Paràgia**, Austr.). **MASARIDÌNÆ**

Discoidal vein in hind wing present, fully developed. (**Gayélla, Paramásaris**, neotrop., N. Am.)..... **GAYELLÌNÆ**

d. Second and third cubital cells each receiving a recurrent nervure. (**Raphiglóssa**, palæarc., Afr.) ..... **RAPHIGLOSSÌNÆ**

Second cubital cell receiving both recurrent nervures..... e

e. Mandibles short and broad, obliquely truncate and toothed at the apex, folding above one another under the clypeus or very slightly crossing ..... f

Mandibles more or less elongate and knife-like, either crossing each other or extended forward to form a beak, their inner margins more or less toothed or notched .... j

f. Tarsal claws bifid or toothed; middle tibiæ with one or two spurs; clypeus broadly truncate at apex; solitary wasps. (**Zèthus**, cosmop.; **Làbus**, Afr., Indo-Mal.) ..... **ZETHÌNÆ**

Tarsal claws simple; middle tibiæ with two spurs, very rarely with one; true social wasps, living in colonies, the females often dimorphic as fertile females and sterile workers..... g

g. Clypeus broadly truncate and more or less emarginate at the apex; first abdominal tergite vertically truncate anteriorly; hind wing without a lobe at the anal angle, the basal third strongly narrowed. Hornets; Yellow-jackets (**Véspa, Véspula**, palæarc., nearc., Indo-Mal.)..... **VESPÌNÆ**

Clypeus pointed at the apex, rarely rounded or straight, in which case the first abdominal tergite is not vertically truncate; hind wing usually with a lobe at the anal angle..... h

[1] This varied and extensive family is divisible into several groups, some of which were formerly regarded as families, but now more generally as of only subfamily rank. A key to these which has been kindly revised by Prof. Bequaert is given below.

h. Second abdominal segment broadly bell-shaped, its tergite and sternite completely or for the most part fused; first segment much narrower than the second; extensory muscle of the abdomen inserted on the propodeum in a narrow and much compressed slit. (One genus, **Ropalídia** (=*Icària*), Afr., Indo-Austr.). (*RHOPALIDIÌNÆ*) ..... **ROPALIDIÌNÆ**

Second abdominal segment of the usual shape, its tergite and sternite freely articulated i

i. Extensory muscle of the abdomen inserted on the propodeum in a narrow and much compressed slit; first abdominal segment never narrowed into a stalk; antennæ always of 12 joints in the female and 13 in the male. (**Polístes,** cosmop.; **Gyróstoma,** oriental) ..... **POLISTÌNÆ**

Extensory muscle of the abdomen inserted on the propodeum in a broad, oval cavity; first abdominal segment often stalk-like; antennæ with 11 or 12 joints in the female and 12 or 13 in the male. (**Polýbia, Chartérgus,** neotrop.; **Mischocýttarus, Nectarìna,** N. Am., neotrop.; **Belonogáster,** Afr.; **Polybiòides,** Afr., oriental) ..... **POLYBIÌNÆ**

j. Middle tibiæ with one apical spur (very rarely two or none); clypeus broadly rounded, truncate or emarginate at tip (very rarely pointed). A large cosmopolitan group. (**Eùmenes, Odynèrus, Symmórphus, Ancistrócerus, Pterochìlus,** cosmop.; **Synàgris,** Afr.; **Pachýmenes,** widespr.; **Monòbia,** N. Am., neotrop.) ..... **EUMENÌNÆ**

Middle tibiæ with two spurs; clypeus projecting in a round or sharp point. (**Stenogáster** (=*Ischnogáster*), Indo-Austr.). **STENOGASTRÌNÆ**

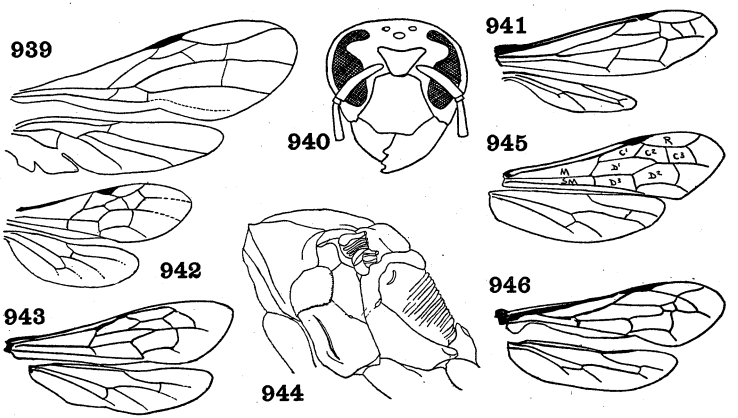
86. Flagellum of antennæ bare or with very short pubescence, not clothed with conspicuous hairs.....87

Flagellum clothed with conspicuous hairs, as long as, or much longer than the width of the antennal joints. (**Plumàrius** (=*Konowiélla*), Chile, Argentina; **Myrmecopterìna** (=*Archihymen*), S. Afr.). (*KONOWIÉLLIDÆ, ARCHIHYMÉIDÆ*) ..... **PLUMARÌIDÆ**

87. Mesopleura divided by an oblique suture into a lower and upper part; legs, including the coxæ very long; hind femora unusually long; middle tibiæ with two spurs. Spider hunting wasps. (**Psammóchares** (=*Pómpilus*), **Pépsis** (Tarantula hawks), **Cerópales, Agènia,** widespr.). (*CEROPÁLIDÆ, POMPÍLIDÆ*) ..... **PSAMMOCHÁRIDÆ**

Mesopleura not thus divided; legs shorter, the hind femora not usually extending to the apex of the abdomen.....88

88. Meso- and metasternum forming together a flat plate which is divided by a transverse, more or less sinuous suture, and overlies the bases of the four posterior coxæ; wing membrane, beyond the closed cells, finely longitudinally wrinkled; hypopygium of male with three spines. Large, usually brightly colored wasps. (**Scòlia, Campsómeris** (=*Èlis*), cosmop., mainly trop.)
SCOLÌIDÆ



Figs. 939–946. **Hymenoptera**

939. **Paniscomima,** wings (Enderlein) Rhopalosomatidæ.
940. **Vespa,** head in front view (Schmiedeknecht) Vespidæ.
941. **Vespa,** wings. Vespidæ.
942. **Sphærophthalma,** wings. Mutillidæ.
943. **Elis,** wings of female. Tiphiidæ.
944. **Polistes,** lateral view of thorax (Bequaert) Vespidæ.
945. **Elis;** wings of male. *R*, radial or marginal cell; *C*1, *C*2, *C*3, cubital or submarginal cells; *D*1, *D*2, *D*3, discoidal cells; *M*, median cell; *SM*, submedian cell. Tiphiidæ.
946. **Eumenes,** wings. Vespidæ.

Meso- and metasternum not forming such a plate overlying all four posterior coxæ; sometimes provided with a pair of thin backwardly directed plates or laminæ which overlie the bases of the middle coxæ 89

89. Joints of antennal flagellum long and slender, each bearing at the apex two slender spines; joints of tarsi broadened and deeply lobed (female); hind wing with a prominent anal lobe and a

deep axillary incision (Fig. 939). (**Rhopalosòma**, Am.; **Paniscomìma**, Afr.; **Hymenochimæra**, India).

RHOPALOSOMÁTIDÆ

Joints of antennal flagellum not spined at tip, tarsi simple.....90

90. Mesosternum with two laminæ that overlie or project between the bases of the middle coxæ and usually extend to the mid-line where they are separated by a median suture.....91

Mesosternum simple, without appendages behind, or with the laminæ reduced to a pair of minute tooth-like projections..94

91. Ocelli small.....92

Ocelli very large; nocturnal insects (males). (**Brachycìstis, Chyphòtes**, Am.). (See couplet 94).

BRACHYCISTÌNÆ of the **MUTÍLLIDÆ**

92. Males with apex of abdomen terminating in a single strongly upcurved spine (if there are 8 ventral abdominal segments and the pygidium is not deeply emarginate, see *Dimorphothynnus* and *Rhagigaster* in the Thynnidæ); females with a deep constriction between the first and second ventral abdominal segments. (Figs. 943, 945). (**Típhia**, cosmop.; **Paratíphia**, Am.; **Èlis** (=*Myzìne*), widespr.; **Pterómbrus** (=*Engycýstis*), Am.). (Including *PTERÓMBRIDÆ* and *MYZÍNIDÆ*). **TIPHÌIDÆ**

Males with apex of abdomen not terminating in a single strongly upcurved spine (except *Dimorphothynnus* and *Rhagigaster*), otherwise armed or without spines; females (of *Anthobosca*) without a deep constriction between the first and second ventral abdominal segments.....93

93. Pygidium of male of various forms, with or without spines; antennæ of male generally inserted under a frontal prominence, their sockets facing anteriorly or laterally instead of dorsally; wing venation of male complete and extending out to the tips of the wings, three closed cubital cells, the first usually divided at least partially by a spur from the first intercubitus; female wingless. (**Diámma, Rhagigáster, Dimorphothýnnus**, Austr.; **Elaphróptera, Encyrtothýnnus**, S. Am.; **Glyptometòpa**, N. Am.)..... **THÝNNIDÆ**

Pygidium of male unarmed; antennæ of male not inserted under a frontal prominence, their sockets facing dorsally; female winged. (**Anthobòsca**, S. Am., Austr.)..... **ANTHOBÓSCIDÆ**

94. Hind wing with a prominent separated lobe at the anal angle..96

Hind wing without a lobe at the anal angle, at most with an obtuse emargination at the posterior basal angle.....95

95. Cubital vein in hind wing originating beyond the transverse median vein; second abdominal segment separated from the first by a strong constriction both above and below; female winged. (**Sierolomórpha**, nearc., Hawaii).
SIEROLOMÓRPHIDÆ

Cubital vein in hind wing not originating beyond the transverse median vein; body almost always conspicuously pilose (Fig. 942); female wingless. Velvet ants. A widespread family occurring mainly in desert regions. (**Mutílla**, palæarc., ethiop., oriental; **Dasymutílla, Photópsis**, Am.; **Traumatomutílla**, neotrop.; **Ephutomórpha**, austr.; ..... **MUTÍLLIDÆ**

96. Abdomen with the several segments separated by strong constrictions (males) 97

Abdomen without such constrictions, except between the first and second segments; hypopygium of male unarmed; female winged; sting long, enclosed in a tubular organ at base; body bare, marked with yellow or white. (**Sapỳga**, widespr.; **Eusapỳga**, Am.) ..... **SAPÝGIDÆ**

97. Hypopygium of male armed with a strong, upcurved spine; female wingless, the thorax constricted into three parts. (**Methòca**, widespr.; **Dryinópsis**, E. Ind.) ..... **METHÓCIDÆ**

Hypopygium of male unarmed; female wingless, the thorax divided into two parts by a transverse suture. (**Myrmòsa**, holarc.) .... **MYRMÓSIDÆ**

98. Thorax clearly divided above into three parts by sutures or sharply defined constrictions, or into two by a constriction; scutellum nearly always present 99

Thorax with only one dorsal sclerite, or with two separated by a suture; no scutellum 114

99. Antennæ with 22 joints or more. (See couplet 72).
Females of the **SCLEROGÍBBIDÆ**

Antennæ with 15 joints or less.....100

100. Antennæ inserted on a frontal shelf or strong prominence....101

No shelf or strong prominence at the base of the antennæ....103

101. First segment of the abdomen forming a distinctly separated petiole; antennæ inserted on a frontal shelf.....102

Abdomen without a distinctly separated petiole; antennæ not inserted on a shelf. (See couplet 69) .. Some **EMBOLÉMIDÆ**

102. Antennæ usually 12-jointed. (See couplet 69).
Some females of the **DIAPRÌIDÆ**

Antennæ usually 15-jointed. (See couplet 84).
Some females of the **BELÝTIDÆ**

103. Abdomen acute or sharply margined along the sides.....104
Abdomen without an acute or sharply margined edge along the sides 105

104. Antennæ 12- or 11-jointed (if rarely 7- or 8-jointed, the club is unjointed). (See couplet 81).
A few females of the **SCELIÓNIDÆ**
Antennæ 10-jointed, rarely with fewer joints, but never more. (See couplet 81) .... A few males of the **PLATYGÁSTRIDÆ**

105. Antennæ inserted low down, next to the border of the clypeus. 106
Antennæ inserted at the middle of the face, far above the clypeus. (**Paracòdrus**). (See couplet 75).
A few females of the **SÉRPHIDÆ**

106. Antennæ 10- or 11-jointed.....107
Antennæ 12- or 13-jointed.....108

107. Front tarsi of female pincers-shaped; antennæ of male 10-jointed. (See couplet 78).....Some **DRYÍNIDÆ**
Front tarsi of female not pincers-shaped; antennæ of male 11-jointed. (See couplet 80). ..... Some **CALLICERÁTIDÆ**

108. Head elongate, usually distinctly longer than wide; thorax divided by sutures, or if divided by constrictions, the head is much longer than wide. (See couplet 79).
A few females of the **BETHÝLIDÆ**
Head almost always oval, slightly broader than high.....109

109. Abdomen with only four visible tergites. (See couplet 52).
ALIÉNIDÆ
Abdomen normal, with six to eight visible tergites..... 110

110. Wings present, though greatly reduced in size; tegulæ normally developed; thorax of normal form, divided by sutures.....111
Wings absent; tegulæ indicated only as minute tubercles; thorax generally of abnormal form, often divided by constrictions..112

111. Antennæ 13-jointed. (See couplet 95).
A very few males of the **MUTÍLLIDÆ**
Antennæ 12-jointed. (See couplet 87).
A very few females of the **PSAMMOCHÁRIDÆ**

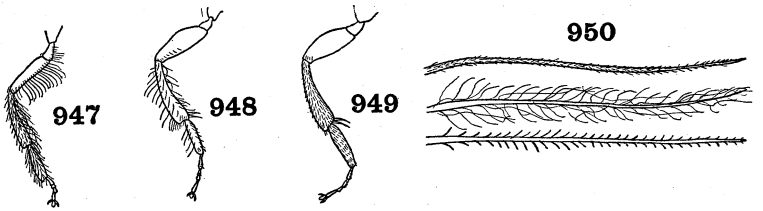
112. Mesosternum simple, without laminæ that overlie or project between the bases of the middle coxæ. (See couplet 97).
Females of the **METHÓCIDÆ**
Mesosternum with two laminæ that overlie or project between the bases of the middle coxæ.....113

113. Abdomen with a distinct cylindrical petiole consisting only of the sternite, the first tergite capping its posterior end. (See couplet 91) (Females of **Chyphòtes**) ..... **MUTÍLLIDÆ**, part

Abdomen not petiolate; femora compressed. (See couplet 93). Females of the **THÝNNIDÆ**

114. Pronotum separated from the remainder of the thorax by a suture 115
Pronotum fused with the remainder of the thorax, the entire thorax without sutures above. (See couplet 95). Females of the **MUTÍLLIDÆ**

115. Ocelli present. (See couplet 97). Females of the **MYRMÓSIDÆ**
Ocelli absent. (See couplet 91). Females of **Brachycístis**). **MUTÍLLIDÆ**, part



Figs. 947–950. **Hymenoptera**

947, 948, 949. Hind legs of bees (Smith) Apoidea.
950. Plumose or compound body-hairs of bees (Smith) Apoidea.

116. Antennæ with 12 (female) or 13 (male) joints; very rarely with 12 in the male 117
Antennæ 10-jointed in both sexes; no closed cubital or discoidal cells; front tarsi of female often pincers-shaped. (See couplet 78) ..... **DRYÍNIDÆ**

117. Hind tarsi slender, filiform, the first joint not broadened or thickened; abdomen often petiolate; all hairs on the body simple, unbranched. (SPHECÒIDEA) 118
Hind tarsi with the first joint thickened or flattened, often densely hairy; abdomen always sessile; at least a part of the body-hairs branched or plumose. Bees. (Figs. 947, 948, 949, 950, 964, 965). (APÒIDEA (*ANTHÓPHILA*)) 136

118. Middle tibiæ with two apical spurs, both well developed..... 119
Middle tibiæ generally with only one well developed apical spur; sometimes with two or none. When a second spur is well developed, the hind femora are widened at the tip (*Alyson, Didineis*), or the mandibles are emarginate externally (*Dinetus*) 125

119. Mesosternum produced into a forked process posteriorly; parapsidal furrows distinct; pronotum usually long, conically produced in front, usually with a median groove, its posterior lobes often approaching close to the tegulæ. (**Ampùlex**, widespr.; **Rhinópsis**, **Dolichùrus**, cosmop.) ..... **AMPULÍCIDÆ**

Mesosternum not thus produced; parapsidal furrows indistinct or wanting 120

120. Abdomen with a distinct, usually long, cylindrical petiole, which at the base, at least, consists only of the sternite. (Figs. 891, 925, 951). (**Chlorìon** (=*Sphéx*, auctt.), **Scéliphron** (=*Pelopœus*), **Sphéx** (=*Ammóphila*), cosmop.). ..... **SPHÈCIDÆ**

Abdomen sessile or subsessile, never with a slender, cylindrical petiole 121

121. Labrum free, well-developed, wider than long, triangular or semicircular, extending beyond the clypeus; sternauli on mesopleura not complete. (**Stìzus**, **Sphècius**, cosmop.; **Exeìrus**, Austr.) (*EXEÍRIDÆ*) ..... **STÍZIDÆ**

Labrum short, small, not or scarcely extending beyond the clypeus. (If the second cubital cell is petiolate and the hind angles of the propodeum are neither acute nor spined, see *Exeirus*, couplet 121) 122

122. Radial cell broadly truncate at apex and prolonged as a small, weakly defined cell; antennæ inserted near the clypeus, very close to the clypeal suture; eyes of male usually very large and contiguous above. (**Dimórpha** (=*Ástata*), cosmop.; **Diplopléctron**, N. Am.) (*ASTÁTIDÆ*) ..... **DIMÓRPHIDÆ**

Radial cell not appendiculate, pointed at apex 123

123. Antennæ inserted very near to the upper edge of the clypeus, close to the clypeal suture; first segment of abdomen usually long, slender, nodose at apex and separated from the second by a distinct constriction; second cubital cell not receiving a recurrent nervure. (**Méllinus**, widespr.)..... **MELLÍNIDÆ**

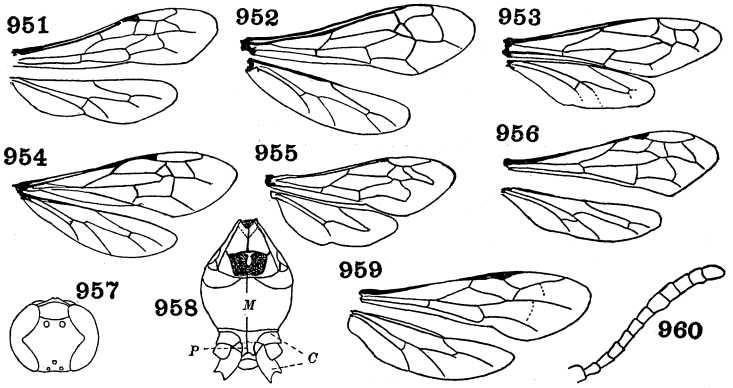
Antennæ inserted on the face well above the margin of clypeus; first segment of abdomen broad and stout; second cubital cell receiving at least one recurrent nervure, usually two 124

124. Sternauli on mesopleura complete, usually deep; second cubital cell with a distinct upper side, not triangular; propodeum rounded; thorax smooth, not coarsely punctate. (Fig. 956). (**Gorỳtes**, cosmop.) ..... **GORÝTIDÆ**

Sternauli wanting or indicated only anteriorly; second cubital cell triangular or petiolate; propodeum with the upper hind

angles acute or produced as stout spines; thorax coarsely punctate. (**Nýsson**, cosmop.) ..... **NYSSÓNIDÆ**

125. Eyes deeply emarginate; one clearly defined cubital cell, abdomen petiolate and gradually enlarged apically (**Trypóxylon**, cosmop.); or two cubital cells, or three with the second petiolate (**Pìson**, cosmop.; **Pisonópsis**, nearc.; **Aulacóphilus**, neotrop.). (Figs. 957, 959). (*TRYPOXYLÓNIDÆ*). **TRYPOXÝLIDÆ**



Figs. 951–960. **Hymenoptera**

951. **Chlorion,** wings. Sphecidæ.
952. **Eucerceris,** wings. Cerceridæ.
953. **Bembix,** wings. Bembicidæ.
954. **Cerceris,** wings. Cerceridæ.
955. **Tachytes,** wings. Larridæ.
956. **Gorytes,** wings. Gorytidæ.
957. **Trypoxylon,** front view of head (Kohl) Trypoxylidæ.
958. **Tachytes,** underside of thorax. *M*, mesosternum; *P*, its posterior process; *C*, coxæ (Williams) Larridæ.
959. **Trypoxylon**, wings. Trypoxylidæ.
960. **Niteliopsis,** antenna of female (Williams) Larridæ.

Eyes not deeply emarginate, or if emarginate, the second of the three cubital cells is not petiolate.....126

126. Fore wings with two or three completely closed cubital cells, the veins enclosing them strong and sharply defined.....127

Fore wings with not more than one closed cubital cell.....133

127. Labrum large, free, triangularly elongated beyond the clypeus, much longer than wide; radial cell simple, not appendiculate

at tip; ocelli more or less aborted. (Fig. 953). (**Bémbix** (=*Bémbex*), cosmop.; **Microbémbex, Bicýrtes** (=*Bembídula*), **Stíctia** (=*Monédula*), **Steniòlia,** Am.) .... **BEMBÍCIDÆ**

Labrum small, usually entirely concealed by the clypeus; radial cell sometimes with a crossvein clearly defined; ocelli, or at least the anterior one, perfectly formed 128

128. Abdomen strongly constricted both above and below between the first and second segments 129

Abdomen without a strong constriction above between the first and second segments 130

129. Mesopleura with a vertical furrow which separates the prepectus from the rest of the mesopleura; hind femora usually simple at apex. (**Philánthus,** cosmop.; **Tráchypus,** neotrop.; **Aphilánthops,** nearc.) ..... **PHILÁNTHIDÆ**

Mesopleura without such a furrow, the prepectus not separated; hind femora with a projection below at apex. (Figs. 952, 954). (**Cercèris,** cosmop.; **Eucercèris,** Am.) ..... **CERCÉRIDÆ**

130. Hind femora produced below at apex as a flattened tubercle which overlaps the base of the tibia; abdomen sessile. (**Ályson,** holarc., neotrop.; **Bothynostèthus,** Am.; **Scapheùtes,** S. Am.). **ALYSÓNIDÆ**

Hind femora simple at apex, without projection 131

131. Marginal cell not appendiculate and mandibles without an emargination externally; one, two, or three submarginal cells; eyes not emarginate on the inner edge. (**Stígmus, Psén,** widespr.; **Pemphrèdon, Passalœcus,** holarc.). (Including *MIMÉSIDÆ* and *PSÉNIDÆ*) .... **PEMPHREDÓNIDÆ**

Marginal cell appendiculate, or if not, the mandibles are emarginate externally 132

132. Second cubital cell present and not petiolate above; upper ocelli usually aborted or deformed. (Figs. 955, 958, 960). (**Táchytes, Lárra, Táchysphex,** cosmop.; **Palàrus, Lyròda,** widespr.; **Dinètus,** Eur.; **Sericóphorus,** Austr.) ..... **LÁRRIDÆ**

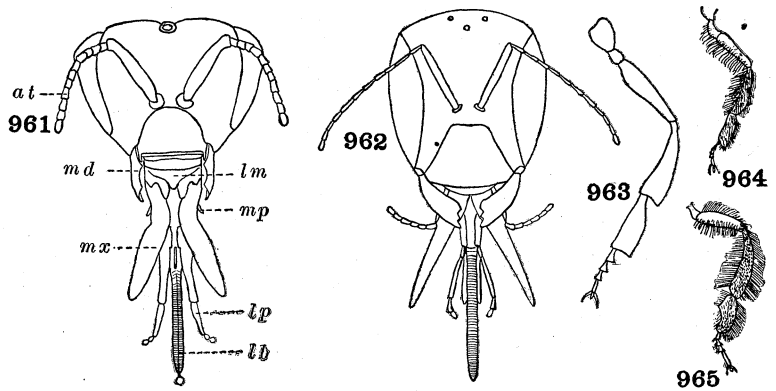
Second cubital cell petiolate, or rarely absent; three perfectly formed ocelli; small species. (**Míscophus,** widespr.; **Plenóculus,** N. Am.). (*NITÉLIDÆ*) ..... **MISCÓPHIDÆ**

133. Postscutellum with two scale-like processes which project back; propodeum above with a long spine or forked process; cubital and discoidal cells not distinctly separated. (**Oxýbelus,** cosmop.; **Belómicrus,** holarc.) ..... **OXYBÈLIDÆ**

Postscutellum and propodeum simple, without scales or spine. 134

134. Hind wing with distinct cells 135
Hind wings without any closed cells. (**Nitèla**, Eur.). (See couplet 132) ..... A few **MISCÓPHIDÆ**

135. Radial cell appendiculate; black, usually with yellow markings. (**Cràbro** (including **Rhópalum**, **Solènius**, and many subgenera), cosmop., mainly holarc.; **Anacràbro**, N. Am.). **CRABRÓNIDÆ**
Radial cell simple, not appendiculate. (**Ammóplanus**, holarc.). (See couplet 131) ..... A few **PEMPHREDÓNIDÆ**



Figs. 961–965. **Hymenoptera**

961. **Apis**, head. *at*, antenna; *md*, mandible; *lm*, labrum; *mx*, maxillary palpus; *lp*, labial palpus; *lb*, labium. (Cheshire) Apidæ.
962. Head of long-tongued bee (Cockerell).
963. **Apis**, hind leg of worker (Smith) Apidæ.
964, 965. Hind legs of bees (Riley).

136. Hind tibiæ without apical spurs; radial cell either very long or incompletely closed; social species living in colonies, the females dimorphic, consisting of fertile individuals and infertile workers. (Figs. 961, 963). (**Àpis**, Ind. (*A. mellífera*, Honey-bee, cosmop.); **Melípona** (Stingless bees), tropicopolitan) ..... **ÁPIDÆ**
Hind tibiæ with apical spurs; when rarely the spurs are very short in some males, the radial cell is neither very long, nor open at apex 137

137. Tongue short, broad, obtuse, and emarginate at apex or divided medially 138

Tongue more or less elongate, pointed, not emarginate at the tip 139

138. Fore wing with three closed cubital cells; moderate-sized, hairy bees; tongue split. (**Collètes,** widespr.; **Megacilíssa,** Am.; **Gastrópsis,** Austr.) ..... **COLLÉTIDÆ**

Fore wing with only two closed cubital cells; small bees with very little hair, face almost always with white or yellow markings. (**Prosòpis** (= *Hylæus*), cosmop.; **Hylæòides,** Austr.). (*HYLÆIDÆ*) ..... **PROSOPÍDIDÆ**

139. The cheeks separating the eyes from the mandibles longer than the pedicel of the antennæ; large, social, densely hairy species, with contrasting black and yellow or sometimes also orange or red pile. Bumble-bees. (**Bómbus** (=*Brèmus*), cosmop.; **Psíthyrus,** holarc., neotrop.). (*BRÉMIDÆ*) ..... **BÓMBIDÆ**

Eyes nearly or quite reaching the base of the mandibles; solitary species 140

140. Abdomen of female with a dense brush of pollen-collecting hairs on the underside; hind legs without a pollen-collecting apparatus; pygidium of female large and broad, without a median flat area, very broad and sometimes toothed on the hind margin in the male; only two closed submarginal cells; labial palpi with the basal joints much elongated, the apical minute. Leaf-cutter bees. (**Megachìle, Lithúrgus,** cosmop.; **Trachùsa,** Eur., Am.; **Ósmia, Herìades, Anthídium,** widespr.). **MEGACHÍLIDÆ**

Abdomen of female without such a dense brush; pollen-collecting apparatus, if present, consisting of a covering of long, dense hairs on the hind legs or of an abnormal widening of the tibiæ; absent in the parasitic forms and considerably reduced in certain others 141

141. Pollen-collecting apparatus present on the hind legs, the first joint of the hind tarsi strongly enlarged and flattened; body conspicuously hairy, especially on the thorax and head; almost entirely non-parasitic forms 142

No pollen-collecting apparatus present; first joint of hind tarsi not conspicuously enlarged or flattened; body without any dense vestiture of long hairs and often with a conspicuous color pattern; parasitic species 146

142. Pygidium of female and frequently of male also with a triangular flat median area; tongue short, moderate, or elongate 143

Pygidium without a median triangular area, although sometimes with a median keel; tongue very long and slender 144

143. Tongue more or less short, dagger-like; radial cell pointed at apex; usually three submarginal cells; maxillary palpi usually six-jointed; pygidium of female with a triangular median area; burrowing bees, sometimes metallic in color. (**Andrèna, Sphecòdes, Halíctus,** cosmop.; **Augochlòra,** Am.).
ANDRÉNIDÆ

Tongue elongate, though not so long as in the higher groups; almost always only two submarginal cells; radial cell blunt or truncate at apex, very rarely pointed; rather densely hairy; never brilliantly metallic, though rarely with the head and thorax green; often with yellow markings. (**Panúrgus, Panurgìnus, Halictòides,** holarc.; **Pérdita,** N. Am.). **PANŪRGIDÆ**

Tongue elongate, very long; first two joints of labial palpi greatly lengthened and flattened, sheath-like, last two minute; generally large and densely hairy bees with well-developed pollen collecting apparatus; males often with long antennæ and usually with yellow clypeus. (**Podalírius** (=*Anthóphora*), **Eùcera** (including **Melissòdes, Diadàsia, Émphor**), cosmop.; **Hemísia** (=*Céntris*), widespr.). (*ANTHOPHÓRIDÆ*).
PODALIRÌIDÆ

144. Hind tibiæ of female greatly widened and posteriorly expanded, smooth on the outer side. Large or moderate sized, often metallic, brilliantly ornamented species. (**Euglóssa, Eulèma,** neotrop.) ..... **EUGLÓSSIDÆ**

Hind tibiæ without smooth corbicula, furnished with hairs for collecting pollen; very large or very small species. (Carpenter bees) 145

145. Hind tibia and tarsus of female with a dense pollen-collecting scopa; stigma obsolete; large robust bees. (One tropicopolitan genus, **Xylócopa**) ..... **XYLOCÓPIDÆ**

Hind tibia and tarsus without distinct scopa, the hairs sparse; stigma large; small species. (**Cerátina,** widespr.; **Allódape,** Afr., As., Austr.) ..... **CERATÍNIDÆ**

146. Apical abdominal tergite of female large and frequently with a median carina; in the male usually emarginate or toothed; only two cubital cells; head large and broad; body generally coarsely sculptured; species of sombre colors. (**Stèlis,** holarc.).
STELÍDIDÆ

Apical tergite of female not unusually large, sometimes very small; body not coarsely sculptured; brightly colored or metallic species 147

147. Hind tibiæ greatly broadened, flattened above; large bees of brilliant blue or green metallic color. (**Chrysántheda**, S. Am.). **CHRYSANTHÉDIDÆ**

Hind tibiæ of the ordinary form; smaller, rarely large bees . . . 148

148. Maxillary palpi six-jointed; usually wasp-like in appearance, with bright yellow and often red color; almost always with three submarginal cells; marginal cell pointed on the costa. (**Nómada**, cosmop.) ..... **NOMÁDIDÆ**

Maxillary palpi two- to six-jointed; usually robust bees with conspicuous, sometimes metallic markings due to appressed hairs, but without yellow tegumentary markings. (Fig. 894). (**Crocìsa**, cosmop.; **Melécta, Epèolus, Pásites**, widespr.; **Melíssa**, neotrop.) ..... **MELÉCTIDÆ**

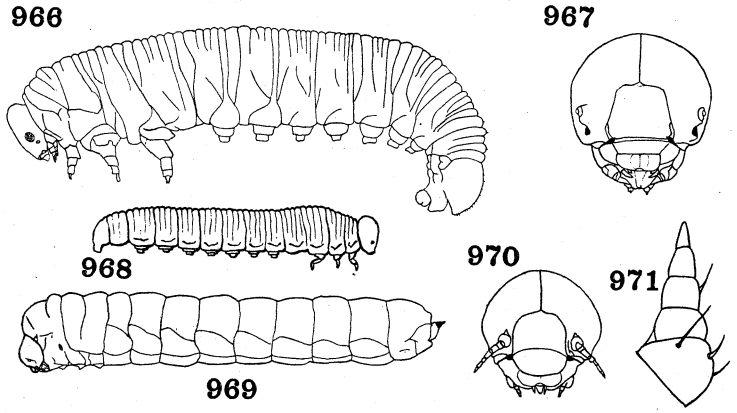
Larvae

At the present time it is impossible to give any reasonably complete or reliable key for the determination of the larvæ of the numerous families of Hymenoptera. Those of the suborder Chalastogastra have been quite extensively studied by several workers in Europe and in North America, and the grouping of these families below is based to a great extent on the work of Yuasa. Many of the larvæ of the other families have become so greatly specialized, modified, or reduced as a result of parasitism, maternal care, or from life as gall insects that the present, very incomplete knowledge affords no basis for a helpful key. Consequently references to habits have necessarily been introduced as differential characters, for the few of the higher forms that are included. It is thought, however, that the following summary will be helpful and reasonably reliable so far as it extends, although it must be borne in mind that the larvæ of only a small proportion of the species in any family are known, and that many families cannot be differentiated at all.

1. Body typically caterpillar-like (eruciform) (Figs. 966, 969), commonly with a color pattern; thoracic legs usually well developed, although sometimes much reduced; head much more strongly chitinized than the rest of the body; abdominal prolegs often present, entirely lost in some groups, but the body always retains an eruciform appearance. (Fig. 969). Antennæ and palpi almost always present and consisting of more than one joint. Mandibles strong, almost always with more than one tooth; ocelli frequently present. Alimentary canal continuous

through the body (except probably Oryssidæ). Larvæ generally free living, feeding externally on plants, boring internally in plant tissue, occasionally forming galls; parasitic only in the Oryssidæ. Suborder CHALASTOGÁSTRA 2

Body legless, of a distinctly helpless, coarctate type, without color pattern; head not heavily chitinized; mouthparts and antennæ much reduced; palpi soft and papilliform; antennæ



Figs. 966–971. **Larvæ of Hymenoptera**

966. **Neodiprion** (Middleton) Diprionidæ.
967. **Pteronidea,** head (Yuasa) Tenthridinidæ.
968. **Phyllotoma.** Tenthredinidæ.
969. **Tremex** (Yuasa) Siricidæ.
970. **Pamphilius,** head (Yuasa) Pamphiliidæ.
971. **Pteronidea,** maxillary palpus (Middleton) Tenthredinidæ.

soft, unjointed; mandibles weak, almost never with more than an apical tooth; ocelli absent; alimentary canal discontinuous, the mid-intestine and hind gut each closed and not connected with one another. (In some groups of Terebrantia and in some parasitic bees, hypermetamorphosis occurs and the first stage larvæ may be campodeiform or with much enlarged mandibles.) Larvæ not free-living, except in the first stage of some hypermetamorphic forms; parasitic, parasitoidal, or living upon a supply of food stored or fed by the mother, or by workers in the social groups; sometimes producing galls in plants. (Suborder CLISTOGÁSTRA) 30

2. Cerci present as distinctly segmented appendages.....3
Cerci absent, or present as unjointed vestiges.....4
3. Cerci multiarticulate, setiform; larvæ feeding externally on leaves.
a. Ocelli below and lateral to the antennæ. (Fig. 970). **PAMPHILÌIDÆ**
b. Ocelli below or near the antennæ.. **MEGALODÓNTIDÆ**
Cerci two-jointed, larva mining in the petioles of ferns. **BLASTICOTÓMIDÆ**
4. Abdominal prolegs present, well developed and distinctly jointed (except in a few leaf-mining forms).....5
Abdominal prolegs wanting; forms either feeding externally or boring in the stems or in woody plants or internal parasites of other insects; never leaf-miners.....26
5. Ten pairs of prolegs, one on each abdominal segment; antennæ with six or seven joints ..... **XYÉLIDÆ**
Six to eight pairs of abdominal prolegs (Fig. 968); reduced or absent in leaf-mining and gall-making forms; antennæ with five joints or less 6
6. Thoracic legs normal in form, five-jointed; if reduced always with tarsal claws; prolegs usually well developed.....7
Thoracic legs fleshy, indistinctly four-jointed; no tarsal claws; prolegs vestigial; larvæ leaf-miners.
Some **PHYLLOTOMÌNÆ**; **TENTHREDÍNIDÆ**
7. Prolegs present on abdominal segments 2–8 and 10; antennæ elongate, usually five-jointed.....8
Prolegs absent on segment 8 or on both 7 and 8; if present on 8, the antennæ are one- or two-jointed.....18
8. Legs five-jointed 9
Legs four-jointed 17
9. Third abdominal segment divided dorsally by transverse grooves into six parts (annulets) 10
Third abdominal segment dorsally with more or less than six annulets 13
10. Antennæ conical; five-jointed 11
Antennæ not conical; three-jointed, the third joint erect and peglike. (Fig. 966) .....Most **DIPRIÓNIDÆ**
11. Labrum bilaterally symmetrical; legs with the tibiæ shorter than the femora; tarsal claws short, strongly curved.....12
Labrum distinctly asymmetrical, tibiæ longer than the femora; tarsal claws slender, only slightly curved.
PHYLLOTOMÌNÆ; **TENTHREDÍNIDÆ**

12. Body rather robust, of uniform diameter throughout, with small distinct tubercles; tenth abdominal segment usually with several small protuberances above.
Some **BLENNOCAMPÌNÆ**; **TENTHREDÍNIDÆ**

Body rather slender, tapering behind, without small distinct tubercles or protuberances.
Some **EMPHYTÌNÆ**; **TENTHREDÍNIDÆ**

13. Third segment with seven annulets on the dorsum; body without conspicuous branched spines or tubercles.....14

Third segment with five, rarely three or four annulets on dorsum; body with conspicuous branched spines or tubercles.
Some **EMPHYTÌNÆ**; **TENTHREDÍNIDÆ**

14. Antennæ short, one-jointed; labrum divided into three parts by a pair of longitudinal sutures..... **CIMBÍCIDÆ**

Antennæ five-jointed; labrum without a pair of longitudinal grooves.....15

15. Prolegs provided with setæ; clypeus with three setæ on each side; labrum without a median longitudinal impression. Some **SELANDRIÌNÆ** and **EMPHYTÌNÆ**; **TENTHREDÍNIDÆ**

Prolegs without setæ; clypeus with two setæ at each side; labrum with or without median impression.....16

16. Tibia small, distinctly shorter than the femur.
Some **SELANDRIÌNÆ**; **TENTHREDÍNIDÆ**

Tibia usually subequal to or longer than the femur.
TENTHREDINÌNÆ; **TENTHREDÍNIDÆ**

17. Prothorax, mesothorax and last abdominal segment above not narrowed behind. Some **EMPHYTÌNÆ**; **TENTHREDÍNIDÆ**

Body not thus ornamented; body often much narrowed behind. (Fig. 968) . . Some **PHYLLOTOMÌNÆ**; **TENTHREDÍNIDÆ**

18. Thoracic legs five-jointed.....19

Thoracic legs with six joints, or with the first pair four-jointed and the others three-jointed..... **ÁRGIDÆ**

19. Anal prolegs present, often fused into a single median process. 20

Anal prolegs wanting.....25

20. Anal prolegs separate, present as a pair; antennæ with three to five joints.....21

Anal prolegs fused; antennæ one-jointed.
SCOLIONEURÌNÆ; **TENTHREDÍNIDÆ**

21. Antennæ with five joints; last abdominal segment with several protuberances above.
Some **HOLPLOCAMPÌNÆ**; **TENTHREDÍNIDÆ**

Antennæ with four, rarely three, joints; last abdominal segment without protuberances 22

22. First seven abdominal segments below each with an eversible gland; body often with numerous prominent setæ..... 23

No eversible glands on the abdomen below; body never conspicuously setose..... 24

23. Body with numerous conspicuous tubercles, each bearing several setæ of different lengths; setæ microscopically barbed; larvæ external feeders on leaves. **CLADIÌNÆ**; **TENTHREDÍNIDÆ**

Body usually without setigerous tubercles and never with tubercles bearing setæ of more than one size. Larvæ frequently leaf-rollers or gall-makers.... **NEMATÌNÆ**; **TENTHREDÍNIDÆ**

24. Antennæ four-jointed; third abdominal segment with five annulets..... Some **HOPLOCAMPÌNÆ**; **TENTHREDÍNIDÆ**

Antennæ one-jointed; third segment with three annulets. (**Acordulécera**) ..... Some **DIPRIÓNIDÆ**

25. Antennæ three-jointed; third abdominal segment with four annulets; body not depressed; larvæ feeding externally or boring in fruits and leaf petioles.

HOPLOCAMPÌNÆ; **TENTHREDÍNIDÆ**

Antennæ one- or two-jointed; third segment with two annulets; body depressed; larvæ leaf-miners.

FENUSÌNÆ; **TENTHREDÍNIDÆ**

26. Thoracic legs large, well developed and distinctly jointed; larvæ gregarious, feeding on leaves..... **PÉRGIDÆ**

Thoracic legs vestigial, indistinctly jointed or entirely wanting; abdomen usually with a spine-like process at tip..... 27

27. Ocelli present; antennæ with four or five joints; cerci present as minute one-jointed appendages; thoracic spiracles present; functional legs very small, indistinctly jointed .. **CÉPHIDÆ**

Ocelli absent; antennæ with three joints or less; cerci entirely absent 28

28. Antennæ with three joints. Larvæ wood-borers. **XIPHYDRÌIDÆ**

Antennæ with only a single joint..... 29

29. Metathoracic spiracles large, functional; abdomen with a spine at tip; larvæ wood-borers ..... **SIRÍCIDÆ**

Metathoracic spiracles vestigial, non-functional; abdomen without a spine at tip; larvæ parasitic on wood-boring insects.

ORÝSSIDÆ

30. Parasitic species feeding internally in the eggs, nymphs, larvæ or pupæ of other insects 31

Free living or feeding externally on other insects, spiders, etc. or on plant materials, sometimes within galls or in specially constructed cells or nests 32

31. Egg parasites. Various **CHALCIDÒIDEA**; some **SERPHÒIDEA** especially **SCELIÓNIDÆ**

Parasites of nymphs, larvæ or pupæ or rarely of adult insects. **ICHNEUMONÒIDEA**, many **CHALCIDÒIDEA**, and **SERPHÒIDEA**; **IBALÌIDÆ**; some **FIGÍTIDÆ**

32. Living in galls formed in the tissues of plants. **CYNÍPIDÆ** and some **FIGÍTIDÆ** that are parasitic on them; a few **CHALCIDÒIDEA** (some **EURYTÓMIDÆ** and a few **PERILÁMPIDÆ**)

Not in plant galls 33

33. Living attached externally on the bodies of immature or adult insects or spiders, sucking the body fluids through openings that they cut through the integument, occasionally crawling inside 34

Not external feeders attached to the bodies of other insects or spiders 35

34. Food-insect and feeder living in the cell, burrow or cavity in which the food-insect normally occurs when not parasitized; *i.e.* the food has not been removed from its normal habitat. Most of the lower **VESPÒIDEA** (**SCOLÌIDÆ**, **TIPHÌIDÆ**, etc.); **DRYÍNIDÆ** (on Leaf-hoppers); **RHOPALOSOMÁTIDÆ**; **PELECÍNIDÆ**; **BETHÝLIDÆ**

Food-insects or spiders and feeder in a cavity, burrow, or specially constructed cell in which the food has been placed after being stung by the mother wasp; the cells or individual nests single, or if several cells are attached together, each is closed after being supplied with food and the larvæ receive no further care. Solitary Wasps.

SPHECÒIDEA, and most non-social **VÉSPIDÆ**

35. Solitary forms, living in specially constructed cells with a store of honey and pollen; the cells usually single, but if in small groups, each is separately sealed after completion and contains a single larva ..... (**APOÌDEA**); a few **VÈSPIDÆ** (**MASARIDÌNÆ**)

Social forms, living in communal nests together with numerous others and attended by adult ants, bees or wasps of the same species 36

36. Living within hexagonal cells of papery material and fed by attendant wasps on malaxated insect-food .... Social **VÈSPIDÆ**

Not in hexagonal papery cells 37

37. Nests consisting of cells constructed of wax, often mixed with much earthy or other material. Social Bees.....38
Nests excavated in soil, in twigs, or other diverse locations, sometimes consisting of papery material or containing silk, but never with hexagonal cells; body usually provided with some simple, hooked or otherwise modified stiff setæ. Ants. **FORMÍCIDÆ**

38. Cells hexagonal in cross section..... **ÁPIDÆ**
Cells rounded. Bumble-bees..... ..... **BÓMBIDÆ**

LITERATURE ON HYMENOPTERA, GENERAL

André, E. and others. Spécies des Hyménoptères d'Europe et d'Algérie. 116 parts (1882–1920). (An extensive work, covering a number of families; we have not listed the parts separately).

Ashmead, W. H. Hymenoptera. In Fauna Hawaiiensis (1901).

Bingham, C. T. and C. Morley, Hymenoptera. Fauna of British India, 3 vols. (1897–1913).

Bischoff, H. Biologie der Hymenopteren. Berlin, J. Springer, 598 pp. (1927).

Börner, C. Stammesgeschichte der Hautflügler. Biol. Zentralbl., **39**, pp. 145–186 (1919).

Cameron, P. Biologia centrali Americana, Hymenoptera, **1**, pp. 1–487 (1883–1900); **2**, pp. 1–143 (1888–1900).
Hymenoptera orientalia. Mem. Manchester Philos. Soc. (various parts) (1889–1903).

Cresson, E. T. Hymenoptera of Cuba. Proc. Entom. Soc. Philadelphia, **4**, pp. 1–196 (1865).
Synopsis of Families and Genera of Hymenoptera of America North of Mexico. Am. Ent. Soc., 1887, 350 pp. (1887).

Dalla Torre, K. Catalogus Hymenopterorum. 10 vols. Leipzig (1892–1902).

Hedicke, H. Hymenoptera. In Tierwelt Mitteleuropas, **5**, Lief. 1, pp. XI 1–246 (1930).

Kirby, W. F. List of Hymenoptera of New Zealand. Trans. Entom. Soc. London, 1881, pp. 35–50 (1881).

Mocsáry, A. Literatura Hymenopterorum. Termes. Füzetek, **6**, pp. 7–122, (1882). (Extensive list, arranged alphabetically by authors).
Hymenoptera. Fauna Regni Hungariæ, pp. 7–113 (1918).

Schmiedeknecht, O. Die Hymenopteren Mitteleuropas. Jena (1930). (An earlier edition appeared in 1904).

Viereck, H. L., A. D. MacGillivray, C. T. Brues, W. M. Wheeler, and S. A. Rohwer. The Hymenoptera or Wasp-like Insects of Connecticut. Bull. State Geol. Nat. Hist. Surv., Connecticut, No. 22 (1916).

SUBORDER CHALASTOGASTRA

ASHMEAD, W. M. Classification of Horntails and Sawflies. (Chalastogastra). Canadian Entom., **30-36** (1898, 1903, 1904).

BRADLEY, J. C. The Siricidæ of North America. Pomona Journ. Entom. and Zool., **5**, pp. 1–30 (1913).

CAMERON, P. A Monograph of the British Phytophagous Hymenoptera. London, Ray Soc., 4 vols. (1882–1893).

ENSLIN, E. Tenthredinoidea. In Insekten Mitteleuropas, **3**, pp. 95–213, Stuttgart (1914).

KONOW, F. W. Lydidæ. Gen. Insectorum, fasc. 27, 27 pp. (1905).
Siricidæ. Gen. Insectorum, fasc. 28, 14 pp. (1905).
Tenthredinidæ. Gen. Insectorum, fasc. 29, 176 pp. (1905).

MORICE, F. D. Australian Sawflies. Trans. Entom. Soc. London, 1918, pp. 247–333 (1919).

NIELSEN, J. C. and K. HENRIKSEN. Danish Siricidæ and Sawflies (in Danish). Danmarks Fauna, pt. 18, 234 pp. (1915).

ROHWER, S. A. Genera of Pamphiliinæ. Canadian Entom., **42**, pp. 215–220 (1910).
Classification of Chalastogastra. Proc. Entom. Soc. Washington, **13**, pp. 215–226 (1911).
Studies in Oryssoidea. Proc. U. S. Nat. Mus., **43**, pp. 141–158 (1913).

ROHWER, S. A. and R. A. CUSHMAN. Idiogastra, a new suborder of Hymenoptera. Proc. Ent. Soc. Wash., **19**, pp. 89–98 (1917).

YUASA, H. A Classification of the Larvæ of the Tenthredinoidea. Illinois Biol. Monogr., **7**, No. 4, Urbana (1922).

ICHNEUMONOIDEA

ASHMEAD, W. H. Classification of the Ichneumon Flies or the Superfamily Ichneumonoidea. Proc. U. S. Nat. Mus., **23**, 220 pp. (1900).

AYYAR, T. V. R. Catalogue of Indian Braconidæ. Rept. Proc. 5th Entom. Meeting, Pusa, pp. 352–362 (1923).

BAKER, C. F. Chelonini of the Philippines (Braconidæ). Philippine Journ. Sci., **31**, pp. 451–489 (1926).

BERTHOUMIEU, V. Ichneumonidæ, Ichneumoninæ. Gen. Insectorum, fasc. 18, 87 pp. (1904).

BRADLEY, J. C. Family Roproniidæ. Entom. News, **16**, pp. 14–17 (1905).
The Evaniidæ. Trans. American Entom. Soc., **34**, pp. 101–194 (1908).

BRUES, C. T. South African Evaniidæ, Braconidæ, Alysiidæ and Plumariidæ, with catalogue of species. Ann. South African Mus., **19**, pp. 1–150 (1924).
Ethiopian Braconidæ, with a List of the African Species. Proc. Amer. Acad. Arts Sci., **61**, pp. 205–436 (1926).

CRESSON, E. T. Species of the Subfamily Ichneumoninæ (Nearctic). Trans. American Entom. Soc., **6**, pp. 129–212 (1877).

CUSHMAN, R. A. Revision of American Cremastini. Proc. U. S. Nat. Mus., **53**, pp. 503–551 (1917).

North American Lycorini, Polysphinctini and Theroniini. (Ichneumonidæ). Proc. U. S. Nat. Mus., **58**, pp. 7–48 (1920).

Tribe Ephialtini. Proc. U. S. Nat. Mus., **58**, pp. 327–362 (1920).

New Oriental and Australian Ichneumonidæ, with key to Genera of Cryptinæ. Philippine Journ. Sci., **20**, pp. 543–595 (1922).

Genera of Paniscini (Ichneumonidæ). Proc. U. S. Nat. Mus., **64**, Art. 20, 48 pp. (1924).

Revision of the North American Ichneumon-flies of Mesostenus and related genera. Proc. U. S. Nat. Mus., **74**, Art. 16, 58 pp. (1929).

CUSHMAN, R. A. and S. A. ROHWER. Holarctic tribes of Ichneumoninæ. Proc. U. S. Nat. Mus., **57**, pp. 379–396 (1920).

North American Acænitini (Ichneumonidæ). Proc. U. S. Nat. Mus., **57**, pp. 503–523 (1921).

DAVIS, G. C. A Review of the Tryphoninæ. Trans. American Entom. Soc., 24, pp. 193–348 (1897).

DUTT, G. R. Stephanidæ. Cat. Indian Ins. Govt. India, Centr. Pub. Br., Calcutta, pt. 10, (1925).

ELLIOTT, E. A. Monograph of the Stephanidæ. Proc. Zool. Soc. London, 1922, pp. 705–831 (1922).

ENDERLEIN, G., Die Braconiden-Subfamilie Mimagathidinæ. Zool. Anz., **28**, pp. 449–454 (1905).

Ueber die Klassification der Stephaniden. Zool. Anz., **28**, pp. 473–477 (1905).

Zur Kenntnis aussereuropäischen Braconiden (Key to Genera of Agathidinæ). Arch. Naturg., Jahr. 87A, Heft 11, pp. 51–224 (1920).

FAHRINGER, J. Opuscula Braconologica. Vienna (1925–). A number of parts have appeared and the work is being continued.

FROGGATT, W. W. Notes on Megalyra. Proc. Linn. Soc. New South Wales, **31**, pp. 399–407 (1906).

GAHAN, A. B. Aphididiinæ of North America. Bull. 152, Maryland Agric. Expt. Sta., pp. 147–200 (1911).

Revision of North American Opiinæ (Braconidæ). Proc. U. S. Nat. Mus., **49**, pp. 63–95 (1916).

HOOKER, C. W. The Ichneumonidæ of the Tribe Ophionini. Trans. American Entom. Soc., **38**, pp. 1–176 (1912).

KIEFFER, J. J. Evaniidæ. Gen. Insectorum, fasc. 2, 13 pp. (1902).

Stephanidæ. Gen. Insectorum, fasc. 77, 10 pp. (1908).

Evaniidæ (including Aulacidæ and Gasteruptionidæ). Das Tierreich, Lief. 30, 432 pp. (1912).

Evaniiden der Philippinen. Philippine Journ. Sci., **11D**, pp. 317–346 (1914).

KRIECHBAUMER, J. Beitrag zu einer Monographie der Joppinen. Berliner Entom. Zeits., **43**, pp. 1–166 (1899).

KEIEGER, R. Revision of Pimpla and Allies (Ichneumonidæ). Ber. naturf. Ges. Leipsig, Jahrg. 1897–98, pp. 47–124 (1898).

Ueber die Ichneumonidengattungen Neotheronia und Theronia. Zeits. Hym. Dipt., Jahrg. **5** and **6** (1905–06) (several parts).

Die Ichneumonidengattung Lissopimpla. Zeits. Hym. Dipt. 1907, pp. 294–302 (1907).

MARSHALL, T. A. Monograph of the British Braconidæ. Trans. Entom. Soc. London, 1885–1899 (seven parts) (1885–99).

MORLEY, C. Ichneumonidæ of Great Britain. 3 vols. (1903–08).

Catalogue of British Chalcididæ. London, 74 pp. (1910).

Revision of Ichneumonidæ. London, British Mus. Nat. Hist. 4 pts. (1912–15).

Notes on Braconidæ. XIII. Dacnusides. Entomologist, **57**, pp. 193–198; 250–255 (1924).

MUESEBECK, C. F. W. Revision of North American Apanteles. Proc. U. S. Nat. Mus., **58**, No. 2349, pp. 483–576 (1920).

Revision of North American Neoneurinæ and Microgasterinæ. Proc. U. S. Nat. Mus., **61**, No. 2436, art. 15, pp. 1–76 (1922).

Revision of North American Microbracon (Braconidæ). Proc. U. S. Nat. Mus., **67**, Art. 8, 85 pp. (1925).

Revision of Braconinæ of North America. Proc. U. S. Nat. Mus., **69**, Art. 16, pp. 1–73 (1927).

ROHWER, S. A. Tribe Xoridini (Ichneumonidæ). Proc. U. S. Nat. Mus., **45**, pp. 353–361 (1913).

North American Cenocœlius (Braconidæ). Canadian Entom., pp. 316–322 (1914).

North American Labenini, Rhyssini, Xoridini, Odontomerini, Phytodietini (Ichneumonidæ). Proc. U. S. Nat. Mus., **57**, pp. 405–474 (1921).

ROMAN, A. Systematische Stellung von Neorhacodes. Entom Tidskr., **44**, pp. 169–174 (1923).

SCHLETTERER, A. Revision of Gasteruptionidæ. Abh. zool.-bot. Ges. Wien, **35**, pp. 267–326 (1885).

Die Hymenopteren Gruppe derEv aniiden. Ann. k. k. naturh. Hofmus. Wien, **4**, pp. 107–180; 289–338, 373–546 (1889).

Revision of Stephanidæ. Berliner Entom. Zeits., **33**, pp. 71–160 (1889).

Die Hymenopteren-Gattungen Stenophasmus, Monomachus, Pelecinus, Megalyra. Berliner Entom. Zeits., **33**, pp. 198–250 (1889).

SCHMIEDEKNECHT, O. Opuscula Ichneumonologica. Blankenburg (1902–1931) (numerous fascicles and additions dealing with palæarctic Ichneumonidæ).

Ichneumonidæ, Pimplinæ. Gen. Insectorum, fasc. 62, 120 pp. (1908).

Ichneumonidæ, Cryptinæ and Ophioninæ, part. Gen. Insectorum, fasc. 34, 71 pp.; fasc. 75, 165 pp.; fasc. 114, 100 pp. (1905, 1908, 1911).

Die Ichneumonidengattung Pimpla. Zeits. angew. Entom., **1**, pp. 396–478 (1914).

SCHULZ, W. A. Beitrag zur Kenntniss der Familie Pelecinidæ. S. B. Akad. Wiss., München, **33**, pp. 435–450 (1903).

Trigonalidæ. Gen. Insectorum, fasc. 61, 24 pp. (1908).

Systematische Uebersicht der Monomachiden. Proc. 1st Congr. Entom., Brussels, pp. 405–424 (1911).

STRICKLAND, E. H. North American Pezomachini (Ichneumonidæ). Ann. Entom. Soc. America, **5**, pp. 113–140 (1912).

SZÉPLIGETI, G. V. Braconidæ. Gen. Insectorum, fasc. 22, 253 pp. (1904).

TOSQUINET, J. Ichneumonides d'Afrique. Mém. Soc. Entom. Belgique, **5**, 430 pp. (1896).

UCHIDA, T. Erster Beitrag zur Ichneumoniden Japans. Journ. Coll. Agric. Kokkaido Imp. Univ., **18**, pp. 43–173 (1926).

VIERECK, H. L. Type Species of the Genera of Ichneumon Flies. Bull. 83, U. S. Nat. Mus., pp. 1–186 (1914).

List of families and subfamilies of Ichneumonoidea. Proc. Biol. Soc. Washington, **31**, pp. 69–74 (1918); also ibid., **32**, p. 48 and 198 (1919).

WATERSTON, J. Dinapsidæ. Ann. Mag. Nat. Hist., (9) **10**, pp. 418–420 (1922).

CHALCIDOIDEA

ASHMEAD, W. H. Classification of Chalcid Flies or the superfamily Chalcidoidea. Mem. Carnegie Mus., Pittsburg, **1**, No. 4, pp. 225–551 (1904).

AYYAR, T. V. R. Check list of Indian Chalcidoidea. Spolia Zeylandica, **13**, pp. 235–254 (1925).

CRAWFORD, J. C. Synopsis of North American Perilampidæ. Proc. Entom. Soc. Washington, **16**, pp. 69–76 (1914).

GAHAN, A. B. and M. M. FAGAN. Type Species of Genera of Chalcidoidea. Bull. U. S. Nat. Mus., No. 124, 173 pp. (1923).

GIRAULT, A. A. Australian Hymenoptera Chalcidoidea. Mem. Queensland Mus., 365 pp. (1912–16). (Numerous parts and supplements dealing with all the families).

Systematic monograph of the Signiphorinæ. Proc. U. S. Nat. Mus., **45**, pp. 189–233 (1913).

Revision of Trichogrammatidæ. Bull. Wisc. Soc., **11**, pp. 150–179; **12**, pp. 59–71 (1913–14).

GRANDI, G. Catalogo dei Agaonidi. Boll. Lab. Entom. Instit. Sup. Agrar., Bologna, **1**, pp. 107–235 (1928).

HOWARD, L. O. New Genera and Species of Aphelininæ, with a Revised Table of Genera. Bull. U. S. Dept. Agric. Tech. Ser., No. 12, pt. 4 (1907).

KIRBY, W. F. Synopsis of Genera of Eucharididæ. Journ. Linn. Soc., London, Zool., **20**, pp. 28–37 (1886).

KRYGER, J. P. The European Trichogrammatidæ. Entom. Meded., **12**, pp. 257–354 (1918–19).

MAYR, G. Die europäischen Torymiden. Verh. zool.-bot. Ges. Wien, **24**, pp. 53–142 (1874).

Die europäischen Encyrtiden. Verh. zool.-bot. Ges. Wien, **25**, pp. 676–778 (1875).

MERCET, R. G. Fauna Iberica; Encírtidos. Mus. Nac. Cienc. Nat. Madrid, 732 pp. (1921).

RUSCHKA, F. Die europäischen Arten der mit Monodontomerus verwandte Gattungen. Zeits. angew. Entom., **9**, pp. 395–408 (1923).

Die europäischen Eucharidinæ und Perilampinæ. Deutsch. Entom. Zeits., 1924, pp. 82–96 (1924).

SCHLETTERER, A. Leucospididæ. Berliner Entom. Zeits., **35**, pp. 141–302 (1890).

SCHMIEDEKNECHT, O. Chalcidoidea. Gen. Insectorum, fasc. 97, 550 pp. (1909).

WELD, C. J. Revision of American Leucospididæ. Proc. U. S. Nat. Mus., **61**, art. 6, pp. 1–43 (1922).

SERPHOIDEA

ASHMEAD, W. H. A Monograph of the North American Proctotrypidæ. Bull. U. S. Nat. Mus., No. 45 (1893).

Classification of the pointed-tailed wasps or the superfamily Proctotrupoidea. Journ. New York Entom. Soc., **10**, p. 241; **11**, pp. 28 and 86 (1902–03).

BRUES, C. T. Scelionidæ. Gen. Insectorum, fasc. 80, 59 pp. (1908), with supplement by J. J. Kieffer.

CRAWFORD, J. C. A new family of parasitic Hymenoptera (Vanhorniidæ). Proc. Entom. Soc. Wash., **2**, pp. 63–64 (1909).

FOUTS, R. M. Revision of North American Platygasterinæ. Proc. U. S. Nat. Mus., **63**, art. 15a, pp. 1–145 (1924).

KIEFFER, J. J. Revision des Scélionides. Ann. Soc. Sci. Brussels, **32**, pp. 111–250 (1908).

Ceraphronidæ. Gen. Insectorum, fasc. 94, 27 pp. (1909).

Serphidæ. Gen. Insectorum, fasc. 95, 10 pp (1909).

Belytidæ. Gen. Insectorum, fasc. 107, 47 pp. (1910).

Diapriidæ. Gen. Insectorum, fasc. 124, 75 pp. (1911).

Serphidæ. Das Tierreich, Lief. 42, 254 pp. (1914).

Diapriidæ. Das Tierreich, Lief. 44, 627 pp. (1916).

Scelionidæ. Das Tierreich, Lief. 48, 885 pp. (1926).

CYNIPOIDEA

ASHMEAD, W. H. Classification of Cynipoidea. Psyche, **10**, pp. 7, 59, 140 (1903).

DALLA TORRE, W. and J. J. KIEFFER. Cynipidæ. Gen. Insectorum, fasc. 9–10, 84 pp. (1902).

Cynipidæ. Das Tierreich, Lief. 24 (1910).

FULLAWAY, D. T. Monograph of the Gall making Cynipidæ of California. Ann. Entom. Soc. America, **4**, pp. 331–380 (1911).

KIEFFER, J. J. Cynipidæ. In Insekten Mitteleuropas, **3**, pp. 1–94, Stuttgart (1914).

KINSEY, A. C. New Species and Synonymy of American Cynipidæ. Bull. American Mus. Nat. Hist., **42**, pp. 293–317 (1920).

Phylogeny of Cynipid Genera and Biological Characteristics. Bull. American Mus. Nat. Hist., **42**, pp. 357–402 (1920).

ROHWER, S. A. and M. M. FAGAN. The type species of the genera of the Cynipoidea. Proc. U. S. Nat. Mus., **53**, pp. 357–380 (1917); **55**, pp. 237–240 (1919).

WELD, L. H. Cynipidæ; Genera of Liopterinæ and Oberthuerellinæ. Philippine Journ. Sci., **21**, pp. 323–335 (1922).

ACULEATA, GENERAL

ASHMEAD, W. H. Classification of the fossorial, predaceous and parasitic wasps or the superfamily Vespoidea. Canad. Entom., **32**, **34**, **35**, **36** (1900–04). (Various parts published at intervals).

BERLAND, L. Hyménoptères Vespiformes. (Vespidæ, Bethylidæ, Dryinidæ, Embolemidæ). Faune de France, **19**, pt. 2, 208 pp., Paris (1928).

BETHYLOIDEA

ASHMEAD, W. H. Rhopalosomidæ, a new family of Wasps. Proc. Entom. Soc. Washington, **3**, pp. 303–309 (1896).

BRUES, C. T. Note on the Hymenopterous family Rhopalosomatidæ. Psyche, **33**, pp. 18–19 (1926).

FULLAWAY, D. T. Revision of Hawaiian Sierola (Bethylidæ). Occ. Pap. Bishop Mus., Honolulu, **7**, pp. 57–159 (1920).

KIEFFER, J. J. Dryinidæ. Gen. Insectorum, fasc. 54, 33 pp. (1907).

Bethylidæ. Gen. Insectorum, fasc. 76, 50 pp. (1908).

Bethylidæ. Das Tierreich, Lief. 41, 595 pp. (1914).

PERKINS, R. C. L. Leaf Hoppers and their Natural Enemies. Dryinidæ. Bull. Hawaiian Sugar Planters Expt. Sta., No. 1, pt. 1 (1905).

CHRYSIDOIDEA

AARON, S. F. The North American Chrysididæ. Trans. American Entom. Soc., **12**, pp. 209–248 (1885).

BISCHOFF, H. Chrysididæ. Gen. Insectorum, fasc. 151, 86 pp. (1913).

BRIDWELL, J. C. Family Alienidæ. Proc. Hawaiian Entom. Soc., **4**, p. 117 (1919).

DUCKE, A. As Chrysididas do Brazil. Cat. Faun. Brasiliera Mus. Paulista, São Paulo, **4**, pp. 1–31 (1913).

Mocsáry, A. Monographia Chrysidarum Orbis Terrarum Universi. Budapest, Soc. Franklinianæ (1889).

Trautmann, W. Die Goldwespen Europas. Weimar, 194 pp. (1927).

SCOLIOIDEA

André, E. Mutillidæ. Gen. Insectorum, fasc. 11, pp. 77 (1903).

Bibliographie générale des Mutillides. Rev. Entom., **29**, pp. 134–166 (1910).

Betrem, J. C. Monographie der Indo-australischen Scoliiden. Treubia, **9**, suppl. 388 pp. (1928).

Bischoff, H. Konowiellidæ (Plumariidæ). Entom. Rundschau, Jahrg. 31, pp. 67–69 (1914).

Monographie der Mutilliden Afrikas. Arch. Naturg., Jahrg. 86A, Heft. 1–5, 830 pp. (1920–21).

Blake, C. A. Monograph of the Mutillidæ of North America. Trans. American Entom. Soc., **13**, pp. 179–286 (1886).

Bradley, J. C. Monograph of North American Mutillidæ. Trans. American Entom. Soc., **42**, pp. 187–214; 309–336 (1916).

Review of the Myrmosidæ. Trans. American Entom. Soc., **43**, pp. 247–290 (1917).

Bradley, J. C. and J. Bequaert. Revision of Mutillidæ of Belgian Congo. Bull. American Mus. Nat. Hist., **58**, pp. 63–122 (1928).

Cresson, E. T. Synopsis of North American species of Sapyga. Trans. American Entom. Soc., **8**, pp. xx–xxi (1880).

Ducke, A. O Genero Pterombrus. Rev. Mus. São Paulo, **9**, pp. 107–122 (1914).

Fox, W. J. The North American Mutillidæ. Trans. American Entom. Soc., **25**, pp. 219–292 (1899).

Guiglia, D. Gli Scoliidei della Liguria. Ann. Mus. Stor. Nat. Genoa, **52**, pp. 424–460 (1928).

Malloch, J. R. Systematic notes on North American Brachycistinæ. Proc. U. S. Nat. Mus., **68**, Art. 3, pp. 1–28 (1926).

Micha, I. Beitrag zur Kenntnis der Scoliiden. Mitt. Zool. Mus. Berlin, **13**, pp. 1–156 (1927).

Mickel, C. E. Monograph N. Am. Dasymutilla. Bull. U. S. Nat. Mus., No. 134. pp. 39–340 (1928).

Turner, R. E. Revision of the Thynnidæ of Australia. Proc. Linn. Soc. New South Wales, **32**, pp. 206–290 (1907).

Thynnidæ. Gen. Insectorum, fasc. 105, 62 pp. (1910).

FORMICOIDEA

Arnold, G. Monograph of the Formicidæ of South Africa. Ann. South African Mus., **23**, pp. 191–295 (1926). Also **14**, pp. 159–270 (1916).

Bingham, C. T. Ants of British India. Fauna of British India, Hymenoptera, vol. 2 (1903).

BORGMEIER, T. Catálogo systemático e synonymico das Formigas do Brasil. Arch. Mus. Nac. Rio de Janeiro, **24**, pp. 33–103 (1924) and ibid., **27**, pp. 69–164 (1927).

BRUCH, C. Catálogo de los Formícidos Argentinos. Rev. Mus. La Plata, **19**, pp. 211–234; 527–537 (1915).

DONISTHORPE, H. ST. J. K. British Ants, their Life History and Classification, London, Routledge & Sons, 1927, 436 pp.

EMERY, C. Formicidæ, Dorylinæ. Gen. Insectorum, fasc. 102, 34 pp. (1910).

Formicidæ, Ponerinæ. Gen. Insectorum, fasc. 118, 125 pp. (1911).

Formicidæ, Dolichoderinæ. Gen. Insectorum, fasc. 137, 50 pp. (1913).

Fauna entomologica italiana, Formicidæ. Bull. Soc. Entom. Ital., **47**, pp. 79–275 (1916).

Formicidæ, Myrmicinæ. Gen. Insectorum, fasc. 174, 174A and B, 206 pp. (1921–22).

Formicidæ, Formicinæ. Gen. Insectorum, fasc. 183, 302 pp. (1925).

FOREL, A. Les Formicides. In Grandidier, Hist. Madagascar, **20**, pt. 2, 280 pp. (1891).

Les Formicides de l'Empire des Indes et de Ceylon. Journ. Bombay Nat. Hist. Soc., **8** and **9** (several parts). (1894–95).

Die Ameisen der Schweiz. Mitt. schweizerischen Entom. Ges. suppl. to **12**, 77 pp. (1915).

Cadre synoptique des Fourmis. Bull. Soc. Vaud., **51**, pp. 229–253 (1917).

LUEDERWALDT, H. Chave para determinar os Dorylineos Brasilieros. Rev. Mus. Paulista, **12**, pp. 229–257 (1920).

STITZ, H. Formicidæ. Die Insekten Mitteleuropas, **2**, pp. 1–111, Stuttgart (1914).

WHEELER, W. M. Ants, their Structure and Behavior. 663 pp. Columbia University Press, New York (1910).

Keys to the Genera and Subgenera of Ants. Bull. American Mus. Nat. Hist., New York, **45**, pp. 631–710 (1922).

WHEELER, W. M. and J. W. CHAPMAN. The Ants of the Philippine Islands. Pt. 1. Dorylinæ and Ponerinæ. Philippine Journ. Sci., **28**, pp. 47–71 (1925).

VESPOIDEA

BEQUAERT, J. Revision of the Vespidæ of the Belgian Congo. Bull. American Mus. Nat. Hist., **39**, pp. 1–384 (1918).

BRADLEY, J. C. Taxonomy of the Masarid wasps, including a monograph of the North American Species. Univ. California Publ., Tech. Bull., **1**, pp. 369–464 (1922).

BUYSSON, R. Monographie des Vespides. Ann. Soc. Entom. France, **73** and **74**, several parts, incomplete (1904–06).

DALLA TORRE, K. W. Vespidæ. Gen. Insectorum, fasc. 19, 108 pp. (1904).

DUCKE, A. Révision des guêpes sociales polygames. Ann. Mus. Nat. Hungarici, **8**, pp. 449–544 (1910).

Ueber Phylogenie und Klassifikation der sozialen Vespiden. Zool. Jahrb. Abth. f. Syst., **36**, pp. 303–330 (1914).

Catálogo das Vespas Sociaes do Brazil. Rev. Mus. Paulista, **10**, pp. 314–374 (1918).

ISELY, D. Synopsis of North American Eumenidæ. Ann. Entom. Soc. America, **10**, pp. 345–366 (1917).

SAUSSURE, H. Synopsis of American wasps. Misc. Coll. Smithsonian Institution, Washington, No. 254 (1875).

ZAVATTARI, E. Materialien zu einer Monographie der Neotropischen Eumeniden. Arch. f. Naturg., **78**A, Heft 4, pp. 1–272 (1912).

PSAMMOCHAROIDEA

BANKS, N. Psammocharidæ: Classification and Descriptions. Journ. New York Entom. Soc., **19**, pp. 219–237 (1911).

HAUPT, H. Monographie der Psammocharidæ von Mittel Nord- und Osteuropa. Beiheft, Deuts. Entom. Zeits. (1926–27).

Weiterer Ausbau meines Systems der Psammocharidæ. Mitt. Zool. Mus. Berlin, **15**, pp. 109–197 (1929).

Classification of Psammocharidæ with two cubital cells. Mitt. Zool. Mus. Berlin, **16**, pp. 673–797 (1930).

LUCAS, R. Die Pompilidengattung Pepsis. Berliner Entom. Zeits., **39**, pp. 449–480 (1894).

SUSTERA, O. Die paläarktischen Gattungen der Psammocharidæ. Verh. zool.-bot. Ges. Wien, **62**, pp. 171–213 (1912).

SPHECOIDEA

ARNOLD, G. The Sphegidæ of South Africa. Ann. Transv. Mus., **9**, **10**, **12**, **13**, **14** (1922–31).

ASHMEAD, W. H. Classification of Sphegoidea. Canadian Entom., **31**, p. 145, 161, 212, 238, 291, 345 (six parts) (1899).

BOUWMAN, B. E. De Graafwespen van Nederland. Levende Natuur, Amsterdam, **31**, **32**, **33** (numerous parts) (1927–28).

BRADLEY, J. C. North American Nyssonidæ. Trans. American Entom. Soc., **46**, pp. 113–132 (1920).

CRESSON, E. T. Monograph of the Philanthidæ of North America. Proc. Entom. Soc. Philadelphia, **5**, pp. 85–132 (1865).

FERNALD, H. T. The Digger Wasps of North America, subfamily Chlorioninæ. Proc. U. S. Nat. Mus., **31**, pp. 291–423 (1906).

FOX, W. J. The North American Pemphredonidæ. Trans. American Entom. Soc., **19**, pp. 307–326 (1892).

The North American Larridæ. Proc. Acad. Nat. Sci. Philadelphia, 1893, pp. 467–551 (1894).

The Crabronidæ of Boreal America. Trans. American Entom. Soc., **22**, pp. 129–226 (1895).

KOHL, F. Zur Kenntnis der Pemphredonen. Ann. naturh. Hofmus. Wien, **5**, pp. 49–65 (1890).

Die Larriden. Verh. zool.-bot. Ges. Wien, **34**, pp. 171–268, 327–454 (1885).

Monographie der Gattung Sphex. Ann. naturh. Hofmus. Wien, **5**, pp. 77–194, 317–462 (1890).

Die Hymenopterengattung Philanthus. Ann. naturh. Hofmus. Wien, **6**, pp. 345–370 (1891).

Über Ampulex Jur. und verwandten Hymenopterengattungen. Ann. naturh. Hofmus. Wien, **8**, pp. 455–516 (1893).

Zur Monographie der Gattung Sphex. Ann. naturh. Hofmus. Wien, **10**, pp. 42–74 (1895).

Die Gattungen der Sphegiden. Ann. naturh. Hofmus. Wien, **11**, pp. 233–516 (1896).

Monographie der Gattung Podium. Abh. zool.-bot. Ges. Wien, **1**, Heft 4, pp. 1–101 (1902).

Monographie der Gattung Ammophila. Ann. naturh. Hofmus. Wien, **21**. pp. 228–382 (1906).

Die Crabronen der paläarktischen Region. Ann. naturh. Hofmus. Wien, **29**, pp. 1–453 (1915).

Die Hautflüglergruppe der Sphecinen. IV. Sceliphron. Ann. naturh. Hofmus. Wien, **32**, pp. 1–170 (1918).

MICKEL, C. E. A Synopsis of the Sphecoidea of Nebraska (Hymenoptera). Nebraska Univ. Studies, **17**, pp. 342–456 (1918).

PARKER, J. B. A Revision of the Bembicine Wasps of America North of Mexico. Proc. U. S. Nat. Mus., **52**, pp. 1–155 (1917).

A Generic Revision of the Fossorial Wasps of the tribes Stizini and Bembecini. Proc. U. S. Nat. Mus., **75**, art. 5, 203 pp. (1929).

PATE, V. S. L. Studies in Oxybeline Wasps. Entom. News, **40**, pp. 219–222 (1929).

ROHWER, S. A. North American genera of Nyssonidæ. Proc. U. S. Nat. Mus., **59**, pp. 403–413 (1921).

SCHLETTERER, A. Die Hymenopteren Gattung Cerceris. Zool. Jahrb. Abth. Syst., **2**, pp. 349–510 (1887).

WILLIAMS, F. X. The Larridæ of Kansas. Kansas Univ. Sci. Bull., **8**, pp. 117–213 (1913).

Larridæ of the Philippines. Bull. Hawaiian Sugar Planters Assoc., No. 19, pp. 61–101 (1928).

APOIDEA

ALFKEN, J. D. Die Bienenfauna von Ostpreussen. Schrift. Königsberg, **53**, pp. 114–182 (1912).

ASHMEAD, W. H. Classification of Apoidea. Trans. American Entom. Soc., **26**, pp. 49–100 (1899).

BISCHOFF, H. Zur Kenntnis afrikanischer Schmartozerbienen. Deuts. Entom. Zeits., 1923, pp. 585–603 (1923).

BLÜTHGEN, P. Beiträge zur Kenntnis der afrikanischen Halictinæ. Zool. Jahrb. Abth. f. Syst., **55**, pp. 163–252 (1928).

COCKERELL, T. D. A. North American Anthophoridæ. Trans. American Entom. Soc., **32**, pp. 63–116 (1906).

Genera of Colorado Bees. Univ. Colorado Stud., **16**, pp. 99–126 (1928).

DUCKE, A. Die Bienengattung Osmia. Ber. naturf. Ver. Innsbruck, **25**, pp. 1–323 (1900).

FRANKLIN, H. J. The Bombidæ of the New World. Trans. American Entom. Soc., **38**, pp. 177–486; **39**, pp. 73–200 (1912–13).

FRIESE, H. Monographie der Gattung Ceratina. Termes. Füzetek, **19**, pp. 34–65 (1896).

Monographie der Gattung Panurgus. Termes. Füzetek, **20**, pp. 78–102 (1897).

Monographie der Gattung Megacilissa. Ann. Hofmus. Wien, **13**, pp. 59–86 (1908).

Monographie der Gattung Euglossa. Termes. Füzetek, **21**, pp. 117–172 (1899).

Monographie der Gattung Exomalopsis und Tetrapedia. Ann. Hofmus. Wien, **14**, pp. 247–304 (1899).

Monographie der Gattung Centris. Ann. Hofmus. Wien, **16**, pp. 237–350 (1901).

Die Bienen Afrikas. Jena. Denkschr., **14**, pp. 85–475 (1909).

Die Bienenfauna von Neuguinea. Ann. Mus. Hist. Nat. Hungarici, **7**, pp. 179–288 (1909).

Megachilidæ. Das Tierreich, Lief. 28, 440 pp. (1911).

Die europäischen Bienen. Berlin (1922–23).

FRISON, T. H. The Bumblebees of the Philippine Islands. Philippine Journ. Sci., **27**, pp. 113–121 (1925); **37**, pp. 273–281 (1928).

KIRBY, W. F. Monographia Apum Angliæ. 2 vols. Ipswich (1882).

LUTZ, F. E. and T. D. A. COCKERELL. Distribution and bibliography of North American Bees (Apidæ, Meliponidæ, Bombidæ, Euglossidæ, Anthophoridæ). Bull. American Mus. Nat. Hist., **42**, pp. 491–641 (1920).

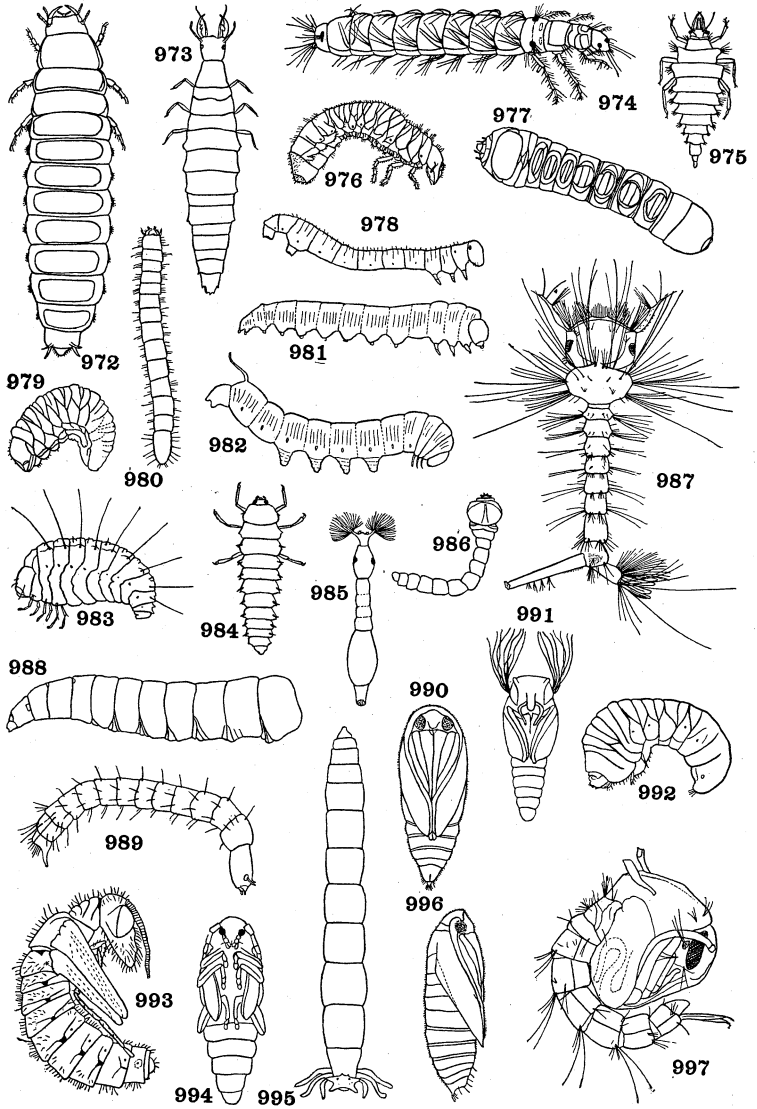
MAIDL, F. Die Xylocopen des Wiener Hofmuseums. Ann. naturf. Hofmus. Wien, **26**, pp. 249–330 (1912).

MEYER, R. Monogaphie der Apidæ-Sphecodinæ. Arch. f. Naturg., Jahrg. 85A, Heft 1–2, pp. 79–242 (1920).

ROBERTSON, C. Synopsis of Panurgidæ. Psyche, **29**, pp. 159–173 (1922).

SCHMIEDEKNECHT, O. Apidæ Europæ. 2 vols., 1112 pp. Berlin (1882–84).

SMITH, H. S. Revision of Ceratinidæ of North and Middle America. Trans. American Entom. Soc., **33**, pp. 115–124 (1907).


973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997

Figs. 972–997. **Larvæ and Pupæ of Various Insects**

972. **Calosoma,** larva (Duncan) Coleoptera, Carabidæ.
973. **Dytiscus,** larva (Maxwell-Lefroy) Coleoptera, Dytiscidæ.
974. Caddis worm, larva (Duncan) Trichoptera, Phryganeidæ.
975. **Chrysopa,** larva (Chittenden) Neuroptera, Chrysopidæ.
976. **Phyllophaga,** larva (Forbes) Coleoptera, Melolonthidæ.
977. **Mallodon,** larva, ventral view. Coleoptera, Prionidæ.
978. Geometrid larva (Packard) Lepidoptera, Geometridæ.
979. **Hylastinus,** larva (Chittenden) Coleoptera, Scolytidæ.
980. **Melanotus,** larva (Forbes) Coleoptera, Elateridæ.
981. Saw-fly, larva (Maxwell-Lefroy) Hymenoptera, Tenthredinoidea.
982. **Acherontia,** larva (Maxwell-Lefroy) Lepidoptera, Sphingidæ.
983. **Mylabris,** larva (Howard) Coleoptera, Mylabridæ.
984. **Anatis,** larva (Britton) Coleoptera, Coccinellidæ.
985. **Simulium,** larva (Osborn) Diptera, Simuliidæ.
986. **Chrysobothris,** larva (Chittenden) Coleoptera, Buprestidæ.
987. **Culex,** larva (Dyar) Diptera, Culicidæ.
988. **Musca,** larva (Howard) Diptera, Muscidæ.
989. **Pulex,** larva (Chittenden) Siphonaptera, Pulicidæ.
990. **Gelechia,** pupa, underside (Hunter) Lepidoptera, Gelechiidæ.
991. **Simulium,** pupa (Miall) Diptera, Simuliidæ.
992. **Lyctus,** larva (Hopkins) Coleoptera, Lyctidæ.
993. **Sialis,** pupa (Davis) Megaloptera, Sialididæ.
994. **Cyllene,** pupa (Hopkins) Coleoptera, Cerambycidæ.
995. **Tipula,** larva (Needham) Diptera, Tipulidæ.
996. **Gelechia,** pupa, ventral side (Hunter) Lepidoptera, Gelechiidæ.
997. **Culex,** pupa (Knab) Diptera, Culicidæ.

PART II

OTHER TERRESTRIAL ARTHROPODA

CONSPECTUS OF THE HIGHER GROUPS OF TERRESTRIAL ARTHROPODS (EXCEPT INSECTS)

Class **ONYCHOPHORA**
- Order **MALACOPODA** (Peripatidæ, Peripatopsidæ)

Class **ARACHNIDA**
- Order **MICROTHELYPHONIDA**
  - (Kœneniidæ)
- Order **PEDIPALPIDA**
  - Suborder **Uropygi**
    - (Thelyphonidæ, Schizomidæ)
  - Suborder **Amblypygi**
    - (Tarantulidæ, Charontidæ, Phrynidæ)
- Order **RICINULEI**
  - (Ricinoididæ)
- Order **SCORPIONIDA**
  - (Buthidæ, Scorpionidæ, Ischnuridæ, Diplocentridæ, Chactidæ, Vejovidæ, Bothriuridæ)
- Order **SOLPUGIDA**
  - (Galeodidæ, Solpugidæ, Hexisopodidæ)
- Order **CHELONETHIDA**
  - Suborder **Heterosphyronida** (Chthoniidæ)
  - Suborder **Diplosphyronida**
    - NEOBISIOIDEA (Syarinidæ, Neobisiidæ, Hyidæ, Ideoroncidæ)
    - GARYPOIDEA (Menthidæ, Olpiidæ, Garypodidæ)
  - Suborder **Monosphyronida**
    - CHELIFEROIDEA (Cheliferidæ, Feaellidæ)
- Order **PHALANGIDA**
  - Suborder **Cyphophthalmi** (Sironidæ)
  - Suborder **Laniatores** (Oncopodidæ, Triænorhynchidæ, Assamiidæ, Phalangodidæ, Cosmetidæ, Gonyleptidæ)
  - Suborder **Palpatores**
    - PHALANGIOIDEA (Phalangiidæ)
    - NEMASTOSOMATOIDEA (Acropsopilionidæ, Trogulidæ, Nemastosomatidæ, Ischyropsalidæ)
- Order **ARANEIDA**
  - Suborder **Liphistiomorphæ**
    - LIPHISTIOIDEA (Liphistiidæ)

Suborder **Avicularimorphæ**

ATYPOIDEA (Ctenizidæ, Atypidæ, Migadidæ, Dipluridæ, Paratropididæ, Pycnothelidæ)

AVICULARIOIDEA (Barychelidæ, Avicularïidæ)

Suborder **Arachnomorphæ**

DYSDEROIDEA (Hypochilidæ, Filistatidæ, Dysderidæ, Oonopidæ, Hadrotarsidæ, Telemidæ, Caponiidæ)

ARGIOPOIDEA (Œcobiidæ, Urocteidæ, Psechridæ, Tengellidæ, Amaurobiidæ, Agelenidæ, Hersiliidæ, Zodariidæ, Palpomanidæ, Eresidæ, Pisauridæ, Lycosidæ, Oxyopidæ, Senoculidæ, Leptonetidæ, Sicariidæ, Pholcidæ, Dictynidæ, Theridiidæ, Linyphiidæ, Archæidæ, Uloboridæ, Dinopidæ, Argiopidæ, Mimetidæ)

CLUBIONOIDEA (Zoropsidæ, Acanthoctenidæ, Ctenidæ, Drassidæ, Ammoxenidæ, Prodidomidæ, Homalonychidæ, Sparassidæ, Selenopidæ, Platoridæ, Thomisidæ, Aphantochilidæ, Clubionidæ, Attidæ)

Order **ACARINA**

EUPODOIDEA (Cryptognathidæ, Bdellidæ, Eupodidæ)

TROMBIDOIDEA (Trombidiidæ, Anystidæ, Erythræidæ, Cæculidæ, Tetranychidæ, Cheyletidæ)

HYDRACHNOIDEA (Halacaridæ, Hydrachnidæ, Hydrovoltziidæ, Limnocharidæ, Eylaidæ, Thermacaridæ, Protziidæ, Sperchonidæ, Pseudohydryphantidæ, Hydryphantidæ, Limnesiidæ, Arrhenuridæ, Lebertiidæ, Atractididæ, Hygrobatidæ, Brachypodidæ, Ewingiidæ)

IXODOIDEA (Argantidæ, Ixodidæ)

PARASITOIDEA (Holothyridæ, Spelæorhynchidæ, Spinturnicidæ, Halarachnidæ, Uropodidæ, Parasitidæ, Dermanyssidæ)

ORIBATOIDEA (Labistommatidæ, Hoplodermatidæ, Oribatidæ)

ACAROIDEA (Tarsonemidæ, Canestrinidæ, Tyroglyphidæ, Listrophoridæ, Analgesidæ, Cytoleichidæ, Acaridæ)

DEMODICOIDEA (Eriophyidæ, Demodicidæ)

Order **PENTASTOMIDA**

CEPHALOBÆNOIDEA (Cephalobænidæ)

LINGUATULOIDEA (Linguatulidæ)

Class **TARDIGRADA**

Order **HETEROTARDIGRADA**

(Halechiniscidæ, Echiniscidæ)

Order **EUTARDIGRADA**

(Milnesiidæ, Macrobiotidæ)

Class **PAUROPODA**

Order **HETEROGNATHA**

(Brachypauropodidæ, Pauropodidæ, Eurypauropodidæ)

Class **DIPLOPODA**
Subclass **PSELAPOGNATHA**
(Polyxenidæ)
Subclass **CHILOGNATHA**
Division OPISTHANDRIA
Order **LIMACOMORPHA**
(Glomeridesmidæ)
Order **ONISCOMORPHA**
(Sphærotheriidæ, Glomeridæ, Gervaisiidæ, Glomeridellidæ)
Division PROTERANDRIA
Superorder EUGNATHA
Order **POLYDESMOIDEA**
Suborder **Polydesmidea** (Polydesmidæ, Mastigodesmidæ, Cryptodesmidæ, Stylodesmidæ, Oniscodesmidæ, Vanhoeffeniidæ, Peridontodesmidæ)
Suborder **Strongylosomatidea** (Strongylosomatidæ, Sphærotrichopidæ, Leptodesmidæ, Oxydesmidæ, Platyrhacidæ, Gomphodesmidæ, Sphæriodesmidæ, Rhacodesmidæ, Fontariidæ)
Order **NEMATOPHORA**
Suborder **Chordumidea** (Trachysomatidæ, Chamæosomatidæ, Metopidothrigidæ, Conotylidæ, Diplomaragnidæ, Caseyidæ, Underwoodiidæ, Chordeumidæ, Orobainosomatidæ, Faginidæ, Heteroporatiidæ, Verhœffiidæ, Heterolatzelidæ, Anthogonidæ, Brachychæteumidæ, Anthroleucosomatidæ, Neatractosomatidæ, Pseudoclididæ, Rothenbuehleriidæ, Attemsiidæ, Opisthocheiridæ, Haplobainosomatidæ, Craspedosomatidæ)
Suborder **Stemmiulidea** (Stemmiulidæ)
Suborder **Striariidea**(Striariidæ)
Suborder **Lysiopetalidea** (Lysiopetalidæ, Dorypetalidæ, Callipodidæ)
Order **JULIFORMIA**
Suborder **Julidea** (Blaniulidæ, Julidæ)
Suborder **Spirobolidea** (Spirobolidæ, Rhinocricidæ, Trigoniulidæ, Pachybolidæ, Spiromimidæ)
Suborder **Spirostreptomorpha** (Spirostreptidæ, Harpagophoridæ, Odontopygidæ, Cambalidæ, Pseudonannolenidæ, Pericambalidæ, Cambalopsidæ, Physiostreptidæ)
Superorder COLOBOGNATHA
Order **PLATYDESMIFORMIA** (Polyzoniidæ, Siphonocryptidæ, Siphonophoridæ, Platydesmidæ, Siphoniulidæ)
Class **CHILOPODA**
Subclass **ANAMORPHA**
Order **SCUTIGEROMORPHA** (Scutigeridæ)
Order **LITHOBIOMORPHA**

LITHOBIOIDEA (Lithobiidæ, Henicopidæ)
CERMATOBIOIDEA (Cermatobiidæ)
CRATEROSTIGMOIDEA (Craterostigmidæ)

Subclass **EPIMORPHA**

Order **GEOPHILOMORPHA** (Himantariidæ, Schendylidæ, Oryidæ, Mecistrocephalidæ, Geophilidæ, Soniphilidæ, Neogeophilidæ, Gonibregmatidæ, Sogonidæ)

Order **SCOLOPENDROMORPHA** (Scolopendridæ, Cryptopidæ)

Class **SYMPHYLA**

Order **CEPHALOSTIGMATA**
(Geophilellidæ, Scutigerellidæ, Scolopendrellidæ)

CLASS **ONYCHÓPHORA**

(*MALACÓPODA, POLÝPODA, PROTRACHEÀTA*)

Moderate-sized or rather large, soft bodied, caterpillar-like species. Body elongate, gently narrowed at the ends, convex above, flattened below, bearing from fourteen to more than forty pairs of short, similar, annulate, but not distinctly jointed legs. Integument transversely wrinkled, each fold bearing many somewhat regularly disposed papillæ. One pair of annulated antennæ. Mandibles blade-like, toothed and denticulate on the edge. Legs with a series of several transverse pads below near tip and two prominent apical claws. Excretory organs opening by a pore on the fourth and fifth pairs of legs. Sexual orifice near the posterior end of the body. Respiration by means of many long, unbranched tracheæ that open by minute spiracles scattered over the body.

1. Sexual opening lying between the last pair of legs or behind them (Figs. 999, 1000, 1001); color pattern of body more or less bluish or greenish, at least in part; dorsal body folds or wrinkles very irregular, numbering from thirteen to twenty-six to each segment ..... **PERIPATÓPSIDÆ**

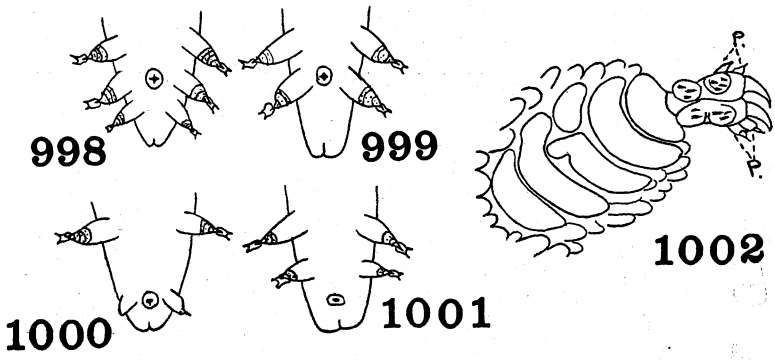
a. Sexual opening between the last pair of legs, which are well developed; no papillæ at bases of the legs. (**Peripatòides, Ooperípatus, Symperípatus,** austr.; **Opisthòpatus,** S. Afr.; **Metaperípatus** Chile) ..... **PERIPATOIDÌNÆ**

Sexual opening behind the last pair of legs; or between the last pair, in which case the last pair of legs are greatly reduced in size and structure. (**Peripatópsis,** equatorial Afr.; **Paraperípatus,** malay.) ..... **PERIPATOPSÌNÆ**

Sexual opening lying between the penultimate pair of legs (Fig. 998); color pattern of body more or less brownish, reddish or purplish; dorsal body folds regular, numbering twelve (rarely twenty-four) to each segment ..... **PERIPÁTIDÆ**

a. Legs bearing from three to seven small, more or less distinctly jointed, conical papillæ at tip above, near the base of the claws. (Fig. 1002). (**Macroperípatus, Epiperípatus, Plicatoperípatus, Perípatus, Oroperípatus,** neotrop.; **Mesoperípatus,** S. Afr.) ..... **PERIPATÌNÆ**

Legs bearing only two such papillæ at tip above, near the base of the claws; (**Eoperípatus,** malay.; **Typhloperípatus,** ind.). **EOPERIPATÌNÆ**



Figs. 998–1002. **Onychophora**

998. **Peripatus,** apical part of body (Bouvier) Peripatidæ.
999. **Peripatoides,** apical part of body (Bouvier) Peripatopsidæ.
1000. **Peripatopsiy,** apical part of body (Bouvier) Peripatopsidæ.
1001. **Paraperipatus,** apical part of body (Bouvier) Peripatopsidæ.
1002. **Oroperipatus,** underside of fourth leg. P, P, papillæ (Bouvier) Peripatidæ.

LITERATURE ON ONYCHOPHORA

BOUVIER, E. L. Monographie des Onychophores. Ann. Sci. Nat., (9) **2**, pp. 1–383, **5**, pp. 61–318 (1905–07).

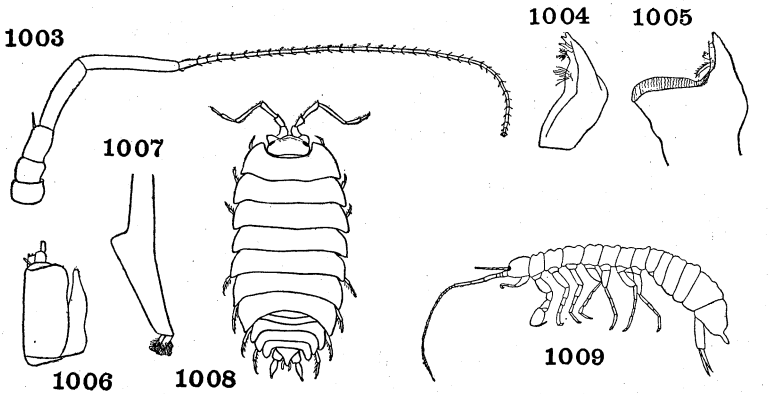
CLARK, A. H. Distribution of Onychophora. Smithsonian Misc. Coll., **65**, No. 1, pp. 1–25 (1915).

CLASS **CRUSTÀCEA**

ORDER **ISÓPODA**

As this group of Crustacea includes a small number of terrestrial forms, these have been included, especially since a few species occur abundantly in places where insects are commonly found. Two suborders are represented among the actually terrestrial species.

1. Body more or less depressed, coxæ of the walking legs developed into plate-like structures and fused with the tergites. (Suborder ONISCÒIDEA) 2



Figs. 1003–1009. **Isopoda**

1003. **Ligidium,** second antenna (Richardson) Ligiidæ.
1004. **Philoscia,** mandible (Richardson) Oniscidæ.
1005. **Haplophthalmus,** mandible (Richardson) Trichoniscidæ.
1006. **Porcellio,** maxilliped (Richardson) Oniscidæ.
1007. **Philoscia,** first maxilla (Richardson) Oniscidæ.
1008. **Porcellio** (Richardson) Oniscidæ.
1009. **Phreatoicus** (Richardson) Phreatoicidæ.

Body more or less compressed; coxæ small, the last six pairs free. (Fig. 1009). (**Phreatoicópsis, Hypsimetòpus**). (Suborder PHREATOICÒIDEA) ..... **PHREATOÍCIDÆ**

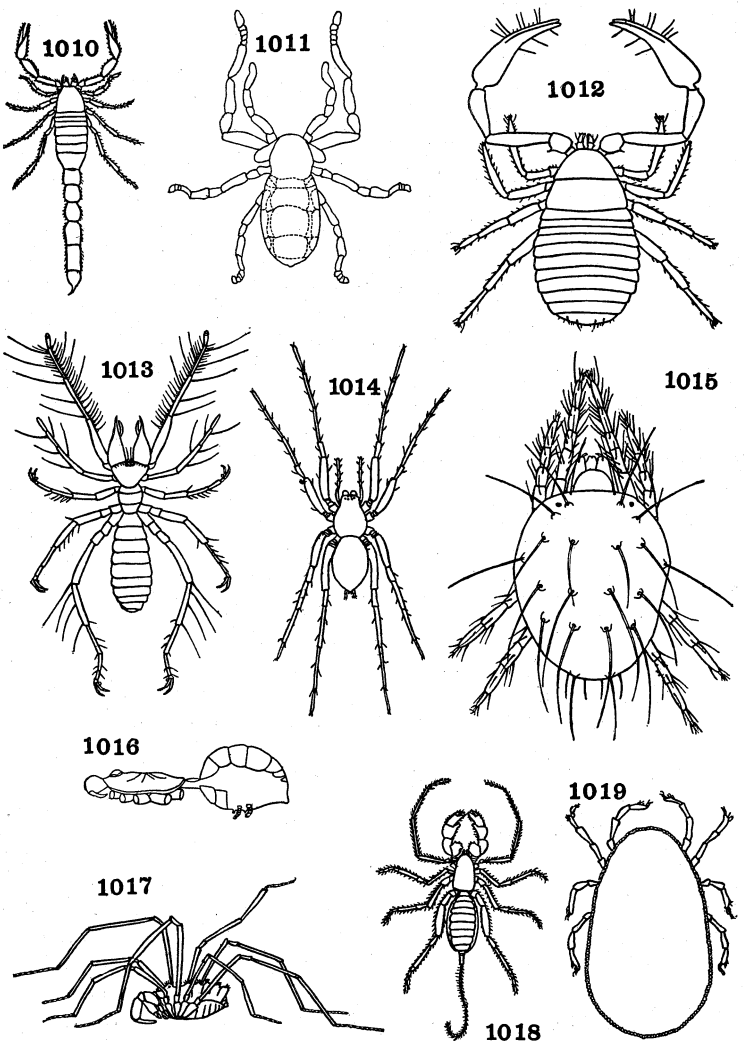
2. Uropods not forming an operculum to cover the walking legs; abdominal segments freely movable. 3

Uropods forming an operculum or cover which conceals the walking legs. (**Tylos**) ..... **TÝLIDÆ**

3. Flagellum of second antennæ multiarticulate. (Fig. 1003). (**Lìgia, Ligídium**). (*LIGÝDIDÆ*) ..... **LIGÌIDÆ**
   Flagellum of second antennæ with not more than six joints.....4
4. Mandible with the grinding surface well developed. (Fig. 1005) (**Trichoníscus, Tithanètes, Brackenrídgia, Haplophthálmus, Androníscus**) ..... **TRICHONÍSCIDÆ**
   Mandible with the grinding surface small, poorly developed. (Fig. 1004) 5
5. Inner lobe of first maxillæ bearing only two or three plumose process at its tip. (Fig. 1007) 6
   Inner lobe of first maxillæ bearing four or more (usually many) plumose processes. (**Eubèlum, Éthelum**) .... **EUBÉLIDÆ**
6. Terminal joints of maxillipeds small. (Fig. 1006).....7
   Terminal joints of maxillipeds large, lamellar. **Scýphax, Scyphacélla**) ..... **SCYPHÁCIDÆ**
7. Body capable of being rolled into a perfect ball; head deeply immersed in the first thoracic segment; uropods short, not reaching beyond the tip of the abdomen. (**Cùbaris** (=*Armadíllo*), **Armadillídium, Péntheus, Sphæroníscus, Uropòdias**). **ARMADILLÍDIDÆ**
   Body not capable of being rolled into a ball; head only slightly immersed in the first thoracic segment; uropods elongate, reaching beyond the apical abdominal segments. (Figs. 1004, 1006, 1007, 1008). (**Oníscus, Procéllio, Oroníscus, Philóscia, Synùropus, Tracheoníscus**) ..... **ONÍSCIDÆ**

CLASS **ARÁCHNIDA**

Moderate-sized, small or very small, rarely large Arthropoda. Body formed of two groups of segments, a cephalothorax and an abdomen, which are usually clearly separate although sometimes entirely fused. Cephalothorax rarely provided with any movable sutures; abdomen usually more or less freely articulated and formed of several similar segments, the apical portion sometimes forming a tail-like prolongation, or (spiders and mites) showing no sutures. Cephalothorax bearing six pairs of appendages, the first usually chelate; the second often hooked and fitted for chewing or crushing prey; second pair sometimes sensory or fitted for walking, usually terminated in claws. No antennæ. No compound eyes; several simple eyes (two to twelve) usually present. No wings. Respiration by tubular tracheæ or by tracheal book-lungs or both. Development direct. Spiders, Mites, Ticks, Scorpions, Harvestmen, Tongue-worms.



Figs. 1010–1019. **Various Arachnida**

1010. **Buthus** (Kraepelin) Scorpionida.
1011. **Cryptocellus** (Ewing) Ricinulei.
1012. **Chelifer** (Ewing) Chelonethida.
1013. **Galeodes** (Dufour) Solpugida.
1014. **Tegenaria** (Emerton) Araneida.

1015. **Tetranychus** (Woodworth) Acarina.
1016. **Liphistius** (Warburton) Araneida.
1017. **Protolophus** (Banks) Phalangida.
1018. **Thelyphonus** (Kraepelin) Pedipalpida.
1019. **Argas** (Bishopp) Acarina.

KEY TO THE ORDERS OF ARACHNIDA

1. Abdomen distinctly segmented, no silk-spinning organs.....2
   Abdomen not segmented, or when rarely with distinct sclerites (Liphistiidæ) with spinning organs (spinnerets) located at the middle of the venter 9
2. Abdomen with the posterior segments forming a contrasting long tail-like prolongation.....3
   Post-abdomen not differentiated.....5
3. Post-abdomen consisting of six segments, terminating in a prominent bulbous sting; abdomen broadly joined to the unsegmented cephalothorax; second ventral segment with a pair of comb-like organs; four pairs of book-lungs opening on the third to sixth sternites; pedipalpi stout, terminating in large pincers; legs fitted for walking, tarsi three-jointed. Distribution widespread, in warm dry countries. (Fig. 1010). Scorpions.
   SCORPIÓNIDA (Page 543)
   Post-abdomen very slender and many-jointed, not ending in a sting; abdomen narrowed at base, no comb-like ventral organs; tarsi of first legs many-jointed.....4
4. Pedipalpi slender, similar to the walking legs; three pairs of book-lungs, opening on segments 4, 5 and 6 of abdomen. Minute species, under 3 mm. in length. Delicate, pale colored, tropical species. (Fig. 1020).. **MICROTHELYPHÓNIDA** (Page 539)
   Pedipalpi very stout, contrasting with the very long first pair of legs; two pairs of book-lungs, opening on segments 2 and 3. Moderate to large species. Tropical. Whip-scorpions.
   PEDIPÁLPIDA (Page 540)
5. Abdomen constricted at base; front legs very long and with long tarsi. Tropical ..... **PEDIPÁLPIDA** (Page 540)
   Abdomen broadly joined to the cephalothorax; front tarsi not elongate 6
6. Pedipalpi with large pincer-like claws. Small flat species, usually living under the bark of trees. (Fig. 1012). Pseudoscorpions, Book-scorpions ..... **CHELONÉTHIDA** (Page 548)
   Pedipalpi without pincer-like claws.....7

7. Head distinct from the three-parted thorax; cheliceræ relatively large, their pincers opening up and down. Pale-colored, mostly nocturnal species, inhabiting hot dry regions. (Fig. 1013). Wind-scorpions, Solpugids ..... **SOLPÙGIDA** (Page 546)

Cephalothorax not distinctly divided into head and segments; cheliceræ usually smaller, their pincers not moving dorso-ventrally 8

8. Abdomen nine-segmented as indicated by the tergites; cheliceræ usually exposed; two eyes usually present, often on tubercles; legs usually excessively long and slender. (Fig. 1017). Cosmopolitan, abundant. Harvestmen, Daddy-long-legs. **PHALÁNGIDA** (Page 551)

Abdomen apparently four-segmented, with lateral as well as dorsal plates, and with a small terminal several-jointed piece; cheliceræ concealed by a large, pendant hood; eyes absent; legs only moderately long. (Fig. 1011). Tropical, rare species. **RICINÙLEI** (Page 542)

9. Abdomen joined to the cephalothorax by a narrow short stalk. (Figs. 1014, 1016). Cosmopolitan. Spiders. **ARANÈIDA** (Page 554)

Abdomen broadly fused with the cephalothorax. Widespread, often parasitic 10

10. Adult always with legs; usually with four, rarely two pairs; young frequently with three pairs; body surface very rarely bearing numerous transverse annulations; rarely living as internal parasites. (Figs. 1015, 1019). Mites, Ticks . . **ACARÌNA** (Page 565)

Adult legless, body long; finely transversely annulate; internal parasites of vertebrates. (Fig. 1083). Tongue worms. **PENTASTÓMIDA** (Page 579)

LITERATURE ON ARACHNIDA

Treatises on the Whole Class, or Dealing with More Than a Single Oder

Banks, N. Synopsis of North American Scorpions, Solpugids and Pedipalpi. American Naturalist, **34**, pp. 421–427, (1900).

Comstock, J. H. The Spider Book. Doubleday, Page & Co., Garden City, N. Y. (1912). (Contains also brief synopses of the North American representatives of several Orders of Arachnida in addition to the Araneida).

Koch, L. Arachniden Australiens. 1489 + 274 pp. Nürnberg (1869–89).

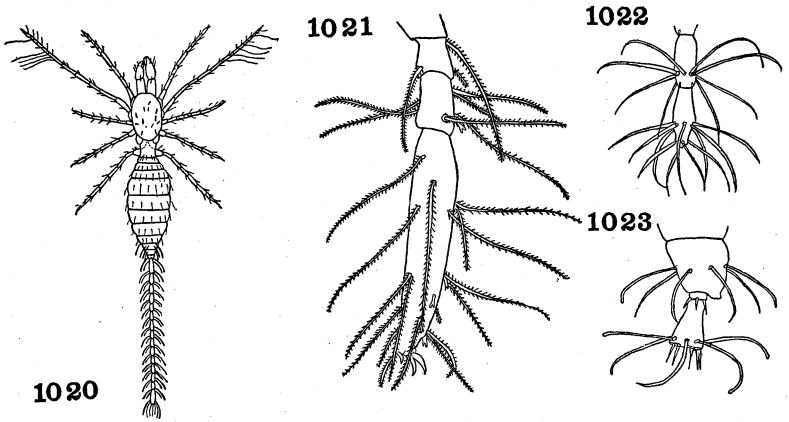
Lawrence, R. F. Arachnida of Southwest Africa, Pt. 2, Ann. S. Afr. Mus., **25**, pp. 217–312 (1928).

Pocock, R. J. Arachnida. Fauna British India (1900).
Arachnida. In Biologia centrali-Americana. 71 pp. (1902).
Simon, E. Arachnides de France, **1–7** (1874–1914).
Thorell, T. Studi sui Ragni Malesi e Papuani. 4 parts. Genoa (1877–90).
Warburton, C. Arachnida, In Cambridge Natural History, **4**, pp. 297–473 (1909).

ORDER **MICROTHELYPHÓNIDA**

(*PALPIGRÀDI*; *PALPIGRÀDA*)

Minute, delicate, elongate species with a long, jointed median appendage at the tip of the abdomen. Cephalothorax above consisting of a large carapace which bears the pedipalps and the first three



Figs. 1020–1023. **Microthelyphonida**

1020. **Kœnenia** (Wheeler) Kœneniidæ.
1021. **Kœnenia,** apical part of third leg (Börner) Kœneniidæ.
1022. **Kœnenia,** two joints of flagellum (Börner) Kœneniidæ.
1023. **Kœnenia,** apex of abdomen (Börner) Kœneniidæ.

pairs of legs, and a small, separate posterior section which bears the fourth pair of legs. Cheliceræ large, chelate; pedipalps leg-like, nine-jointed, bearing a pair of claws at tip. First pair of legs the longest, twelve-jointed, the tarsi consisting of several segments, terminated by a pair of claws. Second and third legs seven-jointed; fourth eight-jointed, all with a pair of claws at tip. Eyes absent. Mouth anterior.

Respiration by three pairs of lung sacs, opening on the fourth to sixth abdominal segments below. Abdomen elongate-oval, consisting of eleven segments, the third to seventh segments larger than the others. Apex of abdomen bearing a long, slender median appendage consisting of nine to fifteen moniliform joints, bearing sparse bristly hairs. (Figs. 1020, 1021, 1022, 1023).

One family. (**Kœnènia**, widespread in tropical and subtropical countries ..... **KŒNENÌIDÆ**

LITERATURE ON MICROTHELYPHONIDA

HANSEN, H. J. Biospeologica LIII. Palpigradi. Arch. Zool. Paris, **65**, pp. 167–180 (1926) (with bibliography).

KRAEPELIN, K. Palpigradi. Das Tierreich, Lief. 12, pp. 1–3 (1901).

ORDER **PEDIPÁLPIDA**

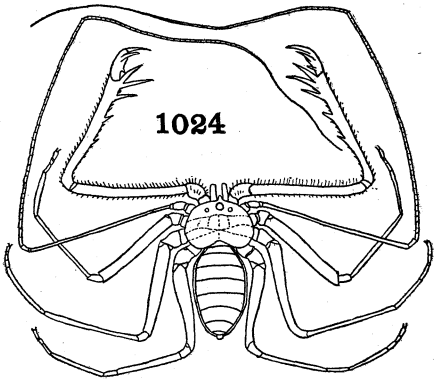
(*PEDIPÂLPI*)

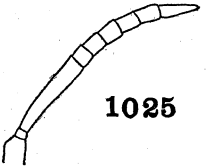
Large or moderate-sized species with heavily chitinized integuments. Cephalothorax forming a solid carapace, or with two small thoracic segments separated by sutures. Cheliceræ claw-like. Pedipalpi six-jointed, strong, sometimes very stout, clawed at apex or imperfectly chelate, sometimes very long; first pair of legs sensory in function, forming a long, many-jointed filament; other legs stouter and fitted for walking, the tarsi with claws at tip. Abdomen consisting of ten or eleven segments; sometimes with a long slender many-jointed median apical appendage or filament, sometimes rounded at apex and without appendage. Respiration by book-lungs in the second abdominal segment and sometimes also in the third. Restricted to warm countries. Whip-scorpions and Tailless whip-scorpions.

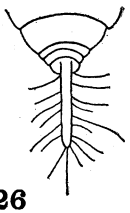
1. Cephalothorax elongate, longer than wide, its lateral margins more or less parallel except in front; last three segments of abdomen very small, the abdomen at apex with a median appendage, which is usually long and consisting of numerous joints, rarely short and one-jointed; femur and tibia of pedipalpi rarely spinose. (Suborder UROPYGI) 2

Cephalothorax short and broad, more or less expanded laterally, the lateral margins strongly convex; abdomen blunt and rounded at apex, without a median appendage at apex; femur and tibia of pedipalpi strongly spinose. (Suborder AMBLYPYGI).....3

2. Cephalothorax dorsally with an undivided shield; eyes well developed, two close together on a tubercle in front and a group of three large ones toward each lateral margin; abdominal appendage long, filiform, consisting of many movable joints; tarsus of first pair of walking legs (second legs) seven-jointed and at least four times as long as the metatarsus; second and







Figs. 1024–1026. **Pedipalpida**

1024. **Damon** (Pocock) Tarantulidæ.
1025. **Schizomus,** metatarsus and tarsus of first pair of legs of female (Graveley) Schizomidæ.
1026. **Schizomus,** apex of abdomen. Schizomidæ.

third segments of abdomen each with a pair of book-lungs. (Fig. 1018). (**Mimoscórpius, Tetrabàlius, Hypóctonus,** malay.; **Thelýphonus,** indomal.; **Typopéltis,** As.; **Mastigopróctus, Thelyphonéllus,** Am.). .... **THELYPHŌNIDÆ**

Cephalothorax dorsally divided into a head and two free thoracic segments separated by membranous sutures and bearing the third and fourth pairs of legs; median eyes absent, at most one pair of lateral eyes; abdominal appendage short, in female subcylindrical and divided into three or four scarcely movable joints; in the male thickened and one-jointed; tarsi of first pair of walking legs six-jointed, less than twice as long as the metatarsus (Figs. 1025, 1026); only one pair or book-lungs, in the second segment. (**Schízomus,** ethiop., ind.; **Trithýreus,** indomal., nearc.) ..... **SCHIZŌMIDÆ**

3. Tibia of the fourth pair of legs divided by sutures into three or four sections, the tarsus four or five-jointed; apical spurs of tibiæ of pedipalpi extending laterally.....4

Tibia of the fourth pair of legs not divided, or consisting of only two sections; the tarsus four-jointed; apical spurs of tibiæ of pedipalpi directed forward. (Fig. 1024). (**Tarántula** (= *Phrynichus*) ethiop., ind.; **Dàmon, Titanodàmon,** ethiop.). (*PHRYNICHÌNÆ,* Kræpelin 1899) .... **TARANTÙLIDÆ**

4. Tarsi five-jointed, with a pulvillus at the base of the claws; second abdominal tergite sometimes distinctly margined. Old World species. (**Chàron,** indomal.; **Charìnus,** ethiop., malay.; **Catagèus, Stygophrỳnus,** ind.; **Sàrax,** austromal.). **CHARÔNTIDÆ**

Tarsi four-jointed, without pulvillus; second tergite not margined. New World species. (**Phrỳnus** (= *Tarántula*), **Hemiphrỳnus, Acanthophrỳnus, Heterophrỳnus,** Am.).. . . **PHRŸNIDÆ**

LITERATURE ON PEDIPALPIDA

BÖRNER, C. Pedipalpida. Zoologica, Heft 42 (1904).

GRAVELEY, F. H. Revision of the Oriental subfamilies of Tarantulidæ. Rec. Indian Mus., **11**, pp. 433–455 (1915).

Indo-australian Thelyphonidæ. Rec. Indian Mus., **12**, pp. 59–85 (1916).

KRAEPELIN, K. Revision der Tarantuliden. Abh. naturh. Ver. Hamburg, **13**, pp. 1–53 (1895).

Revision der Uropygi. Abh. naturh. Ver. Hamburg, **15**, 60 pp. (1897).

Pedipalpida. Das Tierreich, Lief. 8 (1899).

ORDER **RICINÙLEI**

(*MERIDOGÁSTRA, RHIGNOGÁSTRA*)

Small or very small species with extremely thick, hard integument. Body elongate oval, without long tail-like prolongation at the apex of the abdomen but with a very short three segmented projection. Cephalothorax bearing anteriorly a large movable hood which when folded down completely hides the cheliceræ; cheliceræ chelate. Eyes absent. Pedipalpi five-jointed, short; geniculate at the apex of the femur; tarsus minute, opposed to a small projection at the tip of the tibia. Legs rather stout, the second pair the longest; tarsi of second to fourth legs five-jointed. Abdomen oval, broadly joined to the

cephalothorax, consisting of nine segments, basal ones very short; three to six much longer; six to nine forming a very short retractile apical tubercle. Respiration by tubular tracheæ opening by a pair of spiracles at the sides of the cephalothorax above the third coxa. (Fig. 1011).

The living species form a single family. (**Ricinòides** (=*Cryptostémma*), ethiop.; **Cryptocéllus**, neotrop.). (*CRYPTOSTEMMÁTIDÆ, HOLOTÉRGIDÆ, CURCULÒIDIDÆ, POLIOCHÉRIDÆ*). **RICINÒIDIDÆ**

LITERATURE ON RICINULEI

HANSEN, H. J. and W. SÖRENSON. Two Orders of Arachnida. 178 pp. Cambridge, Eng. University Press (1904).

EWING, H. E. A Synopsis of the Order Ricinulei. Ann. Entom. Soc. America, **22**, pp. 583–600 (1929).

ORDER **SCORPIÓNIDA**

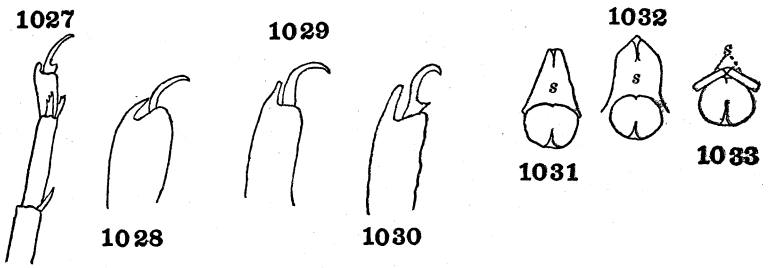
(*SCORPIÒNES*)

Large or very large species. Cephalothorax and abdomen broadly attached; cheliceræ chelate; pedipalpi very large, bearing a large swollen chela at the apex. Cephalothorax with a pair of median eyes near the middle and a group of two to five lateral eyes at each side; rarely absent. Basal portion of abdomen broad, the five apical segments much narrower, forming a highly flexible postabdomen, the last segment of which bears a sting at apex and contains a poison gland. Four pairs of legs, each consisting of seven segments; tarsi three-jointed. Underside of abdomen at base with a pair of movable pectinate organs. Respiration by book-lungs opening by paired slits on the third to sixth abdominal segments. Mainly tropical species. Scorpions.

1. Sternum large, at least half as long as wide and often longer than wide, pentagonal or frequently much narrowed anteriorly; generally nearly as large as or larger than the genital plate which lies behind it. (Figs. 1031, 1032) 2

   Sternum much reduced in size, forming two narrow transverse or oblique plates that are sometimes barely visible, therefore much wider than long (Fig. 1033); tip of tarsus without a lobe at the side. (**Bothriùrus, Brachiostérnus, Théstylus, Urophònius**, neotrop.; **Cercophònius**, Austr.). . . . **BOTHRIÙRIDÆ**

2. Legs with a spine or thorn in the connecting membrane between the last two tarsal joints, only on the outer side; sternum pentagonal, not triangularly narrowed in front.....3
Legs with one or two spines or thorns internally and externally in the membrane between the second and last tarsal joints (Figs. 1027); sternum sometimes triangularly narrowed in front 6



Figs. 1027–1033. **Scorpionida**

1027. **Centruroides,** tarsus of fourth leg. Buthidæ.
1028. **Pandinus,** tip of last tarsal joint. Scorpionidæ.
1029. **Vejovis,** tip of last tarsal joint. Vejovidæ.
1030. **Iomachus,** tip of last tarsal joint. Ischnuridæ.
1031. **Centruroides,** sternum. Buthidæ.
1032. **Pandinus,** sternum (Kraepelin) Scorpionidæ.
1033. **Bothriurus,** sternum (Kraepelin) Bothriuridæ.

3. Postabdomen (narrowed, tail-like, apical body segments) with the four basal segments each bearing below a pair of longitudinal keels near the median line.....4
Postabdomen with only one median ventral keel. (**Uródacus,** Austr.; **Hemiscórpion,** palæarc.). (See couplet 5).
SCORPIÓNIDÆ, part
4. Last segment of postabdomen with a distinct thorn or tubercle below the sting; chela flat or rounded; last joint of tarsi with two rows of spines beneath. (**Diplocéntrus, Òiclus,** neotrop.; **Nèbo,** palæarc.) ..... **DIPLOCÉNTRIDÆ**
Last segment of postabdomen simple, without thorn or tubercle beneath the sting.....5
5. Tip of last tarsal joint rounded or acute and produced on the sides to form a lobe the edge of which forms an acute angle

with the apical projection that lies dorsally between the claws. (Figs. 1028, 1032). (**Scórpio**, palæarc., ethiop.; **Pandìnus**, **Opisthophthálmus**, ethiop.; **Heteromètrus**, indomal.).
SCORPIÓNIDÆ

Tip of last tarsal joint more or less truncate, without rounded lobes, its apical edge forming a right angle with the dorsal projection between the claws; last tarsal joint below with spines or bristles. (Fig. 1030). (**Ischnùrus, Hadógenes**, ethiop.; **Opisthacánthus**, ethiop., neotrop.; **Hormùrus**, indoaustr.; **Iómachus**, ethiop., ind.) ..... **ISCHNÙRIDÆ**

6. Three to five lateral eyes in a group at each side of the cephalothorax in front 7

Only two lateral eyes at each side of cephalothorax, or lateral eyes absent ..... **CHÁCTIDÆ**

This family is divisible into four well-marked subfamilies as follows:

a. Group of two lateral eyes without a pale spot just behind the eyes; movable finger of cheliceræ without well developed teeth, or with only a single tooth on its lower surface.....b

A pale spot behind each group of two lateral eyes; movable finger of cheliceræ with a number of teeth on its lower surface. (**Chærílius**, indomal.). (*CHÆRILÌIDÆ*) ..... **CHÆRILIÌNÆ**

b. Four basal segments of postabdomen with a ventral keel on the median line; ventral surface of body granular or minutely tuberculate. (**Megacórmus**, neotrop.) .. **MEGACORMÌNÆ**

Four basal segments of postabdomen without any distinct keels below, or with a pair, one on each side of the median line....c

c. Hand (basal thickened portion of the apical joint of the pedipalpi) with a strong keel above which divides the surface into two surfaces that meet almost at a right angle. (**Euscórpius**, palæarc.) ..... **EUSCORPIÌNÆ**

Hand rounded, or if keeled, not as above. (**Cháctas, Bròteas, Teuthraùstes**, neotrop.) ..... **CHACTÌNÆ**

7. Sternum more or less triangular, strongly narrowed in front; first tarsal joint of third and fourth pair of legs often with a thorn at tip; three or five lateral eyes; last segment of postabdomen often bearing a spine beneath the sting. (Figs. 1010, 1027, 1031). (**Bùthus**, palæarc., ethiop., indomal.; **Isomètrus**, widespr.; **Títyus, Centruròides**, Am.; **Anánteris**, neotrop.; **Uropléctes, Archisomètrus**, ethiop., indoaustr.; **Isometròides**, austr., **Buthèolus**, palæarc., **Parabùthus**, ethiop.).
BÙTHIDÆ

Sternum with parallel sides, usually wider than long, with a deeply impressed median groove; three lateral eyes; last segment of postabdomen always without a spine beneath the sting. (Fig. 1029). (**Vejòvis, Hadrùrus,** N. Am.; **Scórpiops,** ind.; **Hadruròides, Carabóctonus,** neotrop.; **Iùrus,** palæarc.).
VEJÓVIDÆ

LITERATURE ON SCORPIONIDA

EWING, H. E. Scorpions of the Western United States. Proc. U. S. Nat. Mus., **73**, No. 2730, 24 pp. (1928).

GOUGH, L. H. Key to Egyptian Scorpions. Cairo Ministry Agric. Egypt. Bull. 76, 7 pp. (1927).

HEWITT, J. Survey of the Scorpion Fauna of South Africa. Trans. Roy. Soc. South Africa, **6**, pp. 89–192 (1918).

KÄSTNER, A. Scorpione (Scorpionida). In Tierwelt Mitteleuropas, **3**, Lief. 1, pp. II 1–3 (1928).

KRAEPELIN, K. Revision der Skorpione. Jahrb. Hamburg. wiss. Anst., **8**, pp. 1–144, (1891); **11**, pp. 1–248, (1894); **12**, pp. 1–24 (1895).
Scorpionida. Das Tierreich. Lief. 8 (1899).

ORDER **SOLPÙGIDA**

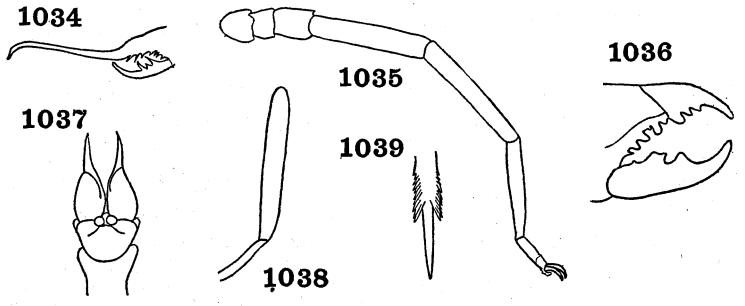
(*SOLÍFUGÆ*)

Large or moderately large, pale-bodied, very active species. Cheliceræ very large, chelate, moving in a vertical plane. Cephalothorax bearing only one pair of legs, separated from three distinct thoracic segments to each of which a pair of legs is attached. Abdomen elongate, oval, consisting of ten segments, without terminal filament or appendage. Pedipalpi long, leg-like, six-jointed. Tarsus of pedipalpi and first pair of legs one-jointed; second to fourth legs with the tarsi often several-jointed; tarsi usually provided with claws. Respiration by tracheæ that open through spiracles behind the first pair of legs on both the first and second abdominal segments. Distribution tropical and subtropical, most generally in dry or arid regions.

1. Fourth pair of legs ending in a pair of claws as do the second and third pairs; basal portion of fourth pair of legs (including the coxæ and two trochanters) clearly shorter than the remainder of the leg (femur, tibia and two tarsal joints); fourth legs with the basal section of femur very much shorter than the apical section.....2

Fourth pair of legs without claws, these replaced by short spines; basal portion of fourth leg almost as long as the remainder of the leg; basal section of femur of fourth leg longer than the apical section. (**Hexìsopus,** S. Afr.) ..... **HEXISOPÓDIDÆ**

2. Spiracles of second and third abdominal segments covered by a plate which has a finely serrated posterior margin; tarsus of pedipalpi freely jointed and capable of folding against the metatarsus. (**Galeòdes,** palæarc., ind.; **Paragaleòdes,** palæarc.). **GALEÓDIDÆ**



Figs. 1034–1039. **Solpugida**

1034. **Gnossipus,** chelicera in lateral view (Kraepelin) Solpugidæ.
1035. **Solpugid,** third leg (Ewing).
1036. **Eremobates,** chelicera in lateral view (Putnam) Solpugidæ.
1037. **Eremobates,** head in dorsal view (Putnam) Solpugidæ.
1038. **Eremobates,** tip of pedipalpus (Putnam) Solpugidæ.
1039. **Solpuga,** tip of flagellum of pedipalpus (Kraepelin) Solpugidæ.

Spiracles of the second and third abdominal segments not covered by serrated plates, freely visible or concealed by lateral folds; tarsus of pedipalpi immovably attached to the metatarsus although separated by an apparent suture. (Figs. 1034, 1036, 1037, 1038, 1039). (**Solpùga, Dæsia, Gnosíppus, Ceròma,** ethiop.; **Rhagòdes,** ethiop., As.; **Dínorhax,** indomal.; **Saró-nomus,** neotrop.; **Ammótrecha, Eremóbates,** Am.; **Gylíp-pus, Kárschia,** palæarc.) ..... **SOLPÙGIDÆ**

LITERATURE ON SOLPUGIDA

KRAEPELIN, K. Zur Systematik der Solifugen. Mitt. naturh. Mus. Hamburg, **16**, pp. 197–258 (1899).

Solpugida. Das Tierriech, Lief. 12, pp. 4–159 (1901).

HEWITT, J. A Short Survey of the Solifugæ of South Africa. Ann. Transvaal Mus., **7**, pp. 1–76 (1919).

PUTNAM, J. D. Solpugida of America. Proc. Davenport Acad. Nat. Sci., **3**, 149 pp. (1882).

SIMON, E. Essai d'une Classification des Galéodes. Ann. Soc. Entom. France, 1879, pp. 93–154 (1879).

ORDER **CHELONÉTHIDA**

(*PSEUDOSCORPIÓNIDA*; *PSEUDOSCORPIÒNES*, *CHERNETÍDEA*)

Small or very small Arachnida with flattened body. Cephalothorax unjointed, although sometimes with distinct transverse grooves; abdomen with 11 or 12 tergites, each often composed of a pair of plates, narrowly separated along the median line. Cheliceræ two-jointed, chelate. Pedipalpi very large, six-jointed, much longer than the walking legs, their tarsi forming a much enlarged pincers-like grasping organ. Legs six-jointed, the tarsi one or two-jointed and the femur sometimes divided into two sections; tarsi with a pair of apical claws. Cephalothorax narrower than the abdomen which is often much widened; abdomen without any apical prolongation, joined to the cephalothorax along its entire base. Eyes two or four, placed near the sides of the carapace; sometimes wanting. Respiration by tracheæ opening by four spiracles placed just behind the second and third abdominal plates at the sides of the body. Genital aperture on the first sternite. Slow-moving carnivorous species of retiring habits, living under bark, stones, etc. False-scorpions; Book-scorpions.

1. Tarsi of the first two pairs of legs one-jointed; those of the third and fourth legs two-jointed. (Suborder HETEROSPHYRÓNIDA). (**Chthònius**, holarc.; **Dìtha**, neotrop., ind.; **Tyrannochthònius**, widespr.; **Verrucadìtha**, **Mundochthònius**, nearc.) ..... **CHTHONÌIDÆ**

   Tarsi of all four pairs of legs with the same number of joints...2

2. Tarsi two-jointed. (Suborder DIPLOSPHYRÓNIDA).....3

   Tarsi one-jointed (Fig. 1040). (Suborder MONOSPHYRÓNIDA) 9

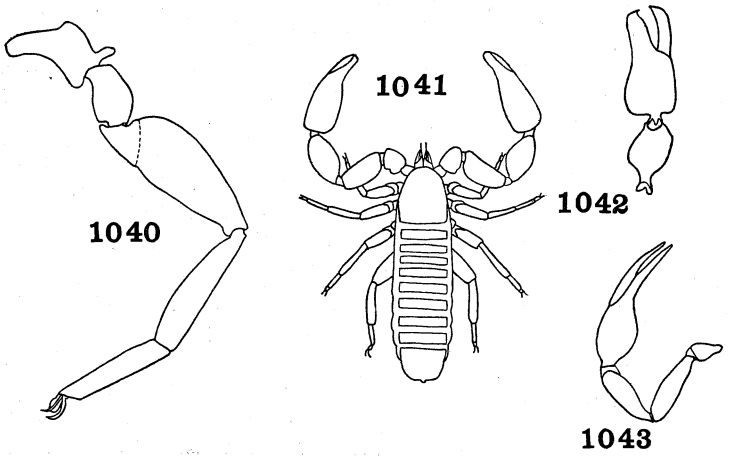
3. Movable finger of cheliceræ clearly multidenticulate, without a true subapical lobe; carapace usually produced medially in front. (Superfamily NEOBISIÒIDEA).....4

   Movable finger of cheliceræ with a single subapical lobe or tooth which is rarely secondarily subdivided, but never multidenticu-

late; carapace in front, often somewhat emarginate, rarely if ever produced medially. (Superfamily GARYPODÒIDEA) 7

4. Venom apparatus present in the fixed finger of the claw only, the movable finger with a definite sheath for the reception of the venom-tooth 5

Venom apparatus present in both the fixed and movable fingers; a sheathing structure rarely present in either finger..... 6



Figs. 1040–1043. **Chelonethida**

1040. **Chelifer,** fourth leg (Ewing) Cheliferidæ.
1041. **Chelifer** (Tullgren) Cheliferidæ.
1042. **Chelifer,** pedipalpus (With) Cheliferidæ.
1043. **Ideoroncus,** pedipalpus (With) Ideoroncidæ.

5. Pleural membrane of abdomen smoothly longitudinally plicate, never granulate; femur of fourth pair of legs with an oblique cross-suture (rarely nearly perpendicular to the longitudinal axis). (**Chìtra, Syarìnus, Hyarìnus,** nearc.). **SYARÍNIDÆ**

Pleural membrane granulate or granulate-striate; femoral articulation of fourth pair of legs truly vertical to the longitudinal axis of the femur-patella. (**Neobísium, Microbísium,** holarc.; **Blòthrus, Róncus,** palæarc.) ..... **NEOBISÌIDÆ**

6. Pleural membrane of abdomen granulate; claw with twelve tactile setæ on the fingers. (**Hỳa,** indomal.) ..... **HỲIDÆ**

Pleural membrane of abdomen evenly longitudinally plicate; fingers of claw usually with many more than twelve tactile setæ. (Fig. 1043). (**Ideoróncus**, **Bóchica**, neotrop.; **Albìorix**, N. Am.; **Shravàna**, indomal.) ..... **IDEORÓNCIDÆ**

7. Venom apparatus present in both the movable and fixed fingers of the claw; no sheathing structure on either claw to receive the venom-tooth 8

Venom apparatus present in the fixed finger of the claw only; a well developed sheathing structure present on the movable finger to receive the venom-tooth. (**Ménthus**, nearc., neotrop.). **MÉNTHIDÆ**

8. Pleural membrane of abdomen smoothly and evenly plicate; carapace not or rarely noticeably narrowed in front; sides of abdomen more or less parallel, the abdomen not greatly wider than the cephalothorax. (**Ólpium**, palæarc.; **Garypìnus**, Am.; **Seriànus**, nearc., neotrop., indomal.; **Solìnus**, nearc., Austr.; **Hòrus**, ethiop.; **Xenólpium**, indoaustr.) .. **OLPÌIDÆ**

Pleural membrane prickly, granular, or irregularly wrinkled; carapace narrowed in front, clearly triangular; abdomen subovate, much broader than the cephalothorax. (**Gárypus**, palæarc., neotrop.; **Geogárypus**, palæarc., indomal.; **Lárca**, holarc.; **Anagárypus**, austromal.; **Maorigárypus**, austr.). **GARYPÓDIDÆ**

9. Four well developed eyes 10

Two eyes or none. (Figs. 1040, 1041, 1042) .... **CHELIFÉRIDÆ**

10. Carapace triangular, narrowed in front, without horn-like processes in front of the eyes; abdomen without pleural plates. (**Synsphyrònus**, Austr.) ..... **GARYPÓDIDÆ**, part

Carapace not triangular, with two or more prominent horn-like processes in front of the eyes ..... **FEAÉLLIDÆ**

LITERATURE ON CHELONETHIDA

BALZAN, L. Revisione dei Pseudoscorpioni de Paraguay. Ann. Mus. Civ. Genova (2), **29**, pp. 401–451 (1890).

Pseudoscorpiones de Venezuela. Ann. Soc. Entom. France, **60**, pp. 497–552 (1891).

CHAMBERLIN, J. C. Synoptic Classification of False Scorpions, Part I. Ann. Mag. Nat. Hist. (10), **4**, pp. 50–80 (1929), **5**, pp. 1–48, and pp. 585–618 (1930).

COOLIDGE, K. R. List of North American Pseudoscorpionida. Psyche, **15**, pp. 108–114 (1908).

ELLINGSEN, E. Die Pseudoscorpione des Berliner Museums. Mitt. zool. Mus. Berlin, **4**, pp. 355–423 (1910) (extensive bibliography).

Pseudoscorpions of South Africa. Ann. South African Mus., **10**, pp. 75–128 (1912).

KÄSTNER, A. Afterscorpione (Pseudoscorpionida). In Tierwelt Mittleuropas, **3**, Lief. 1, pp. IV 1–13 (1928).

KEW, H. W. Synopsis of False Scorpions of Britain and Ireland. Proc. Roy. Irish Acad., **29**, Sec. B, No. 2, (1911), and Supplement, *ibid.*, **33** (1916).

WITH, C. J. Chelonethida of the Australian Region. Ann. Mag. Nat. Hist., (7) **15**, pp. 94–143 (1905).

Indian False-Scorpions. Kgl. Danske Vid. Selsk. Skrifter., **7**, pp. 1–124 (1906).

ORDER **PHALÁNGIDA**

(*OPILIÒNES*)

Usually moderate-sized species with long or very long legs. Cephalothorax not separated from the abdomen by a constriction, forming an unsegmented or very indistinctly segmented dorsal carapace. Abdomen segmented, with nine dorsal plates and fewer ventral ones. Head with two eyes, often on stalk-like tubercles. Cheliceræ three-jointed, chelate; rather long and sometimes thickened. Pedipalpi similar to the legs, but usually much shorter. Legs very long and slender; coxæ very large and firmly attached to the body. Respiration by tracheæ; one pair of spiracles opening ventrally near the base of the abdomen. Harvestmen, Daddy-long-legs.

1. Genital opening covered by a movable plate or operculum; openings of the scent glands situated at the side margin of the cephalothorax, not on tubercles 2

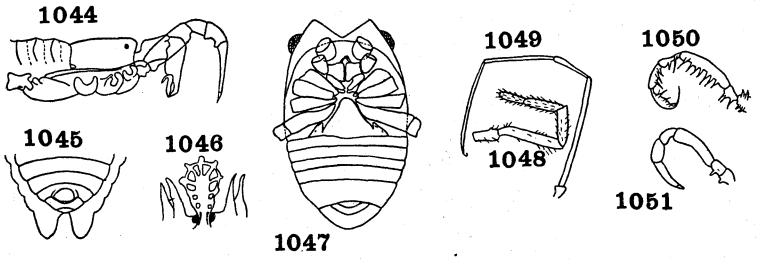
   Genital opening exposed, not covered by an operculum; scent glands each placed upon a conical protuberance at the sides of the cephalothorax. (Fig. 1045). (Suborder CYPHOPHTHÁLMI). (**Sìro,** palæarc.; **Ogòvea,** ethiop.; **Miópsalis, Stylocéllus,** Indomal.; **Péttalus,** ind.). ..... **SIRÓNIDÆ**

2. Pedipalpi stout, their tarsi with a strong grasping claw; apical joint of the tarsus of first and second pairs of legs with only one simple claw; the third and fourth tarsi with either two, or with a tridentate claw; sternite of first abdominal segment much reduced, not reaching in front of the hind coxæ; hind legs usually the longest. (Fig. 1044). (Suborder LANIATÒRES)...3

   Pedipalpi slender, palpiform, their tarsi with a weaker claw which is occasionally lacking; apical joint of all four tarsi with only

one simple claw; sternite of first abdominal segment extending much in front of the hind coxæ; second pair of legs the longest. (Suborder PALPATÒRES) 8

3. Last four tergites freely movable, not fused..... 4
   All tergites except the apical one fused to form a scutum, the latter forming a movable anal plate. (Fig. 1044, 1051). (**Óncopus, Gnómulus, Pelítnus,** Indomal.) ..... **ONCOPÓDIDÆ**



Figs. 1044–1051. **Phalangida**

1044. **Oncopus,** anterior part of body in profile (Roewer) Oncopodidæ.
1045. **Pettalus,** apical part of abdomen (Roewer) Sironidæ.
1046. **Ortholasma,** anterior part of cephalothorax (Roewer) Trogulidæ.
1047. **Acropsopilio,** underside of body (Roewer) Acropsopilionidæ.
1048. **Trogulidæ,** pedipalpus (Roewer) Trogulidæ.
1049. **Phalangiidæ,** pedipalpus (Roewer) Phalangiidæ.
1050. **Gonyleptidæ,** pedipalpus (Roewer) Gonyleptidæ.
1051. **Oncopodidæ,** pedipalpus (Roewer) Oncopodidæ.

4. Third and fourth tarsi each with a pair of apical claws which are simple or furnished with curved teeth..... 5
   Third and fourth tarsi each with a single three-pronged claw; or in partly grown specimens with a single claw furnished with denticles laterally. (**Triænònyx,** neotrop.; **Scleróbunus,** nearc.; **Núncia, Soerensenélla,** Austr.; **Acumóntia,** Madagasc.; **Adæum, Ceratomóntia,** ethiop.).
   TRIÆNONÝCHIDÆ

5. Pedipalpi carried with the tips curved backwards behind the patella, weakly armed; anterior margin of the cephalothorax below with five erect, conical teeth. (**Assàmia, Metassàmia,** indomal.; **Trionyxélla,** ind.; **Mérmerus,** mal.; **Macrodampètrus, Dampètrus, Mosòia,** Austr.) .... **ASSAMÌIDÆ**

Pedipalpi not curved, held straight forward or at most bent to the side of the chelicerae; anterior margin of the cephalothorax sometimes sharply excavated, but never with five erect, conical teeth 6

6. Tarsi of the third and fourth legs each with a false claw (pseudonychium) below the true claws 7

Tarsi of third and fourth legs without a pseudonychium. (**Beloníscus, Obaloniànus,** indomal.; **Scotolèmon,** palæarc.; **Phalangòdes,** Am.; **Zalmóxis,** Austr.; **Metabiántes,** ethiop.). **PHALANGÓDIDÆ**

7. Pedipalpi weak, their femur, tibia and tarsus broadly flattened and keeled, curved in front of and to the side of the chelicerae; all joints of the pedipalpi almost unarmed, without stout spines. (**Libitòides, Metacynórta,** Am.; **Paravanònes, Cynórta, Cynórtula, Metarhaucus, Flírtea, Ergínulus,** neotrop.). (*PALPÍNIDÆ*) ..... **COSMÉTIDÆ**

Pedipalpi very stout, their femur not flattened, their tibia and tarsus rounded, at most flattened beneath between the stout tibial and tarsal spines, not keeled; the pedipalpi porrect and not curved toward the chelicerae. (Fig. 1050). (**Discocýrtus, Metagynòdes, Eusárcus, Pachylòides, Wèyhia, Gonyléptes, Goniosòma, Cælopỳgus,** neotrop.). **GONYLÉPTIDÆ**

8. Tarsi of the pedipalpi always shorter than their tibiæ (Fig. 1048); without, or with only a very minute claw; maxillary lobe of the second coxa very small or absent, never freely movable; no accessory spiracles on the legs. (Superfamily NEMASTOSOMATÒIDEA) 9

Tarsi of the pedipalpi always longer than the tibiæ and always with a distinct, simple or pectinate claw; maxillary lobe of the second coxa distinct, freely movable, long and narrow; two accessory spiracles on the first to fourth tibiæ. (Fig. 1049). (**Lacínius, Phalángium, Opílio,** holarc.; **Cáddo,** nearc.; **Mítopus, Odiéllus,** palæarc.; **Rhampsinìtus,** ethiop.; **Gagrélla,** indoaustr.). (Superfamily PHALANGIÒIDEA). **PHALANGÌIDÆ**

9. Eyes large, highly convex, widely separated, not on a common ocular tubercle, placed one at each side of the cephalothorax. (Fig. 1047). (**Acropsopílio,** neotrop.). **ACROPSOPILIÓNIDÆ**

Both eyes placed on a common median ocular tubercle 10

10. Ocular tubercle separated distinctly from the anterior margin of the cephalothorax which is sharply truncate, exposing the chelicerae and pedipalpi.....11

Ocular tubercle placed at the anterior margin of the cephalothorax and forming with it a large lobe which covers the chelicerae and pedipalpi from above. (Figs. 1046, 1048), (**Trógulus, Dicranolásma,** palæarc.; **Ortholásma, Dendrolásma,** nearc.).
TROGÙLIDÆ

11. First and second thoracic tergites fused together in the cephalothorax; first to fourth coxæ each with a series of tubercles before and behind. (**Nemastosòma,** holarc.; **Crósbycus,** nearc.).
NEMASTOSOMÁTIDÆ

First thoracic tergite fused with the cephalothorax and forming a prosoma; second thoracic tergite free, not fused with the cephalothorax nor the first tergite; first to fourth coxæ without an anterior and posterior row of tubercles. (**Ischyrópsalis,** palæarc.; **Táracus, Sábacon, Tomicomèrus,** nearc.).
ISCHYROPSÁLIDÆ

LITERATURE ON PHALANGIDA

BANKS, N. Synopsis of North American Phalangida. American Naturalist, **35**, pp. 669–679 (1901).

BISHOP, S. C. and C. R. CROSBY. Phalangida of the Southeastern United States. Journ. Elisha Mitchell Soc., 1924, pp. 8–26 (1924).

ROEWER, C. F. Die Weberknechte der Erde. 1116 pp. Jena, G. Fischer. (1923).

Weitere Weberknechte. Abh. Naturw. Ver. Bremen, **26**, pp. 261–402 (1927).

Weberknechte (Opiliones). In Tierwelt Mitteleuropas, **3**, Lief. 1, pp. V 1–10 (1928).

WALKER, M. E. Revision of Phalangida of Ohio. Ohio State Univ. Studies, Biol. Surv., Bulletin 19, **4**, No. 4, pp. 153–175 (1928).

ORDER **ARANÈIDA**

Small or moderate-sized, rarely large Arachnida. Cephalothorax usually oval, the head frequently separated by an indistinct suture. Usually eight simple eyes, sometimes less or occasionally none. First pair of appendages (chelicerae) hooked or chelate, each provided with a poison-gland opening near the tip. Second pair of appendages (pedipalpi) six-jointed, with one-jointed tarsi; similar to, but usually much

shorter than the four pairs of walking legs which are seven-jointed. Tarsi two-jointed, clawed at tip and often with additional claws or bristles used for manipulating the web. Abdomen almost always entirely unsegmented, its integument thinly chitinized, attached to the cephalothorax by a very strongly constricted base. Respiration by book-lungs opening by one or two pairs of slits on the underside of the abdomen; tracheæ usually present in addition to book-lungs, opening by one or two spiracles on the abdomen below. Silk-spinning glands present, opening by short tubular organs on the abdomen below. Development direct, the young essentially like the adults. Spiders.[1]

1. Abdomen entirely unsegmented in the adult (OPISTHOTHÈLÆ) 2

   Abdomen segmented above and showing several distinct segments posteriorly between the anal tubercle and spinnerets which are separated by a considerable space; six to eight spinnerets; fangs of cheliceræ moving up and down; two pairs of lungs. (Suborder LIPHISTIOMÓRPHÆ (=*MESOTHÈLÆ*)). (**Liphístius, Heptathèla, Anadiastothèle**) ..... **LIPHISTÌIDÆ**

2. Fangs of cheliceræ moving up and down; two pairs of lungs. (Suborder AVICULARIMÓRPHÆ (=*MYGALOMÒRPHÆ*)) .. 3

   Fangs of cheliceræ moving in and out. (Suborder ARACHNOMÓRPHÆ) 10

3. Tips of tarsi beneath the claws without claw-tufts. (NELÍPODA) 4

   Tarsi with claw-tufts, *i.e.* a bundle of hairs at the tip, just beneath the claws; two claws with a single row of teeth, or claws smooth; maxillary lobes wanting; lip free. (HYPODÉMATA) 9

4. All tarsi with a brush of hairs (scopula) beneath; two claws pectinate in two rows; cheliceræ without rastellum; maxillary lobes wanting; lip immobile; four spinnerets, the anterior pair small, close together, the posterior pair heavier and longer; eight eyes in a compact group, heterogeneous. (**Pycnothèle, Lycìnus**). **PYCNOTHÉLIDÆ**

   At least the third and fourth tarsi without a scopula 5

5. Basal segment of cheliceræ with a rastellum, *i.e.* armed on outer side near tip with several rows of stout teeth; maxillary lobes wanting; three claws, upper claws similar, pectinate in a single or double row; four (rarely six) comparatively short spinnerets,

[1] The accompanying key follows that given by Professor Petrunkewitch in his recent "Systema Aranearum," with a very few changes in nomenclature, some modifications of arrangement and the frequent omission of characters of lesser diagnostic value or more difficult recognition.

the anterior pair more or less approximated; eight eyes, heterogeneous. (**Actínopus, Ctenìza, Ídiops, Acáttyma, Brachybóthrium, Pachylomèrus**). Trap-door spiders. **CTENÍZIDÆ**

Cheliceræ without a rastellum 6

6. Lip free; maxillary lobes wanting; three claws, the upper ones pectinate in a single or double row; four or six spinnerets, the posterior pair very long; eight or six eyes, heterogeneous; species spinning webs. (**Brachythèle, Evàgrus, Haplothèle, Hexùra, Diplùra, Áname, Tréchona, Macrothèle**). **DIPLÙRIDÆ**

Lip immobile 7

7. Six spinnerets, the anterior pair close together; maxillary lobes well developed; three claws, the upper ones pectinate in a single row; eight eyes in three groups, heterogeneous. (**Átypus, Calómmata, Microhexùra**) ..... **ATÝPIDÆ**

Four or two spinnerets 8

8. Four claws, the upper ones with one or several teeth, sometimes dissimilar; maxillary lobes wanting; four spinnerets; eight eyes in two rows, heterogeneous; body with simple hairs. (**Cádmon, Mìgas, Moggrídgea, Pœcilomìgas**). (*MÍGIDÆ*). **MIGÁDIDÆ**

Two claws with a single tooth each, sometimes with a vestigial third claw; four or two spinnerets; coxæ of pedipalpi with a vestigial maxillary lobe; eight eyes in a compact group, heterogeneous; body with scales and clubbed hairs. (**Parátropis, Anisáspis, Anisaspòides**) ..... **PARATROPÍDIDÆ**

9. Last joint of posterior spinnerets very short; four or two spinnerets; cheliceræ often with several rows of stout teeth exnally at apex (rastellum); claws similar, smooth or with a few teeth in a single row; eight eyes, heterogeneous. (**Barychèlus, Diplothèle, Leptopélma, Sàson**) ..... **BARYCHÉLIDÆ**

Last joint of posterior spinnerets as long as, or often longer than the preceding joint; four spinnerets; claws similar, pectinate in a single row; cheliceræ without a rastellum; eight eyes in a compact group, heterogeneous. Tarantulas. (**Theraphòsa, Aviculària, Eurypélma, Grammóstola, Eumenóphorus, Selenocósmia, Ornithóctonus**) ..... **AVICULARÌIDÆ**

10. Abdomen with two pairs of spiracles (TETRASTÍCTA) 11

Abdomen with a pair of spiracles leading into book-lungs and a single median spiracle behind them, leading into a tracheal tube 17

11. Cribellum and calamistrum present, at least in the female.....12
Cribellum and calamistrum absent in both sexes.....13
12. Two pairs of lungs; cribellum entire, not divided; eight eyes in two rows, heterogeneous. (**Hypochîlus, Ectatostícta**). **HYPOCHÍLIDÆ**
One pair of lungs; cribellum divided; lip immobile; eight eyes in a compact group, heterogeneous. (**Filístata**). **FILISTÁTIDÆ**
13. The first pair of spiracles leading into book-lungs, the second pair into tracheal tubes.....14
Book-lungs entirely absent; both pairs of spiracles leading into tracheal tubes.....16
14. Three or two claws pectinate in a single row; lip free, long; six eyes, the antero-median ones (direct eyes) wanting or all eyes absent; third pair of legs sometimes reversed in position, directed forward; coxæ of four anterior legs long and cylindrical. (**Dýsdera, Segéstria, Ariàdna, Harpáctes, Stalìta**). . . **DYSDÉRIDÆ**
Two claws pectinate in a double row.....15
15. Six eyes or none; six spinnerets, the anterior ones approximated. (**Orchéstina, Gamasomórpha, Òonops, Epéctris, Scaphiélla**) ..... **OONÓPIDÆ**
Eight eyes, heterogeneous; four spinnerets in a chitinous ring. (**Hadrotársus, Gmógala**) ..... **HADROTÁRSIDÆ**
16. Three claws, dissimilar, pectinate in a single row; cheliceræ without boss, their oblique margins with teeth; lip immobile; colulus (a slender appendage in front of the spinnerets) present; eyes wanting; six spinnerets, the anterior pair longest. (**Telèma, Apneumonélla**) ..... **TELÉMIDÆ**
Two or three claws; upper ones similar, pectinate in a single row; cheliceræ without boss, with smooth margins; lip free; colulus wanting; eight or two eyes, the anterior median eyes always present. (**Capònia, Nóps, Caponìna, Diploglèna**). **CAPONÌIDÆ**
17. Three claws, rarely the third vestigial in which case there are only two spinnerets and the first pair of legs are exceptionally heavy. (TRIÓNYCHA) 18
Two claws (DIÓNYCHA) 42
18. Anal tubercle large, two-jointed, with a fringe of long hair.....19
Anal tubercle normal.....20
19. Cribellum and calamistrum present; eight eyes in a compact group, heterogeneous. (**Œcòbius**) ..... **ŒCOBÌIDÆ**
Cribellum and calamistrum wanting; eight eyes in two rows, heterogeneous. (**Uróctea**) ..... **UROCTÈIDÆ**

20. Cribellum and calamistrum present in the female and in the immature male 21
Cribellum and calamistrum wanting 27
21. Tarsi with claw tufts (a bundle of hairs at tip, just beneath the claws); three claws, the upper ones pectinate in a single row; eight eyes in two rows, homogeneous, diurnal. (**Pséchrus, Fecènia, Stiphídion, Matáchia**) ..... **PSÉCHRIDÆ**
Tarsi without claw-tufts 22
22. First and second tarsi and metatarsi with a brush of hairs (scopula) beneath; tarsi with two rows of trichobothria; six spinnerets; cheliceræ with teeth on both margins; three claws, the upper ones pectinate in a single row; eight eyes in two rows. (**Tengélla, Themàcrys**) ..... **TENGÉLLIDÆ**
All tarsi without scopula; no trichobothria, or with a single row . 23
23. Eyes homogeneous, diurnal 24
Eyes heterogeneous; only the anterior median ones diurnal. . . . 26
24. Cribellum divided; six spinnerets, the posterior pair longer and heavier than the anterior pair; three claws, the upper pair dissimilar, pectinate in a single row; eight eyes in three rows, of which the first is formed of four eyes. (**Erèsus, Dórceus, Adonèa, Stegódyphus**) ..... **ERÉSIDÆ**
Cribellum entire; spinnerets more nearly equal; claws similar. . 25
25. Femora with trichobothria; eight eyes in two rows; orb-weaving species. (**Ulóborus, Sýbota, Hyptiòtes, Miagrámmopes, Avellópsis**) ..... **ULOBÓRIDÆ**
Femora and tarsi without trichobothria; eight eyes in three or two rows, the first row formed of four eyes, those of the second row often very large. (**Dinòpis, Ménneus**). . . . **DINÓPIDÆ**
26. Tarsi with a single row of trichobothria; cribellum divided. (**Amauròbius, Amphigỳrum, Badúmna, Titanœca**). **AMAUROBÌIDÆ**
Tarsi without trichobothria; cribellum usually entire. (**Dictỳna, Scotolàthys, Làthys, Myrópsis, Altélla, Chærèa**). **DICTÝNIDÆ**
27. Trochanter of pedipalp inserted on the dorsal surface of the maxillary lobe; head conspicuously elevated over the thorax; cheliceræ inserted far above the mouth; eight or six eyes. (**Archæa, Mecysmauchènius**) ..... **ARCHÆIDÆ**
Trochanter of pedipalp inserted on the outer edge of the maxillary lobe; cheliceræ inserted nearer to mouth; claw tufts wanting . 28
28. Six spinnerets; three claws 29

Only two spinnerets, the middle and hind pair wanting; pedipalp of female without claw; lip free; two or three claws, the upper ones dissimilar, pectinate in a single row; eight eyes, heterogeneous. (**Lùtica, Otíothops, Palpimànus, Stenochìlus, Hermíppus**) ..... **PALPIMÁNIDÆ**

29. Anterior lateral edge of the first and second tibia and metatarsus with a row of long spines, the interspaces between which are occupied by a row of much shorter, curved spines; tarsi with serrated bristles; eight eyes in two rows, heterogeneous, the lateral eyes contiguous. (**Mimètus, Èro, Gélanor, Oárces, Phobetìnus**) ..... **MIMÉTIDÆ**

First and second metatarsi and tibiæ without such spines.....30

30. Fourth tarsi with a ventral row of serrated bristles forming a distinct comb; legs without spines; upper claws similar, pectinate in a single row or smooth; eight, rarely six or four eyes in two rows, heterogeneous. (**Steatòda, Latrodéctus, Argyròdes, Spíntharus, Therídion, Monèta, Crustulìna, Nicódamus**). **THERIDÌIDÆ**

No ventral comb of serrated bristles on the fourth tarsi.....31

31. Cheliceræ immovably fused or united at the base.....32

Cheliceræ free 33

32. Usually six nocturnal eyes in three groups of two each; if eight eyes, then the direct eyes are also nocturnal and eyes are arranged in two rows of four each; lip long. (**Sicàrius, Scytòdes, Loxósceles, Plectreùrys, Diguètia, Drymùsa**). (*SCYTÓDIDÆ*) ..... **SICARÌIDÆ**

Usually eight eyes, heterogeneous, direct eyes alone diurnal or absent when there are only six eyes; nocturnal eyes in two groups of three eyes each, or all eyes in a single compact group; lip wide. (**Phólcus, Modísimus, Spermóphora, Psilóchorus, Physoglènes, Ninètis**) ..... **PHÓLCIDÆ**

33. Serrated bristles present on tarsi, forming at least one pair of spurious claws 34

Tarsi without serrated bristles, or at least not in the shape of spurious claws 36

34. Six eyes in a compact group, nocturnal; tarsi with onychium; one pair of spurious claws; lip immobile, short; legs with spines. (**Leptonèta, Merizócera, Ochyrócera, Psilodérces, Usòfila**). **LEPTONÉTIDÆ**

Eight eyes, rarely six or none; lip rebordered.....35

35. Cheliceræ with stridulating ridges on the external surface; upper

claws similar, pectinate in a single row; legs with fine spines or smooth; eyes heterogeneous. Sheet-web weavers. (**Bolyphántes, Drapetísca, Labúlla, Linýphia, Eriógone, Tapinòpa, Lophocarènum, Màso**) ..... **LINYPHÌIDÆ**

Cheliceræ without stridulating ridges; upper claws similar or dissimilar, pectinate in a single row; legs usually with stout spines; eyes usually homogeneous, diurnal, rarely heterogeneous. Orb-weavers. (**Argìope, Aránea** (=*Epeìra*), **Mèta, Néphila, Leucaùge, Tetrágnatha, Theridiosòma, Gasteracántha**). (*EPEÍRIDÆ*) ..... **ARGIÓPIDÆ**

36. Cheliceræ without a boss.....37
Cheliceræ with a boss 38

37. Colulus present; last joint of posterior spinnerets always long; anterior spinnerets shorter than the posterior pair; eight eyes on a tubercle, heterogeneous; the anterior lateral ones nocturnal, all others diurnal. (**Hersília, Hersilìola, Murrícia, Tàma**) ..... **HERSILÌIDÆ**

Colulus wanting; last joint of posterior spinnerets short; anterior pair of spinnerets usually considerably longer than the posterior pair; eyes in two or three rows. (**Zodàrion, Storèna, Làches, Cryptothèle, Cithæron**). ..... **ZODARÌIDÆ**

38. Anterior median eyes not far in advance of all the other eyes..39
Anterior median eyes small, approximated, placed far in advance of the other eyes near the edge of the clypeus; eight eyes, heterogeneous; body with plumose hairs. (**Senóculus**). **SENOCÙLIDÆ**

39. Trichobothria on the tarsi either in two rows or irregularly distributed 40
Trichobothria on the tarsi in a regular row; legs without scopulæ; body with plumose hairs; eight eyes (rarely six or none) in two rows of four each, usually heterogeneous, only the anterior median eyes diurnal; eyes sometimes almost homogeneous. (Fig. 1014). (**Agalèna, Tegenària, Cœlótes, Argyronèta, Cybæus, Hahnia, Rhoicìnus**) ..... **AGALÉNIDÆ**

40. All trochanters strongly notched; posterior row of eyes always recurved 41
Only the fourth trochanter with a slight notch; eyes often grouped in a hexagon, the posterior four forming a procurved line; body with scale-like hairs; eight eyes, all diurnal. (**Oxyòpes, Hamatáliva, Oxyopeìdon, Peucètia, Tappònia**). **OXYÓPIDÆ**

41. Upper claws with numerous teeth in a single row; lower claw with two or three teeth; body always bearing plumose hairs; legs rather long, sometimes formed for running sideways; female carrying her egg-cocoon in her cheliceræ, or if attached to the spinnerets, it is hemispherical. (**Chiasmòpes, Pisaùra, Thanatídius, Dolómedes, Thaumàsia, Thalássius**).
PISAURIDÆ

Upper claws with few teeth; lower claw either smooth or with a single tooth; body usually with only simple hairs; legs shorter, always formed for running forwards; cocoon globular, carried attached to the spinnerets. Wolf spiders. (**Lycòsa, Pardòsa, Allocòsa, Arctòsa, Piràta, Evíppa, Híppasa**) . **LYCÓSIDÆ**

42. Cribellum and calamistrum present.....43
Cribellum and calamistrum absent.....44

43. First and second tarsi and metatarsi with a scopula; claw tufts wanting; cribellum divided; eight eyes in two rows, homogeneous, diurnal. (**Zorópsis, Rècius, Zorócrates**).
ZORÓPSIDÆ

None of the tarsi or metatarsi with scopula; claw-tufts present; cribellum divided or entire; eight eyes in three rows, homogeneous, diurnal. (**Acanthóctenus**) . **ACANTHOCTÉNIDÆ**

44. Cheliceræ and lip free 45
Cheliceræ immovably attached at base; with a boss and a row of teeth along the entire inner edge; lip immobile; eyes eight, in a compact group. (**Ammóxenus**) ..... **AMMOXÉNIDÆ**

45. Eight eyes in three rows, homogeneous, diurnal, the first row of four, second and third of two each; sometimes with first row so strongly curved that four rows are apparently formed; legs formed for running forwards and jumping; body often scaly. Jumping spiders. A very large family. (**Lyssómanes, Sálticus, Myrmarächne, Marpíssa, Phidíppus, Dendryphántes, Pellènes, Áttus**) ..... **ÁTTIDÆ**

Eyes either in two rows, or if in three rows, the second is composed of four eyes, or else the eyes are distinctly heterogeneous 46

46. Sternum wider than long, broadly truncate behind; body very flat; middle pair of spinnerets between the anterior pair. (**Plàtor, Véctius, Doliomàlus**) ..... **PLATÓRIDÆ**

Sternum normal; middle pair of spinnerets not thus placed....47

47. Six eyes in the first row; eight eyes in two rows, heterogeneous, only the posterior median ones nocturnal; body flat; legs

adapted for running sideways; anterior pair of spinnerets close together. (**Selènops**) ..... **SELENÓPIDÆ**

First row never composed of six eyes.....48

48. Anterior pair of spinnerets wide apart.....49

Anterior pair of spinnerets contiguous or nearly so.....50

49. Eight eyes in two rows of four each, if only six eyes are present, the direct eyes are wanting; cheliceræ with boss, the margins toothed; pedipalp of female with claw. (**Drássus, Drassòdes, Zelòtes, Gnaphòsa, Callílepis, Anágraphis, Hemiclœa**). **DRÁSSIDÆ**

Eight eyes in a compact group, the first row composed of four eyes; cheliceræ without boss, with smooth, oblique margins; pedipalp of female without claw. (**Prodídomus, Zimìris, Elelèis, Pródida**) ..... **PRODIDÓMIDÆ**

50. Sternum oval or long; posterior coxæ approximated; tarsi without spurious claws 51

Sternum wide, pointed behind; posterior coxæ far apart; tarsi with one pair of spurious claws; eight eyes in two rows of four, homogeneous, the posterior row strongly recurved and much wider than the anterior one. (**Homalónychus**). **HOMALONÝCHIDÆ**

51. All tarsi without scopula; colulus present; cheliceræ with boss, but without scopa, their margins usually smooth.....52

At least the first and second tarsi with scopula; colulus absent; cheliceræ with boss and scopula, the margins toothed.....53

52. Lip lance-shaped, very long and narrow; sternum narrow, pointed posteriorly, not reaching beyond the third coxæ; fourth metatarsi longer than the second; pedipalp of female without claw. (**Aphantochìlus, Bucrànium, Majélla**). **APHANTOCHÍLIDÆ**

Lip and sternum not thus, of the usual form; second metatarsi longer than the fourth; pedipalpi of female with claw. (**Strò-phius, Stephanópsis, Philódromus, Dièta, Coriaráchne, Misùmena, Oxýptila, Synæma, Xýsticus**). **THOMÍSIDÆ**

53. Legs formed for running forwards; apex of metatarsus with a chitinous rim..... 54

Legs formed for running sideways; apex of metatarsi with a soft, trilobate membrane; pedipalpi of female with a claw; eight eyes in two rows of four each. (**Delèna, Spariánthis, Micrómmata, Heterópoda, Palístes, Clástes, Staîanus**). **SPARÁSSIDÆ**

54. Eight eyes in two rows of four each; scopula of maxillary lobes not extending over external surface. (**Chiracánthium, Clubiòna, Gayénna, Liócranum, Corínna, Tráchelas, Castaneìra**) ..... **CLUBIÓNIDÆ**

Eight eyes in three rows, two in the first, four in the second and two in the third row; scopula of maxillary lobes extending partly over external surface. (**Ctènus, Acanthèis, Calóctenus, Òdo**) ..... **CTÉNIDÆ**

LITERATURE ON ARANEIDA

AUSSERER, A. Die Arachniden-Familie der Territelariæ. Verh. k. k. zool.-bot. Ges. Wien, **21**, pp. 117–224 (1871), and **25**, pp. 156–206 (1875).

BANKS, N. Families and Genera of Araneida. American Naturalist, **39**, pp. 293–323 (1905).

Catalogue of Nearctic Spiders. Bull. U. S. Nat. Mus., No. 72 (1910).

BISHOP, S. C. Revision of Pisauridæ of the United States. Bull. N. Y. State Mus., No. 252, 140 pp. (1924).

BÖSENBERG, W. Die Spinnen Deutschlands (1901–03).

CAMBRIDGE, F. P. Spiders of the Genus Latrodectus. Proc. Zool. Soc. London, 1892, pp. 247–261 (1892).

CHAMBERLIN, R. V. Revision of North American Lycosidæ. Proc. Philadelphia Acad. Nat. Sci., 1908, pp. 157–318 (1908).

North American Gnaphosidæ. Proc. Biol. Soc. Wash., **35**, pp. 145–172 (1922).

CHYZER, C. and L. KULCZYNSKI. Araneæ Hungaricæ. 2 vols. Budapest (1892–97).

COMSTOCK, J. H. The Spider Book. Doubleday Page & Co., Garden City, N. Y. (1912).

DAHL, F. Die Spinnen Norddeutschlands (1883).

Die Lycosiden Deutschlands. Abh. K. Leop. Car. Deutsch. Akad. Naturf., **88**, pp. 179–678 (1908).

Salticidæ in Tierwelt Deutschlands, **3**, Lief. 1, 55 pp. (1926).

DALMAS, COMPTE DE. Araignées de Nouvelle Zélande. Ann. Soc. Entom. France, **86**, pp. 317–430 (1918).

Synopsis des araignées de la famille des Prodidomidæ. Ann. Soc. Entom. France, **87**, pp. 279–340 (1918–19).

EMERTON, J. H. Theridiidæ of New England. Trans. Conn. Acad. Arts Sci., **6**, pp. 1–86 (1882).

Epeiridæ of New England. Trans. Conn. Acad. Arts Sci., **6**, pp. 295–342 (1884).

New England Lycosidæ. Trans. Conn. Acad. Arts Sci., **6**, pp. 481–505 (1884).

Dictynidæ of New England. Trans. Conn. Acad. Arts Sci., **7**, pp. 443–460 (1888).

Drassidæ, Agalenidæ and Dysderidæ of New England. Trans. Conn. Acad. Arts Sci., **8**, pp. 1–40 (1890).

New England Spiders of the Family Thomisidæ. Trans. Conn. Acad. Arts Sci., **8**, pp. 359–381 (1892).

Common Spiders of the United States. Boston (1902).

Supplement to New England Spiders. Trans. Conn. Acad. Arts Sci., **14**, pp. 173–236 (1909).

GRAVELEY, F. H. Indian Lycosidæ. Rec. Indian Mus., **26**, pp. 587–613 (1924).

HENTZ, N. M. Spiders of the United States. Collected writings, edited by J. H. Emerton. Boston Soc. Nat. Hist. (1875).

KEYSERLING, E. Die Spinnen Amerikas. Nürnberg. **1**, Laterigradæ (1880); **2**, Theridiidæ (1884–86); **3**, Brazilian Spiders (1891), **4**, Epeiridæ (1892–93).

KOCH, L. Die Arachnidenfamilie der Drassiden. (1866).

LESSERT, R. Araignées du Kilimandjaro et du Mérou. Rev. Suisse Zool., **27**, pp. 99–234 (1919). See also Rept. Kilimandjaro-Meru Exped. (1915).

MELLO-LEITÃO, M. Aphantochílidas e Thomísidas do Brasil. Arch. Mus. Nac. Rio de Janeiro, **31**, pp. 1–359 (1929).

PECKHAM, G. W. and E. G. Revision of North American Attidæ. Trans. Wisconsin Acad. Sci., **16**, pp. 355–596 (1909).

PETRUNKEWITCH, A. Catalogue of American Spiders. Bull. American Mus. Nat. Hist., **29**, pp. 1–809 (1911).

On Families of Spiders. Ann. Acad. Sci., New York, **29**, pp. 145–180 (1923).

Arachnida from Panama. Trans. Conn. Acad. Sci., **27**, pp. 51–248 (1925).

Systema Aranearum. Trans. Conn. Acad. Arts Sci., **29**, pp. 1–270 (1928).

Spiders of Porto Rico. Trans. Conn. Acad. Arts Sci., **30**, pp. 1–355; **31**, pp. 5–191 (1930).

RAINBOW, W. J. Census of Australian Araneida. Rec. Australian Mus., **9**, pp. 107–319 (1911).

Terretelariæ of Australia. Rec. Australian Mus., **10**, pp. 187–270 (1914).

RAINBOW, W. J. and R. H. PULLEINE. Australian Trap-door Spiders. Rec. Australian Mus., **12**, pp. 81–169 (1918).

REIMOSER, E. Catalog der paläarktischen Spinnen. Abh. zool.-bot. Ges. Wien, **10**, pp. 1–280 (1919).

ROEWER, C. F. Spinnen (Araneida). In Tierwelt Mitteleuropas, **3**, Lief. 2, pp. VI 1–144, (1928).

SIMON, E. Avicullariides de l'Amérique du Nord. Act. Soc. Linn. Bordeaux, **44**, pp. 307–339 (1892).

Histoire naturelle des Araignées. Paris, 2 vols. (1892–03).

SMITH, C. P. Theraphosidæ of California. Ann. Entom. Soc. America, **1**, pp. 207–250 (1908).

THORELL, T. Descriptive Catalogue of Spiders of Burma. London, British Museum, 404 pp. (1895).

TUCKER, R. W. E. Drassidæ of South Africa. Ann. South African Mus., **19**, pp. 251–438 (1923).

ORDER **ACARÌNA**

(*ACÁRIDA*)

Usually small or minute species of rounded or oval form, with the body not divided by any deep constrictions. Abdomen not segmented although occasionally with a large number of minute transverse ridges; very broadly joined to the cephalothorax from which it is sometimes separated by a suture. Cheliceræ usually two-jointed, frequently chelate. Pedipalpi with five joints or less, usually clawed or chelate, occasionally long and serving as tactile organs. Adults usually with four pairs of legs, occasionally with only two; larva almost always with three pairs. Legs with five to seven joints, usually ending in one or two claws. Eyes usually present, commonly as one or several at each side of the body; rarely with a median one. Respiration by tubular tracheæ opening by one or several pairs of spiracles, or through the integument only. Habits varied, vegetarian or carnivorous, frequently parasitic. Mites and Ticks.

The Acarina are an extremely large and diverse group, but have received comparatively little attention. The classification given below follows in general that of Banks, while the arrangement of the water mites is that adopted by Viets. Many families and subdivisions in use by other acarologists have been merged with the larger and better known families.

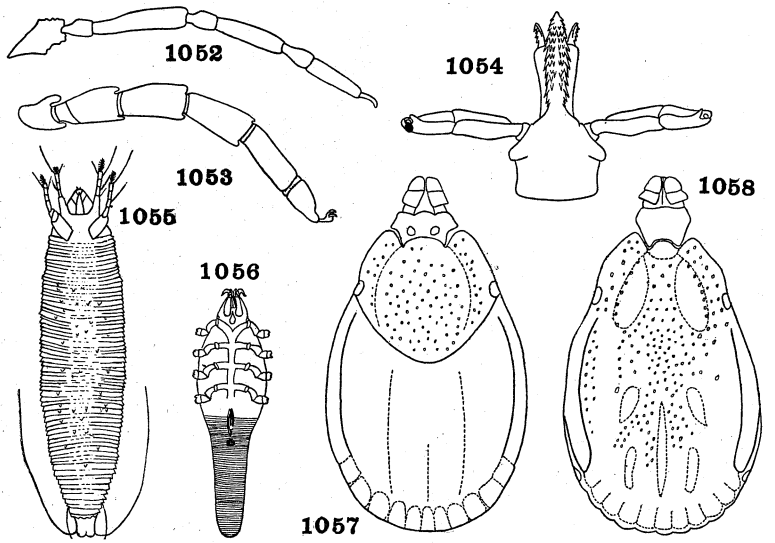
1. Body rounded, oval, rarely noticeably elongate; abdomen not annulate, vermiform nor prolonged behind; adult form always with eight legs 3

   Body elongate or lanceolate, the abdomen vermiform, prolonged behind and annulate; often with only four legs; very minute forms living in plants, forming galls, or parasitic in the skin of mammals. (Superfamily DEMODICÒIDEA) 2

2. Body with four legs placed near the anterior end, each composed of five joints; plant-inhabiting species, usually forming deformations or galls. (Fig. 1055). (**Eriòphyes** (= *Phytóptus*) (*E. pyri*, Pear blister mite), **Phyllocóptes, Anthocóptes, Tegonòtus, Epitrímerus**). (*PHYTÓPTIDÆ*).

ERIOPHÝIDÆ

Body with eight legs, placed on the anterior half of the body, each composed of only three joints; living in the skin of various mammals. (**Démodex** (*D. folliculòrum*, Follicle mite)). (Fig. 1056)) ..... **DEMODÍCIDÆ**



Figs. 1052–1058. **Acarina**

1052. **Holosiro,** leg (Ewing).
1053. **Rhipicephalus,** leg (Ewing) Ixodidæ.
1054. **Ixodes,** mouthparts (Nuttall) Ixodidæ.
1055. **Eriophyes** (Kendall) Eriophyidæ.
1056. **Demodex** (Banks) Demodicidæ.
1057. **Rhipicephalus,** female (Nuttall) Ixodidæ.
1058. **Rhipicephalus,** male (Nuttall) Ixodidæ.

3. Body at each side with a distinct spiracle upon a stigmal plate, usually below the lateral margin and above the third or fourth coxa or a little behind; palpi free; skin often coriaceous or leathery; tarsi often with a sucker.....4
   No such spiracle on a stigmal plate on this part of the body..12
4. Hypostome (median portion of mouthparts) large, provided below with a large number of recurved teeth or barbs; ventral surface of body posteriorly with at least one pair of furrows extending

backwards from the genital pore; skin leathery; large species usually parasitic on mammals, more rarely on birds or reptiles. (Superfamily IXODÒIDEA) 5

Hypostome small, not toothed or barbed; venter without furrows; body often with coriaceous shields; posterior margin never crenulated nor fluted; eyes absent. (Superfamily PARASITÒIDEA) 6

5. Body above with a chitinous plate or scutum which almost covers the body of the male, but is reduced to a small plate near the front of the body in the female; body below sometimes with ventral shields; mouthparts of adult clearly visible from above; stigmal plate behind the coxæ; tarsus with a pulvillus. (Figs. 1053, 1054, 1057, 1058). (**Ixòdes, Dermacéntor, Hæmaphỳsalis, Margáropus, Amblyómma**) ..... **IXÓDIDÆ**

Body without scutum in either sex; without any ventral shield; mouthparts of adult almost entirely concealed from above; stigmal plate between coxæ of third and fourth legs; tarsi without pulvillus. (Fig. 1019). (**Árgas, Ornithódoros**). **ARGÁNTIDÆ**

6. Palpi not enlarged at tip; spiracles behind the coxæ of the third legs 7

Palpi with the last joint enlarged; a spiracle above the coxa of the third leg; moderately large species. (**Holòthyrus,** ethiop., indoaustr.) ..... **HOLOTHÝRIDÆ**

7. Genital aperture near the anus; mouthparts capable of being retracted within a large buccal cavity, which is near the anterior end of the body and separated from the rest of the body by a suture; living on bats. (**Spelæorhýnchus,** neotrop.). **SPELÆORHÝNCHIDÆ**

Genital aperture not or only slightly behind the hind coxæ; anterior part of body not separated by a suture; body rather broad and flat, with relatively short legs 8

8. Spiracle and peritreme clearly on the ventral side of the body. (Fig. 1060) 9

Spiracle and peritreme situated on the dorsum, or very nearly so; legs short and very bristly, all with large caruncles, larva living in body of female. (Fig. 1066). (**Spintúrnix** (=*Pterópptus*), **Periglíschrus,** on bats; **Ptilonýssus,** on sparrows). (*PTEROPTÌNÆ*) ..... **SPINTURNÍCIDÆ**

9. Anus surrounded by a chitinous plate or shield; rarely parasitic on mammals 10

Anus without a chitinous plate or shield; internal parasites in the respiratory tract of mammals. (**Halarách**ne, in bronchi of seals; **Pneumonýssus,** in lungs of monkeys). (Fig. 1062).
HALARÁCHNIDÆ

10. First pair of legs inserted outside the mouth opening; dorsal surface of body not projecting in front of the camerostome; male genital opening usually on the anterior margin of the sternal plate, sometimes in the middle.....11
First pair of legs inserted in the mouth cavity with the oral tube; dorsum of body projecting beyond the camerostome; male genital opening in the sternal plate. Species often occurring on insects. (**Urópoda, Discopòma, Cílliba, Uroplitélla, Polyáspis, Tráchytes, Dínychus, Deraióphorus**).
UROPÓDIDÆ

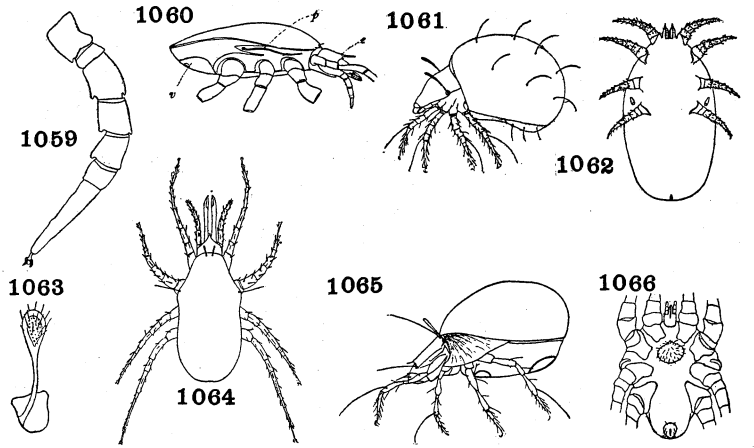
11. Claw of cheliceræ usually without teeth, often stylate or needle-like, the fixed arm always without a seta; tarsi of first pair of legs with claws or caruncles; second legs of male without processes; anus of female usually at anterior end of anal shield; all the chitinous shields rather weak and often not evident. Species parasitic on birds, mammals and reptiles. (**Dermanỳssus** (*D. gallìnæ*, Chicken mite); **Liponỳssus,** on mammals; **Ophionỳssus,** on snakes) ..... **DERMANÝSSIDÆ**
Claw of cheliceræ toothed, rarely stylate or needle-like, the fixed arm usually with a seta. Species often occurring on insects, but rarely on vertebrates ..... **PARASÍTIDÆ**
Three well-defined subfamilies may be distinguished as follows:

a. Body usually elongate; first pair of legs with or without claws; genital opening of male usually in front of the sternal plate; usually free-living species; rarely myrmecophilous.....b
Body circular in outline, or nearly so; conspicuously hairy; first pair of legs greatly elongated and without claws; genital opening of male in the sternal plate; usually myrmecophilous species living externally on the bodies of ants. (**Antennóphorus, Echinomegístus, Antennomegístus**).
ANTENNOPHORÎNÆ

b. First pair of legs with claws or caruncles, used for walking; second pair of legs often enlarged in the male; species free-living or parasitic, often on vertebrates. (Figs. 1060, 1064). (**Parásitus** (=*Gámasus*), **Làelaps, Echinolælaps, Hæmogámasus**).
PARASITÎNÆ
First pair of legs without claws or caruncle, as long as or longer than the body and serving as sensory organs; second pair of

legs in male rarely much enlarged; not parasitic on vertebrates. (Fig. 1059). (**Macrochèles, Rhodácarus, Megísthanus, Cælenópsis, Euzércon**) ..... **MACROCHELÌNÆ**

12. Body usually coriaceous, with few hairs; with a specialized seta arising from a pore near each posterior corner of the cephalothorax (pseudostigmatic organ, Fig. 1063); eyes absent, mouthparts and palpi usually very small; ventral openings of abdo-



Figs. 1059–1066. **Acarina**

1059. **Macrocheles,** leg (Ewing) Parasitidæ.
1060. **Parasitus** (Banks); *e*, epistoma; *p*, peritreme; *v*, anal plate. Parasitidæ.
1061. **Hoploderma** (Banks) Hoplodermatidæ.
1062. **Pneumonyssus** (Banks) Halarachnidæ.
1063. **Oribatidæ,** pseudostigmatic organ (Banks) Orbatidæ.
1064. **Parasitus** (Banks) Parasitidæ.
1065. **Oribatella** (Banks) Oribatidæ.
1066. **Spinturnix,** underside (Banks) Spinturnicidæ.

men large; coxæ close together; tarsi without sucker. Species free-living, not parasitic. (Superfamily ORIBATÒIDEA) . . 13

Body nearly always of softer texture; pseudostigmatic organ absent 15

13. Cephalothorax and abdomen separated by a suture 14

Cephalothorax and abdomen not separated by a suture; mandibles very large and prominent. (**Labidostómma** (= *Nicoletiélla*)). **LABIDOSTOMMÁTIDÆ**

14. Cephalothorax loosely attached to the abdomen, so that it is freely movable; palpi four-jointed. (Fig. 1061). (**Hoplodérma, Phthirácarus, Protolóphora, Mesolóphora**).
HOPLODERMÁTIDÆ

Cephalothorax immovably united with the abdomen; palpi five-jointed. (Figs. 1063, 1065). (**Oríbata, Oribatélla, Galúmna, Pèlops, Hypochthònius, Trizètes, Hermánnia**).
ORIBÁTIDÆ

15. Aquatic species, living entirely in and laying their eggs in water and nearly always in fresh water; palpi four or five-jointed; parasitic or free-living. Superfamily HYDRACHNÒIDEA..16

Terrestrial or parasitic species, never living in water, except certain parasitic species with two-jointed palpi and chelate hind legs 38

16. Basal attachment of the third and fourth pairs of legs strongly lateral in position, visible from above next to the lateral margin of the body, cephalothorax with two large posterior and two small lateral plates 17

Basal attachment of the third and fourth pairs of legs not visible from above 18

17. Palpi composed of five joints; red species. (**Hydrovólzia**).
HYDROVOLZÌIDÆ

Palpi with only three or four joints; species living on marine algæ, not adapted for swimming. (**Halácarus, Porohalácarus, Walterélla, Soldanellònyx**) ..... **HALACÁRIDÆ**

18. Eyes placed near the middle of the vertex, connected by a transverse median chitinized structure 19

Eyes placed at the sides of the body, not connected across the vertex by a chitinized structure, although sometimes with chitinous plates between them.....20

19. Chitinized plate connecting the eyes forming a median band, *i.e.* much higher than wide; no swimming hairs on any of the legs; very soft-bodied species with thinly chitinized integument. (**Limnóchares**) .... **LIMNOCHÁRIDÆ**

Chitinized plate connecting the eyes forming a transverse band that is much wider than high; three anterior pairs of legs with swimming hairs. (**Eylàis**) ..... **EYLÀIDÆ**

20. Legs six-jointed..... 21

Legs five-jointed; body with a dorsal shield; two lateral eyes and a median one. (**Thermácarus**, holarc., in hot springs).
THERMACÁRIDÆ

21. Lateral eyes placed together on a chitinized tubercle or plate at each side of the head 22
Lateral eyes not placed together on a chitinized plate, although sometimes close together as a contiguous pair 27
22. Eye-plate free, not attached to any other plate. (**Piersígia**). (See couplet 19) ..... **EYLÀIDÆ**, part
Eye-plate fused laterally to a chitinous plate which is produced medially behind 23
23. Body without a dorsal shield; legs without swimming hairs. (**Prótzia, Calònyx, Partnùnia, Wandèsia**). . **PROTZÌIDÆ**
Body usually with dorsal shield; legs frequently with swimming hairs 24
24. Cheliceræ styliform; beak produced, tubular. (**Hydráchna, Bárgena**) ..... **HYDRÁCHNIDÆ**
Cheliceræ with basal segment and opposable claw, not styliform; beak not produced 25
25. Second joint of palpi without a sharp projection inwardly 26
Second joint of palpi with a sharp projection inwardly. (**Spérchon, Pseudospérchon**) ..... **SPERCHÓNIDÆ**
26. Body without a dorsal shield; body spinose. (**Pseudohydryphántes**) ..... **PSEUDOHYDRYPHÁNTIDÆ**
Body with a dorsal shield. (**Hydryphántes, Thỳas, Viètsia, Pánisus, Mamérsa, Eupàtra, Georgélla**). **HYDRYPHÁNTIDÆ**
27. Eyes separated, not forming contiguous double-eyes 28
Eyes united to form a double-eye at each side of the body . . 29
28. Fourth pair of legs with apical claws; palpi distinctly chelate at tip. (**Diplodóntus, Oxyópsis**) . **HYDRYPHÁNTIDÆ**, part
Fourth pair of legs without apical claws; palpi not chelate at tip. (**Limnèsia, Limnesiélla, Duralimnèsia**). . **LIMNESÌIDÆ**
29. Palpi simple at tip, without a stout hook 30
Last joint of palpi forming a stout hook which is opposable to the broad tip of the preceding joint. (**Arrhenùrus, Thoracophorácarus, Mundamélla, Wùria**). .... **ARRHENÙRIDÆ**
30. Epimera of the fourth pair of legs with a large pore near the inner angle; tarsus of fourth leg pointed, without claws. (**Teutònia**) **LEBERTÌIDÆ**, part
Epimera of the fourth leg without a pore 31
31. Second joint of palpi with a strong bristle inwardly which often arises from a sharp projection 32
Second joint of palpi without a sharp projection or bristle 34

32. Third joint of palpi bearing five to seven stout bristles that are longer than the joint. (**Lebértia, Pilolebértia, Hexalebértia**). **LEBERTÌIDÆ**

Third joint of palpi without such bristly hairs.....33

33. Cheliceræ long, beak-like or extensile within a tube formed by the epistoma; carapace composed of several plates. (**Atráctides, Pseudotorrentícola**) ..... **ATRACTÍDIDÆ**

Cheliceræ of a different conformation. (See couplet 32). (**Dártia, Bandàkia**) ..... **LEBERTÌIDÆ**, part

34. Body strongly compressed from the sides, or narrowly elongate-oval; legs inserted one above another near the anterior end of the body; fourth pair of legs without apical claws. (See couplet 33). (**Óxus, Gnaphíscus, Frontípoda**). **ATRACTÍDIDÆ**, part

Body not compressed nor narrowly elongate; legs inserted one behind another in the usual position 35

35. Epimera of the first pair of legs free, not fused medially behind the maxillæ 36

Epimera of the first pair of legs completely fused. (**Hygróbates, Mégapus**) ..... **HYGROBÁTIDÆ**

36. First pair of legs bearing blunt bristles, usually placed in pairs on tubercles. (**Unionícola, Neumánnia, Huitféldtia**). **HYGROBÁTIDÆ**, part

First pair of legs not thus bristly 37

37. Integument usually weak and thin, always without any pore-bearing shields; usually convex species. (**Féltria, Nautaráchna, Foréllia, Piòna, Hydrochoreùtes, Acércus**). **HYGROBÁTIDÆ**, part

Body with pore-bearing plates; usually flattened. (**Mìdea, Mideópsis, Brachỳpoda, Atùrus, Álbia**). **BRACHYPÓDIDÆ**

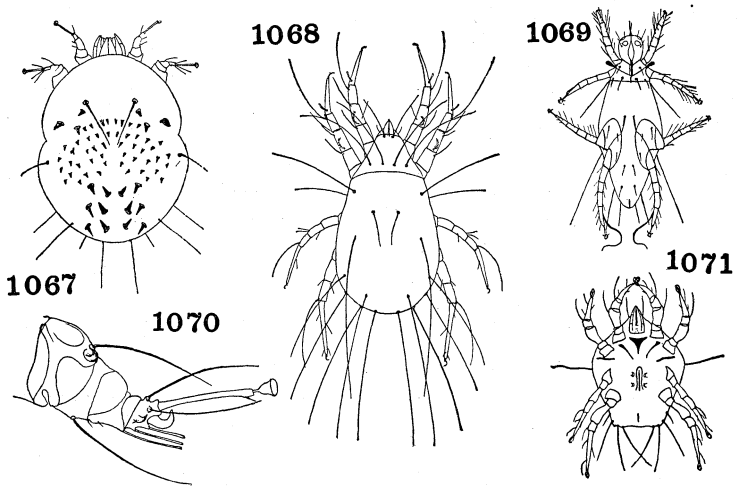
38. Palpi two-jointed, partly enclosing the cheliceræ; third and fourth pairs of legs in both sexes greatly thickened, the last two joints opposable to form grasping organs; tarsi without suckers; parasitic in the gills of crabs. (**Ewíngia**, nearc.). **EWINGÌIDÆ**

Palpi with three or more joints; rarely the fourth pair of legs enlarged to form a grasping organ in the male only, in which case the other tarsi bear suckers.....39

39. Palpi small, three-jointed, adhering for some distance to the beak; body usually with ventral suckers at the genital opening or near the anal opening; eyes absent; tarsi often with suckers at tip; frequently parasitic. (Superfamily ACARÒIDEA).....40

Palpi usually four or five-jointed, free; rarely with ventral suckers near the anal or genital openings; eyes present or absent; tarsi without suckers at tip; nearly always free living.....46

40. Tracheæ absent, female without a clavate hair below at each side between the first and second pairs of legs.....41



Figs. 1067–1071. **Acarina**

1067. **Acarus** (Banks) Acaridæ.
1068. **Tyroglyphus** (Banks) Tyroglyphidæ.
1069. **Pediculoides** (Banks) Tarsonemidæ.
1070. **Acarus,** leg (Banks) Acaridæ.
1071. **Canestrinia** (Banks) Canestriniidæ.

Tracheæ present, no ventral suckers; legs terminated in claws; cephalothorax and abdomen clearly separated; female with a prominent clavate hair below on each side between the first and second pairs of legs; not parasitic on birds or mammals. (Fig. 1069). (**Tarsonèmus, Pediculòides, Scutácarus, Pigmeophórus**) ..... **TARSONÉMIDÆ**

41. Not parasitic on birds or mammals; genital suckers usually present; integument usually without fine parallel lines.....42

Parasites of birds or mammals; genital suckers absent; integument marked with fine parallel lines.....43

42. Legs short; the tarsi of the first and second pairs without clavate hairs, terminating in suckers; species parasitic on insects. (Fig. 1071). (**Canestrínia, Hemisarcóptes, Linòbia, Coleopteróphagus**) ..... **CANESTRINÌIDÆ**

Legs longer; the tarsi of the first and second pairs of legs externally near the base with a clavate hair; usually free-living, rarely parasitic on insects. (Fig. 1068). (**Tyróglyphus, Rhizóglyphus, Aleuròbius, Histiosòma, Glycíphagus, Monieziélla, Trichotársus**) ..... **TYROGLÝPHIDÆ**

43. External parasites of mammals; legs or mouthparts modified to form clasping organs to cling to the hairs of the host. (**Listróphorus, Labidocárpus, Schizocárpus, Myocóptes, Trichœcius**) ..... **LISTROPHÓRIDÆ**

Species not living externally on the hair of mammals and without such specialized clinging apparatus 44

44. External parasites of birds, living on the plumage. (**Análges, Freyàna, Pterólichus, Pterodêctes, Allóptes**). **ANALGÉSIDÆ**

Internal parasites living in the skin or tissues of birds, and in or on the skin of mammals 45

45. Genital aperture of female longitudinal in position; species living in the skin or internal tissues of birds. (**Cytoleìchus, Laminosióptes**). (*CYTODÓTIDÆ*) ..... **CYTOLEÌCHIDÆ**

Genital aperture of female transverse; skin parasites of mammals or birds. (Figs. 1067, 1070). (**Ácarus** (=*Sarcóptes*) (Itch mites), **Psoróptes, Chorióptes, Cnemidóptes**). (*SARCÓPTIDÆ*) ..... **ACÁRIDÆ**

46. Last joint of palpi opposable like a thumb to the preceding joint which is nearly always claw-like at tip (Fig. 1076); body often bearing many hairs. (Superfamily TROMBIDÒIDEA).... 47

Palpi not thus modified; simple or rarely modified to hold prey; body with few hairs. (Superfamily EUPODÒIDEA)..... 52

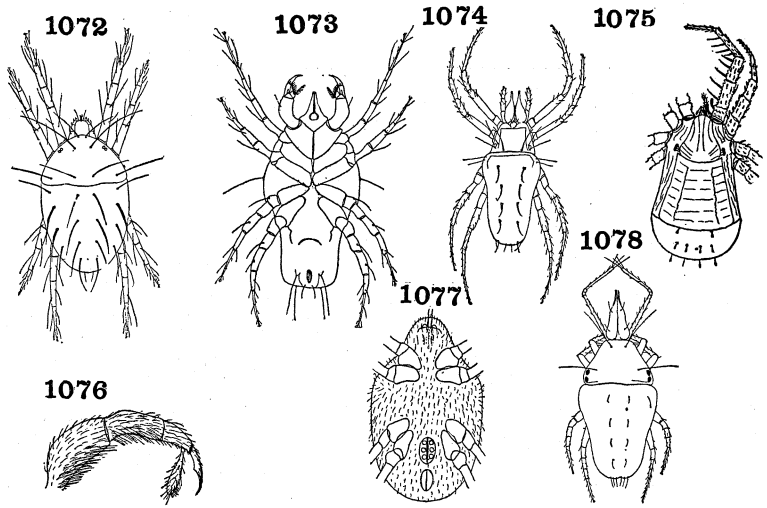
47. Legs simple, without processes bearing spines; body without, or with inconspicuous chitinous shields..... 48

First and second pairs of legs with processes bearing spines; cephalothorax with a large, sculptured, median chitinous shield, abdomen with two or more similar shields; coxæ contiguous (Fig. 1075). (**Cæculus**) ..... **CÆCÙLIDÆ**

48. Cheliceræ chelate or pincers-like at tip, with a movable claw opposable to the basal portion 49

Cheliceræ stylet-shaped or needle-like, retractile..... 50

49. Last joint of first pair of legs usually enlarged; cephalothorax with a median dorsal line or groove; legs inserted in two groups, the coxæ of the first two pairs placed far forward and those of the two posterior pairs in a second group far removed from the first. (Fig. 1076). Harvest mites. (**Trombídium**).
TROMBIDÌIDÆ



Figs. 1072–1078. **Acarina**

1072. **Tetranychus** (Banks) Tetranychidæ.
1073. **Cheyletus** (Banks) Cheyletidæ.
1074. **Rhagidia** (Banks) Eupodidæ.
1075. **Cæculus** (Banks) Cæculidæ.
1076. **Trombidium,** palpi (Banks) Trombidiidæ.
1077. **Smaris** (Banks) Erythræidæ.
1078. **Bdella** (Banks) Bdellidæ.

Last joint of first pair of legs not enlarged, often long; cephalothorax without median line or groove; coxæ of all legs usually closely approximated, forming a single group. (**Anýstis, Tarsótomus, Gekòbia, Pterygosòma**) ..... **ANÝSTIDÆ**

50. Last joint of legs not enlarged; cephalothorax without a median dorsal groove 51

Last joint of first and fourth pairs of legs enlarged; cephalothorax usually with a median dorsal groove; adults free-living, usually

active and with long slender legs. (Fig. 1077). (**Erythrèus** (= *Rhynchólophus*), **Smàris, Fessònia, Átomus, Eatoniàna**). (Including *SMÁRIDÆ*). (*RHÝNCHOLÓPHIDÆ*).
ERYTHRÆIDÆ

51. Feeding on plants; all legs terminated by claws; body bristles or hairs usually simple. (Figs. 1015, 1072). Red spiders. (**Tetránychus, Rhaphígnathus, Bryòbia** (*B. praténsis*, Clover mite), **Achèles, Stigmæus**). (Including *RHAPHIGNÁTHIDÆ*) ..... **TETRANÝCHIDÆ**

Predaceous or parasitic; claws often absent on one or more pairs of legs; body bristles often branched or pectinate. (Fig. 1073). (**Cheylètus, Cheylètia, Cheyletiélla, Myòbia, Picòbia**).
CHEYLÉTIDÆ

52. Cephalothorax and abdomen completely fused, the body showing no division into these two parts; no bristles on body above; palpi simple; last joint of first pair of legs not noticeably longer than the preceding joint; mouthparts covered by a large hyaline hood. (**Cryptógnathus**, palæarc.). **CRYPTOGNÁTHIDÆ**

Cephalothorax and abdomen more or less distinctly separated; upper surface of body furnished with bristles; palpi sometimes geniculate; mouthparts without hood-like covering..... 53

53. Last joint of first pair of legs longer than the preceding joint, often twice as long; cephalothorax with four bristles, a pair in front and a more widely separated pair behind. (**Bdélla** (Fig. 1078), **Cunáxa, Cỳta, Eùpalus, Scírula**). (Including *CUNÁXIDÆ*) ..... **BDÉLLIDÆ**

Last joint of first pair of legs not or only slightly longer than the preceding joint; bristles of cephalothorax not arranged as above. (**Eupòdes, Linopòdes, Notophállus, Tỳdeus, Rhagídia** (Fig. 1074), **Ereynètes, Álichus, Bimichàelia, Teneríffia**). (Including *TENERIFFÌIDÆ*) ..... **EUPÓDIDÆ**

LITERATURE ON ACARINA

ANDRÉ, M. Contribution a l'étude des Acariens libres. Trombididæ. Bull. Soc. Zool. Paris, **51**, pp. 175–228 (1926).

BAGNALL, R. S. and J. W. H. HARRISON. A Catalogue of the British Eriophyidæ. Ann. Mag. Nat. Hist., (10) **2**, pp. 427–445 (1928).

BANKS, N. Oribatoidea of the United States. Trans. Amer. Entom. Soc., **5**, pp. 1–16 (1895).

Catalogue of the Acarina of the United States. Proc. U. S. Nat. Mus., **32**, pp. 595–625 (1907).

Revision of Ixodoidea of the United States. Bull. U. S. Dept. Agric., Bur. Entom. Tech. ser., No. 15 (1908).

The Acarina or Mites. Rept. No. 108, U. S. Dept. Agric. 153 pp. (1915).

BERLESE, A. Acari, Miriopodi e Scorpione Italiani. Prostigmata, Cryptostigmata, Mesostigmata, Sarcoptidæ. 4 vols. (1882–1910).

Monografia del Genere Gamasus. Redia, **3**, pp. 68–304 (1905).

Trombidiidæ. Redia, **8**, pp. 1–291 (1912).

CANESTRINI, G. Prospetto dell' Acarofauna Italiana. Padova, 7 parts (1885–97).

CANESTRINI, G. and P. KRAMER. Demodicoidea. Das Tierreich, Lief. 7, pp. 1–3 (1899).

Sarcoptidæ. Das Tierreich, Lief. 7, pp. 4–193 (1899).

EWING, H. E. Oribatoidea of Illinois. Bull. Ill. State Lab. Nat. Hist., **7**, pp. 337–389 (1909).

Synopsis of Beetle-mites (North America). Ann. Entom. Soc. America, **10**, pp. 117–132 (1917).

Classification of Mites. Ann. Entom. Soc. America, **15**, pp. 213–222 (1922).

FIELDING, J. W. Australasian Ticks. Service Publ. Australia, **9**, pp. 1–114 (1926).

JACOT, A. P. Annotated Bibliography of the Oribatoidea. Tsingtao, pp. 1–60 (1929).

Oribatid Mites of the Subfamily Phthiracarinæ of Northeastern United States. Proc. Boston. Soc. Nat. Hist., **39**, pp. 209–261 (1930).

JAKOB, E. Die Verwandschaft der Zeckengattungen. Zeits. Morph. Ökol., **1**, pp. 309–372 (1924).

KOENICKE, F. Nordamerikanische Hydrachniden. Abh. naturw. Ver. Bremen, **13**, pp. 167–226 (1900).

Acarinen- insbesondere Hydracarinen- System. Abh. naturw. Ver. Bremen, **20**, pp. 121–161 (1910).

Acarina. Süsswasserfauna Deutschlands, Heft 12, (1916).

LUNDBLAD, O. Süsswasseracarinen aus Dänemark. Vid. Selsk. Skr. Math.-natv. Afd. Copenhagen, (8) **6**, No. 2, 150 pp. (1920).

MARSHALL, R. The Arrhenuri of the United States. Trans. Am. Microscop. Soc., **28**, pp. 851–40 (1908).

MCGREGOR, E. A. Red Spiders of America. Proc. U. S. Nat. Mus., **56**, pp. 641–679 (1919).

MICHAEL, A. D. Oribatidæ. Das Tierreich, Lief. 53, 93 pp. (1898).

British Oribatidæ. 2 vols. London, Ray Soc. (1883–87).

British Tyroglyphidæ, 2 vols. London, Ray Soc. (1901–03).

NALEPA, A. Eriophyidæ. Das Tierreich, Lief. 4 (1898).

Die Systematik der Eriophyiden. Verh. zool.-bot. Ges. Wien, **67**, pp. 12–38 (1917).

Index nominum Eriophyidarum. Marcellia, Avellino, **20**, pp. 25–66 (1923).

Neuer Catalog der bisher beschriebenen Gallmilben. Marcellia, **25**, pp. 67–183 (1929).

NEUMANN, L. G. Revision de la Famille des Ixodides. Mém. Soc. Zool. France, **9**, pp. 1–44; **10**, pp. 324–420; **11**, pp. 120–230; **12**, pp. 249–372 (1896–01).

Ixodidæ. Das Tierreich, Lief. 26, 166 pp. (1911).

NUTTALL, G. H. F. and C. WARBURTON. Ticks of the Belgian Congo. Bull. Entom. Res., **6**, pp. 313–352 (1916).

NUTTALL, G. H. F., C. WARBURTON, W. F. COOPER, and L. E. ROBINSON. A Monograph of the Ixodoidea. Cambridge University Press, London, pt. 1 (1908); pt. 2 (1911); pt. 3 (1915).

OUDEMANS, A. C. New List of Dutch Acari. Tijdschr. v. Entom., **43** (1901); **45** (1902).

Revision des Chélétines. Mém. Soc. Zool. France, **18**, pp. 36–144 (1906).

Analytical Key for the Classification of Families and Genera of Diacrotricha. Entom. Berich., **6**, pp. 226–235 (1924).

Kritisch historisch Overzicht der Acarologie. Tijdschr. Entom. Suppl. to **69**, 500 pp. (1926).

PAOLI, G. Monografia dei Tarsonemidi. Redia, **7**, pp. 215–281 (1911).

PIERSIG, R. Deutschlands Hydrachniden. Zoologica, Heft 22 (1897–1900).

Hydrachnidæ. Das Tierreich, Lief. 13, 336 pp. (1901).

RAINBOW, W. J. A Synopsis of Australian Acarina. Rec. Australian Mus., **6**, pp. 145–193 (1906).

SCHULZE, P. Ixodoidea. Biol. Tiere Deutschlands, Lief. 2 (1923).

Zecken (Ixodoidea). Tierwelt Mitteleuropas, **3**, Lief. 4, pp. X 1–10 (1929).

SELLNICK, M. Die Tardigraden und Oribatiden der ostpreussischen Moosrasen. Schr. physik. Ges. Königsberg, **49**, pp. 317–350 (1908).

Oribatei (Oribatoidea). In Tierwelt Mitteleuropas, **3**, Lief. 4, pp. IX 1–42 (1929).

SOAR, C. D. Acarina or Mites. Watson's Micros Rec., London, Nos. 6–9 (various parts).

SOAR, C. D. and WILLIAMSON, W. The British Hydracharina, 3 vols. Ray Soc. London (1925–29).

THON, K. Monographie der Hydrachniden Böhmens. Arch. naturw. Landesdurchforsch. Prag, **12**, pt. 2, pp. 1–84 (1906).

THOR, S. Zur Systematik der Acarinenfamilien Bdellidæ, Eupodidæ und Cunaxidæ. Ver. k. k. zool.-botan. Ges. Wien, **52**, pp. 159–165 (1902).

TRÄGÅRDH, I. Monographie der arktischen Acariden. Fauna Arctica, **4**, pp. 1–78 (1904).

TROUESSART, E. L. Revision des Genres des Analgesinæ. Bull. Soc. Zool. Paris, **40**, pp. 207–223 (1916).

VIETS, K. Fortschritte in der Kenntnis der Hydracarinen (Bibliography). Arch. Hydrobiol. u. Planktonk., **8**, pp. 589–629 (1913); **9**, pp. 550–578 (1914).

Versuch eines Systems der Hydracariden. Zool. Anz., **69**, pp. 188–199 (1926).

Die Halacaridæ der Nordsee. Zeits. wiss. Zool., **130**, pp. 83–173 (1927).

Wassermilben (Aquatic Acarina). In Tierwelt Mitteleuropas, **3**, Lief. 4, pp. VIII 1–57 (1928).

Halacaridæ. In Die Tierwelt der Nord- und Ostsee. XI C. 72 pp. Grimpe and Wagner (1928).

VITZTHUM, H. Acari aus Spanien. Senckenbergiana, Frankfurt-am-M., **8**, pp. 30–39 (1926).

Malayische Acari. Treubia, **8**, pp. 1–198 (1926).

Landmilben (Terrestrial Acarina). In Tierwelt Mitteleuropas, **3**, Lief. 3, pp. VII 1–112 (1928).

WALTER, C. Die Hydracarinen der Schweitz. Rev. Suisse Zool., **15** (1907).

WOLCOTT, R. H. A Review of the Genera of Water Mites. Trans. Am. Microscop. Soc., **26**, pp. 161–243 (1905).

ORDER **PENTASTÓMIDA**

(*LINGUATÙLIDA*)

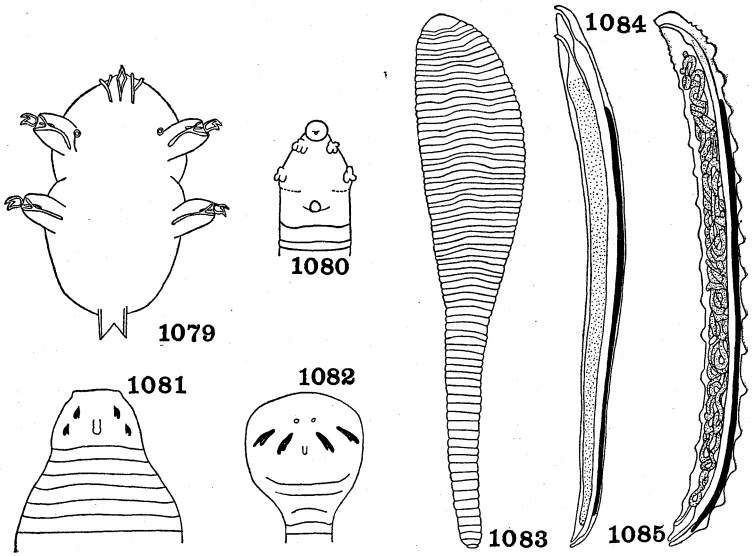
Rather large, elongate, vermiform, cylindrical or somewhat flattened animals. Body divided externally by constrictions into a large number of annuli or apparent segments; straight, bent or sometimes coiled. Mature form legless, but the embryo and very young animal with two or three pairs of short, imperfectly jointed legs. No antennæ. Mouth opening rounded or oval, situated close to two pairs of claw-like, movable chitinous hooks that arise from shallow pits. Respiratory organs wanting. Genital opening of male always at the base of the abdomen, of the female either at the base or apex of the abdomen; ovary or uterus either large and sac-like, or long, tubular and strongly sinuous or coiled, lying either above, below or twined about the alimentary tract. Metamorphosis slight, but evident. Parasitic; the adult form usually in the respiratory tract of reptiles, the immature one frequently in the tissues or internal organs of mammals. Tongue-worms.

The following classification is similar to that developed by Sambon, except that his subfamilies are regarded as families to render the divisions of this group more nearly on an equality with those of related orders.

1. Mouth opening lying in front of the oral hooks; genital opening of female at the anterior end of the abdomen, the uterus large and sac-like; salivary glands of moderate size; larva with three pairs of short legs. (Figs. 1080, 1084). (*RAILLIETIÉLLIDÆ*). **CEPHALOBÆNIDÆ**

Three subfamilies may be distinguished as follows:

a. Anterior end of body forming a short, blunt beak. (**Cephalobæna**, neotrop., in lungs of snakes) . . . . **CEPHALOBÆNÌNÆ**
Anterior end of body not forming a beak-like projection, rounded. b



Figs. 1079–1985. **Pentastomida**

1079. "**Pentastomum,**" young larva (Stiles) Linguatulidæ.
1080. **Raillietiella,** anterior extremity (Sambon) Cephalobænidæ.
1081. **Sebekia,** anterior extremity (Sambon) Linguatulidæ.
1082. **Kiricephalus,** anterior extremity (Sambon) Linguatulidæ.
1083. **Linguatula** (Sambon) Linguatulidæ.
1084. **Cephalobænidæ,** diagrammatic vertical section of body (Sambon) Cephalobænidæ.
1085. **Linguatulidæ,** diagrammatic vertical section of body (Sambon) Linguatulidæ.

b. Body with two apical projections at the posterior end; posterior pair of oral hooks larger than the anterior ones. (Fig. 1080). (**Raillietiélla,** in reptiles and batrachians, widespr.). **RAILLIETIELLÌNÆ**

Body without apical projections, bent downwards at posterior end; both pairs of oral hooks very small. (**Reighárdia,** in birds, neotrop.) . . . . . **REIGHARDIÌNÆ**

Mouth opening lying between or behind the oral hooks; genital opening of female at posterior end of abdomen, the uterus tubular, greatly elongated and irregularly coiled; salivary glands as long as the body; larva with only two pairs of legs. (Figs. 1079, 1081, 1082, 1083, 1085). (*POROCEPHÁLIDÆ*).
LINGUATÙLIDÆ

This family includes three well-marked subfamilies, as follows:

a. Body cylindrical ..... b
Body flattened, fluke-like; more or less convex centrally above, the sides depressed; mouth hooks placed in an arch or curved line; alimentary canal following the axis of the body, the uterus twined about it. (**Linguátula**, in mammals, holarc., neotrop., ethiop., ind.; **Subtriquètra**, in crocodiles, neotrop., indomal.).
LINGUATULÌNÆ

b. Body with well marked latero-ventral grooves; mouth hooks forming a trapezoid; alimentary canal sinuous, longer than the body. (Fig. 1081). (**Sebèkia**, in crocodiles, neotrop., ethiop., indomal.; **Alòfia**, malay., ethiop.; **Leipèria**, in crocodiles, ethiop., **Sambònia**, in lizards, ethiop., neotrop.; **Diesíngia**, in turtles, neotrop., indomal.) ..... **SEBEKIÌNÆ**
Without latero-ventral grooves; mouth hooks placed in a curve or arch; alimentary canal straight, not longer than the body. (Fig. 1082). (**Porocéphalus**, in snakes, ethiop., Amer.; **Kiricéphalus**, in snakes, Amer., indomal., austr.; **Armíllifer**, in snakes and mammals, ethiop., indomal.; **Waddycéphalus**, austr.). ..... **POROCEPHALÌNÆ**

Note: **Pentastoma** and **Pentastomum** have in the past been used as more or less inclusive generic names for the adult and immature stages of various species.

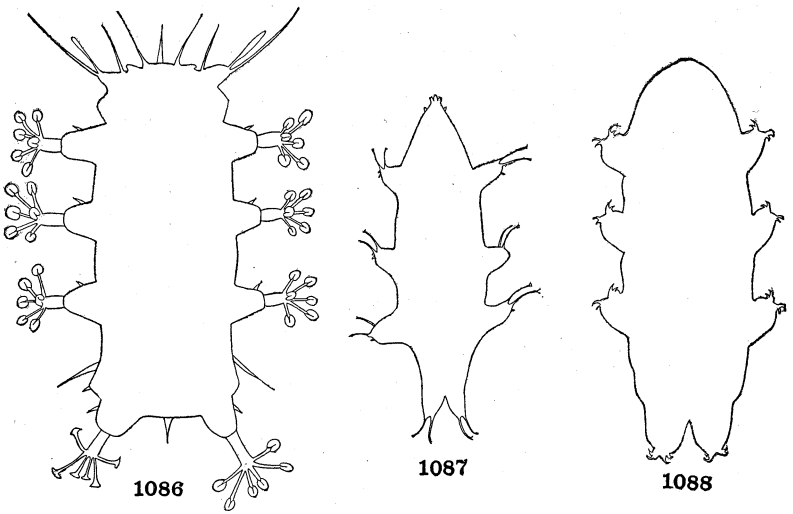
LITERATURE ON PENTASTOMIDA

HEYMONS, R. Pentastomida. Kükenthal und Krumbach, Handbuch der Zoologie, **3**, pt. 1, pp. 69–131 (1926).
Zungenwürmer, in Tierwelt Mitteleuropas, **3**, Lief. 1, pp. 1–2 (1926).
SAMBON, L. W. A Synopsis of the Family Linguatulidæ. Journ. Trop. Med., **25**, pp. 188–206; 391–428 (1922).

CLASS **TARDÍGRADA**

Very small or minute species, usually less than one mm. in length. Body more or less elongate oval, consisting of a head and four body-

segments; integument tough and more or less transparent, not chitinous. Four pairs of short, fleshy, unjointed legs, each terminated by several claws or clavate vesicles. Cuticula usually forming distinct plates; often granulate or sometimes spinose. Mouthparts tubular, provided with a central piercing organ or stylet. Antennæ absent. Eyes absent, or present as two ocelli. Terrestrial or aquatic species; no special respiratory organs. Species capable of excessive and prolonged dessication without injury. Sexes separate; development from the egg direct, without metamorphosis. Water Bears.



Figs. 1086–1088. **Tardigrada**

1086. **Batillipes** (Marcus) Halechiniscidæ.
1087. **Milnesium** (Marcus) Milnesiidæ.
1088. **Macrobiotus** (Marcus) Macrobiotidæ.

1. Head bearing in front a pair of central and a pair of lateral cirri, in addition to two sensory appendages at each side. (Fig. 1086). (Order HETEROTARDÍGRADA) 2
   Head usually without such sensory appendages, or at least with only the four anterior ones present; the two at each side always wanting. (Order EUTARDÍGRADA) 3
2. Middle portion of leg capable of being withdrawn or telescoped within the basal part, the two parts separated by a distinct fold;

legs without long, hooked claws. (Fig. 1086). (Suborder ARTHROTARDIRGADA). (**Halechiníscus, Tetrakéntron,** palæarc.; **Batíllipes,** holarc.) ..... **HALECHINÍSCIDÆ**

Middle portion of leg only partly folding into the basal part; legs terminating in long, hooked claws. (Suborder ECHINISCHÒDEA). (**Echiníscus,** cosmop.; **Pseudechiníscus,** widespr.; **Parechiníscus, Echiniscòides,** palæarc.; **Oreélla,** palæarc., austr.)..... **ECHINÍSCIDÆ**

3. Head entirely without sensory appendages. (Fig. 1088). (**Macrobiòtus, Hypsíbius,** cosmop.)..... **MACROBIÓTIDÆ**

Head with six rostral papillæ about the mouth and also with two papillæ below on each side. (Fig. 1087). (**Milnèsium** (= *Arctíscon*), cosmop.). (*ARCTÍSCIDÆ*) ..... **MILNESÌIDÆ**

LITERATURE ON TARDIGRADA

AMMAN, J. Schweizerische Tardigraden. Berne (1908).

CARLZON, C. Schwedische Tardigraden. Zool. Anz., **34** (1909).

FOREL, F. A. Tardigrades. Le Léman, Monographie Limnologique, **3** (1904).

MARCUS, E. Tardigrada. Tierwelt Deutschlands, **12**, 230 pp. (1928).

Tardigrada. In Bronn's Klassen und Ordnungen des Tierreichs, **5**, Abth. 4, Buch 3, 608 pp. (1929).

NEDERSTRÖM, P. Die aus Finland bekannten Tardigraden. Act. Soc. Faun. Flor. Fennica, **46**, No. 8 (1919).

RAHM, G. Tardigrada, Bärtierchen. Biol. Tiere Deutschlands., pt. 22, pp. 1–56, Geb. Bornträger, Berlin (1927).

RICHTERS, F. Tardigrada. In Kükenthal und Krumbach, Handbuch der Zoologie, **3**, pp. 1–68 (1926).

CLASS **PAURÓPODA**

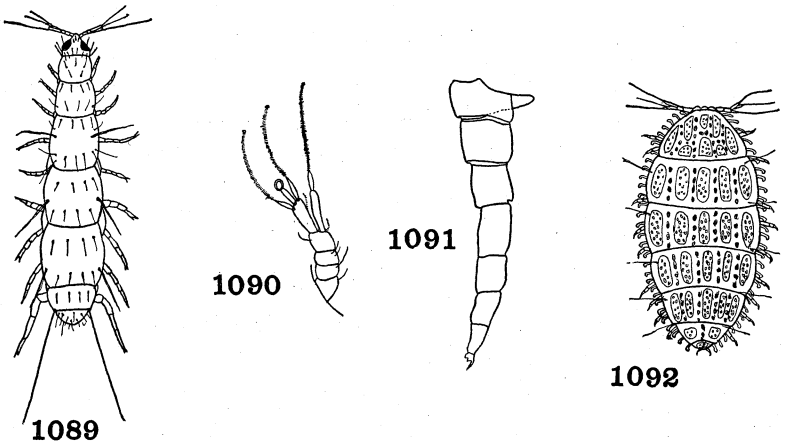
Very small species of elongate, rounded and more or less flattened form. Body composed of from six to ten segments, as indicated by the tergites, and bearing nine pairs of legs. Antennæ branched apically; composed of four stout basal joints, the fourth bearing two elongate joints, one of which bears at tip a whip-like many-jointed flagellum and the other bears two such flagella. Mouthparts composed of a pair of mandibles, and one pair of maxillæ. Cerci bristle-like. Tracheæ absent; no respiratory organs.

1. Six tergites present..... 2

Ten tergites; head free, not covered by the first tergite; body

with a few bristles above; anal segment exposed, not covered by the preceding tergite. (**Brachypaùropus**, palæarc.).
BRACHYPAUROPÓDIDÆ

2. Integument thinly chitinized, with a few bristles above; usually white or pale colored; head and anal segment free, not covered above. (Figs. 1089, 1091). (**Paùropus, Allopaùropus, Stylipaùropus, Hemipaùropus, Scleropaùropus**).
PAUROPÓDIDÆ



Figs. 1089–1092. **Pauropoda**

1089. **Pauropus** (Latzel) Pauropodidæ.
1090. **Eurypauropus,** antenna (Latzel) Eurypauropodidæ.
1091. **Pauropus,** leg (Ewing) Pauropodidæ.
1092. **Eurypauropus** (Latzel) Eurypauropodidæ.

Integument heavily chitinized, thickly spinose or tuberculate and strongly pigmented; head and anal segment concealed from above by the adjacent tergites. (Fig. 1092). (**Eurypaùropus,** holarc.) ..... **EURYPAUROPÓDIDÆ**

LITERATURE ON PAUROPODA

KENYON, F. C. The Morphology and Classification of the Pauropoda. Tufts College Studies, No. 4 (1895).

LATZEL, R. Die Myriapoden der Œsterreichisch-Ungarischen Monarchie. Vienna, Alb. Hölder (1880-84).

CLASS **DIPLÓPODA**

Body long, comparatively narrow and of generally uniform width; cylindrical or at least not usually noticeably depressed or flattened. Eleven or more body segments or somites; thirteen or more pairs of legs; usually considerably more. Legs always more numerous than the dorsal segments, most of the apparent segments bearing each two pairs of legs, but the first three or four and the last one or two with only a single pair. Head with a pair of short, usually seven-jointed, antennæ, a pair of lateral eyes and a pair of mandibles; other mouth-parts forming a plate-like structure (gnathochilarium). Eyes two, consisting of a group of ocelli. Legs usually six or seven-jointed, bearing an apical claw. Genital ducts opening between the second and third pairs of legs. Respiration through spiracles opening into paired pockets, one or two pairs corresponding to each of the somites. Second or fourth legs of male usually modified into copulatory appendages. Somites often with paired repugnatorial glands, opening laterally.

Slow moving, usually vegetarian animals. A large group, more abundant in the tropics. Millipedes.

The System adopted here follows that of Attems in his recent "Myriopoda of South Africa."

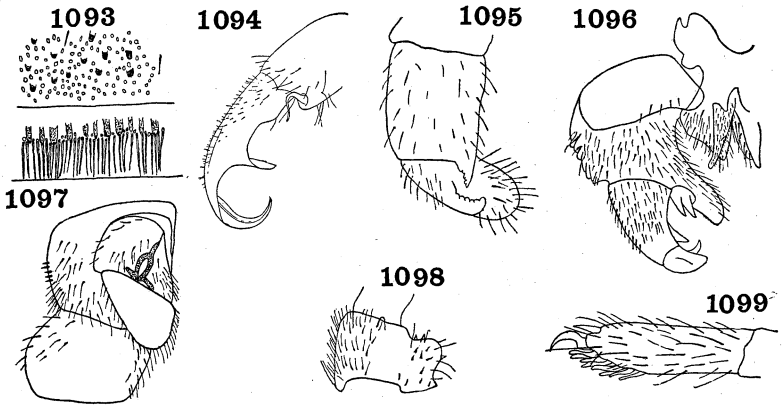
1. Integument strongly chitinized, hardened by a deposit of calcareous material; body hairs if present simple, never in long tufts. (Subclass CHILÓGNATHA) 2

   Integumental bristles highly modified, short, scaly on body above, laterally forming long tufts; mandibles one-jointed; integument very weakly chitinized, not hardened by a deposit of calcareous material; usually eleven body segments and thirteen pairs of legs (rarely 12 and 17). (Subclass PSELAPÓGNATHA). (**Polýxenus**, cosmop.; **Saróxenus**, ethiop.; **Lophopróctus**, widespr.; **Schindalmonòtus**, S. Afr.; **Macróxenus**, palæarc.; **Trichopróctus**, austr.) ..... **POLYXÉNIDÆ**

2. Sternites divided into two parts, tracheæ dichotomously branched; male with one or two pairs of modified copulatory appendages (telopods) at the posterior end of the body, but without modified legs on the seventh segment. (OPISTHÁNDRIA) 3

   Sternites not divided; tracheæ not branched, but arising in tufts from the tracheal trunks; male with one or two pairs of modified legs (gonopods) on the seventh body segment. (PROTERÁNDRIA) 7

3. Body composed of 22 somites with 36 pairs of legs, not including one pair of telopods in the male; body not capable of being rolled into a ball. (Order LIMACOMÓRPHA). (**Glomeridésmus,** neotrop.; **Termitodésmus,** indomal.; **Zephroniodésmus,** mal.) ..... **GLOMERIDÉSMIDÆ**



Figs. 1093–1099. **Diplopoda**

1093. **Sphærotherium,** pygidium and marginal bristles (Attems) Sphærotheriidæ.
1094. **Sphæriodesmus,** gonopod (Chamberlin) Sphæriodesmidæ.
1095. **Sphærotherium,** anterior gonopod (Attems) Sphærotheriidæ.
1096. **Sphærotherium,** posterior gonopod (Attems) Sphærotheriidæ.
1097. **Sphærotherium,** vulva (Attems) Sphærotheriidæ.
1098. **Sphærotherium,** coxa of fourth leg (Attems) Sphærotheriidæ.
1099. **Sphærotherium,** last joint of a leg (Attems) Sphærotheriidæ.

Body of twelve or thirteen somites; with 17 to 21 pairs of legs, not including two pairs of telopods in the male; body capable of being rolled up into a ball so as to conceal the head and legs. (Order ONISCOMÓRPHA) 4

4. Seventeen pairs of legs, not including the telopods of the male; ocelli in a single row or wanting. (GLOMERÍDIA)..... 5

Twenty-one pairs of legs, not including the telopods of the male; ocelli numerous, in several rows. (Figs. 1095, 1096, 1097, 1098, 1099). (SPHÆROTHÈRIA). (**Sphærothèrium, Globothèrium,** ethiop.; **Sphæropœus, Arthrosphæra,** indomal.; **Cyliosòma,** austr.) ..... **SPHÆROTHERÌIDÆ**

5. Seventeenth pair of legs of male with one to three small joints beyond the large coxa. (**Glómeris**, palæarc.; **Rhopalómeris, Apiómerus,** indomal.) ..... **GLOMÉRIDÆ**
   Seventeenth pair of legs of male with four or five small joints beyond the large coxa (Fig. 127) 6
6. Nineteenth pair of legs in male with the second and third joints (prefemur and femur) simple, without a bristly projection; body smooth. (**Glomeridélla, Typhloglómeris, Glomerellìna,** palæarc.) ..... **GLOMERIDÉLLIDÆ**
   Nineteenth pair of legs in male with a bristle-bearing projection on the prefemur and femur; body often tuberculate or carinate. (**Gervàsia, Dodèria,** palæarc.) ..... **GERVAISÌIDÆ**
7. First pair of legs of the seventh somite of the male modified into gonopods, often the second pair of this somite also and the adjacent pairs on the sixth and eighth segments similarly modified; mouthparts with three pairs of palpal lobes. (EUGNATHA) 8
   First pair of legs of the seventh somite of the male normal, not modified to form gonopods; mouthparts without palpal lobes. (COLOBÓGNATHA) 66
8. Anal segment without spinning styles or spinning glands; body of less than 23 or more than 40 somites 9
   Anal segment with two or three pairs of spinning glands, opening by one to three pairs of spinning styles; body of 26 or more somites. (NEMATÓPHORA) 25
9. Nineteen to 22 body somites (usually 20); only the first pair of legs on the seventh somite of the male modified into gonopods; the gonopods inserted in a completely closed circular opening; body cylindrical, or flattened with lateral expansions. (POLYDESMÒIDEA) 10
   More than 40 body somites; both pairs of legs of seventh somite of the male modified into gonopods, or the second pair absent; opening in which the gonopods are inserted never closed in front; body cylindrical. (JULIFÓRMIA) 52
10. Coxæ of the gonopods rather widely separated, but connected by broad, medially coalescent processes; the median part raised and keel-shaped. (POLYDESMÍDEA) 11
    Coxæ of the gonopods close together, free or more or less connected but not by broad, medially keel-like, raised processes. (STRONGYLOSOMATÍDEA) 17
11. Coxæ of the gonopods with a hooked process on the external

margin; tergites broadly expanded at the sides, the lateral margins produced, with a number of sharp teeth, each tooth bearing a bristle. (**Peridontodésmus**, neotrop.).

PERIDONTODÉSMIDÆ

Of a different conformation.....12

12. Head not or incompletely covered by the first tergite, which is generally small, not lengthened or enlarged.....13

Head completely or almost completely hidden by the first tergite when seen from above; this tergite large.....16

13. Coxa of gonopod bearing a long, annulate flagellum; posterior portion of each tergite with three transverse rows of bristles, which usually arise from small tubercles. (**Mastigonodésmus, Schedoleiodésmus**, palæarc.) ... **MASTIGONODÉSMIDÆ**

Of a different conformation.....14

14. Second tergite enlarged; posterior portion of tergites smooth or granulate, often densely clothed with setæ. (**Oniscodésmus, Trigonóstylus, Oncodésmus**, neotrop.; **Doratodésmus**, mal.; **Hyperóthrix**, ethiop.) ..... **ONISCODÉSMIDÆ**

Second tergite not enlarged.....15

15. Gonopod with a brush of hairs inwardly near the tip and a seminal pouch which opens at the base of this brush. (Fig. 1101). (**Polydésmus**, holarc.; **Brachydésmus, Epanerchòdus**, palæarc.; **Opisthotrètus**, mal.; **Opisthoporodésmus**, austromal.) ..... **POLYDÉSMIDÆ**

Gonopod without brush of hairs or seminal pouch. (**Vanhoeffènia**, ethiop.; **Gyrophállus**, nearc.; **Trichopolydésmus**, palæarc.) ..... **VANHŒFFENÌIDÆ**

16. Openings of the repugnatorial glands located on small, separate, transparent projections from the sides of some of the abdominal tergites (usually 5th, 7th, 9th, 10th, 12th, 13th and 15th). (**Stylodésmus**, ethiop.; **Myrmecodésmus, Corypherépsis, Synoptùra**, neotrop.; **Myxodésmus**, mal.). **STYLODÉSMIDÆ**

Openings of the repugnatorial glands very minute or not visible. (**Cryptodésmus**, neotrop.; **Phenacóporus**, austromal.; **Cryptocórypha**, ethiop., mal.; **Atopodésmus**, austr.).

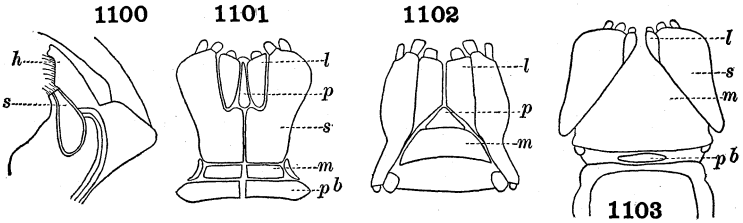
CRYPTODÉSMIDÆ

17. Coxa of the gonopod with a prominent curved horn-shaped process 18

Coxa of the gonopod without any such process; 20 body somites. (**Rhacodésmus**, Am.; **Acutángulus, Rhachidomórpha, Strongylodésmus**, neotrop.) ..... **RHACODÉSMIDÆ**

18. Certain joints of the anterior (or more) legs furnished with peculiar bristles that have a bulbously swollen base, and long slender or short nipple-shaped tip. (**Sphærotríchopus**, austr.; **Pleonaràius, Semnosòma**, neotrop.; **Scytonòtus**, nearc., austr.; **Icosidésmus**, ethiop., austr.; **Gnoméskelus**, ethiop.). **SPHÆROTRICHÓPIDÆ**

Legs destitute of such swollen bristles 19



Figs. 1100–1103. **Diplopoda**

1100. **Polydesmus,** gonopod: *h*, hair-brush; *s*., seminal vesicle.
1101. **Blaniulus,** gnathochilarium: l. lingual lamellæ; p., promentum; s., stipes; pb., prebasilare. Blaniulidæ.
1102. **Xiphochætoporatia,** gnathochilarium. Lettering as in Fig. 1101.
1103. **Rhinocricus,** gnathochilarium. Lettering as in Fig. 1101.

19. Femur of the gonopod distinctly separated from the tibia by a strong constriction 20

Femur and tibia of the gonopod completely fused, without any line of demarcation 22

20. Coxa of the gonopod long and slender; femur ovate, clothed with hairs; tibia usually with a long flagelliform process. (**Strongylosòma,** palæarc.; **Catharosòma, Habrodésmus,** neotrop.; **Nedy̆opus, Prionopéltis,** indomal.; **Phæodésmus,** ethiop.; **Australiosòma,** austr.) ..... **STRONGYLOSOMÁTIDÆ**

Of a different conformation 21

21. Coxæ of the gonopods large, connected by a narrow band; femur with a large process that is often longer than the tibia and tarsus together. (**Leptodésmus, Cyclorhábdus,** neotrop.; **Ísaphe,** nearc.; **Devíllea,** palæarc.) ..... **LEPTODÉSMIDÆ**

Coxæ of the gonopods free, not connected with one another. (**Oxydésmus, Metaphóricus, Orodésmus,** ethiop.). **OXYDÉSMIDÆ**

22. Lateral expansions of the tergites well developed or large, more or less horizontal 23
Lateral expansions of the tergites very strongly declivous, almost vertical; body very strongly convex above, its form highly adapted for curling up tightly. (**Sphæriodésmus, Cyclodésmus, Colobodésmus,** neotrop.; **Desmònus,** nearc.). **SPHÆRIODÉSMIDÆ**

23. Legs of male with fleshy lobes beneath the claws; gonopod articulated at the end of the coxa; tergites without striking sculpture. (**Gomphodésmus, Antíphonus, Aulodésmus, Ulodésmus, Astrodésmus, Elaphógonus,** ethiop.). **GOMPHODÉSMIDÆ**
Legs of male without lobes beneath the claws 24

24. Tibia and tarsus of gonopods not separated. (**Fontària,** holarc.; **Rhysodésmus,** neotrop., palæarc.; **Mélaphe,** palæarc.; **Pachydésmus,** nearc.; **Tuberculàrium,** ethiop.; **Asphalidésmus,** austr.) ..... **FONTARÌIDÆ**
Tibia and tarsus of gonopods usually separated by a distinct constriction; gonopod articulated at the end of the coxa. (**Platýrhacus,** neotrop., indoaustr.; **Amplìnus, Pycnótropis,** neotrop.; **Polýlepis,** mal.) ..... **PLATYRHÁCIDÆ**

25. Body of 26–32 (usually 30) somites; repugnatorial glands absent. 26
Body of 39 or more somites; repugnatorial glands present on the fifth and following somites 49

26. First tergite small; each somite above with three pairs of bristles arising from minute tubercles. (Superfamily CHORDEUMÒIDEA) 27
First tergite very large, its sides partly enclosing the head; body capable of being rolled into a spiral; some tergites with strong longitudinal carinæ; a few ocelli at each side of the head. (Superfamily STRIARIÒIDEA). (**Striària,** nearc.). **STRIARÌIDÆ**

27. First four joints of antennæ short, subequal in length; fifth much longer and thicker, forming a club together with the apical joints; dorsum tuberculate or spinulose, very strongly convex; legs short and stout. (TRACHYZÒNA) 28
First three joints of antennæ increasing in length, the second and third each much longer than the preceding joint; fourth at least twice as long as the first; legs long and slender. (XESTOZÒNA) 29

28. Body tuberculate, pale in color; 30 somites. (**Trachysòma, Halleinosòma,** palæarc.) ..... **TRACHYSOMÁTIDÆ**

Body surface spinulose, dark in color; 28 somites. (**Chamæosòma, Achrochórdum,** palæarc.) . . **CHAMÆOSOMÁTIDÆ**

29. Promentum present as a separate, more or less triangular sclerite in front of the mentum (Fig. 1102) 30
Promentum absent 45

30. Hind gonopod forming a large, stout, unjointed club 31
Hind gonopod never forming a stout, unjointed club; usually one- or two-jointed, or sometimes more or less like a walking leg, with three to six joints 32

31. Sides of body longitudinally striate; tergites without lateral expansions. (**Càseya,** nearc.) . . . . . **CASEYIDÆ**
Sides of body not longitudinally striate; anterior tergites with carinate lateral expansions. (**Underwoodia,** nearc.). **UNDERWOODÌIDÆ**

32. Hind gonopod with a long thread-like or flagelliform process. . . 33
Hind gonopod without such long process. 34

33. Front gonopod with a filiform process like that of the hind gonopod; second pair of legs of female with the joints beyond the coxæ vestigial. (**Heteroporàtia, Tessinosòma, Haploporàtia,** palæarc.) . . . . . **HETEROPORATÌIDÆ**
Front gonopod without such process; second pair of legs of female normally developed, similar to the other legs. (**Verhoeffia,** palæarc.) . . . . . **VERHŒFFÌIDÆ**

34. Posterior pair of legs of eighth somite with coxal glands. 35
Posterior pair of legs of eighth somite without coxal glands. (**Fagìna,** palæarc.) . . . . . **FAGÍNIDÆ**

35. Tarsi of male without papillæ 36
Tarsi of third to seventh pairs of legs of male furnished with papillæ 38

36. Hind gonopods one- or indistinctly two-jointed 37
Hind gonopods three- or four-jointed. (**Brachychæteùma, Scutógona, Macrochæteùma,** palæarc.). **BRACHYCHÆTEÙMIDÆ**

37. Tracheal pockets (the cavities next to the spiracles, leading into the tracheal tube) fused with the sternite and not movable. (**Anthógona, Cranógona,** palæarc.). . . . . **ANTHOGÓNIDÆ**
Tracheal pockets not anchylosed with the sternite, movable. (**Anthroleucosòma, Pródicus,** palæarc.). **ANTHROLEUCOSOMÁTIDÆ**

38. Coxæ of the front gonopods not forming a ring. 39
Coxæ of the front gonopods partly fused, forming together a ring

which bears the unsegmented, movable part of the gonopod. (**Heterolatzélla**, palæarc.). ..... **HETEROLATZÉLLIDÆ**

39. Coxæ of the front gonopods without an elongate, flagelliform process or long, stalked pencil of hairs. 40

Coxæ of front gonopods each bearing an elongate, flagelliform process or a long, stalked pencil of hairs. (**Neatractosòma, Trimeróphoron**, palæarc.) .... **NEATRACTOSOMÁTIDÆ**

40. Coxæ of the second pair of legs of the eighth segment without a horn-like projection internally; hind gonopods highly modified, wanting or one- to three-jointed, rarely four-jointed, and not resembling walking legs. 41

Coxæ of second pair of legs of the eighth segment with a horn-like projection internally; hind gonopods four- to six-jointed and with claw, retaining the appearance of walking legs. (**Pseùdoclis**, palæarc.; **Cleidógona**, Am.; **Pseudotrèmia**, nearc.). **PSEUDOCLÍDIDÆ**

41. Sternite bearing the second pair of legs of the sixth somite in the male, produced into a long, rod-shaped process; coxæ of front gonopods elongate, free or nearly so. (**Rothenbuehlèria**, palæarc.) ..... **ROTHENBUEHLERÌIDÆ**

This sternite without rod-shaped prolongation; coxæ of front gonopods shorter, not extending beyond the remainder of the gonopod, frequently fused together. 42

42. Coxæ of the second pair of legs of the sixth somite of the male elongate; rounded inwardly or without distinct process medially 43

Coxæ of second pair of legs of sixth somite of the male transverse, with one or two processes which extend to the apex of the sternite. (**Attémsia, Syngonopòdium, Dendromonómeron, Haasea**, palæarc.) ..... **ATTEMSÌIDÆ**

43. Sternite of the front gonopod obsolete or absent, never with a median process; the coxæ firmly united. 44

Sternite of the front gonopod very large, bearing a long median process; the coxæ not fused with one another. (**Opisthocheìron**, palæarc.) ..... **OPISTHOCHEÌRIDÆ**

44. Coxæ of the front gonopods flat, not prominent; hind gonopods two- to four-jointed. (**Haplobainosòma, Brœlemanneùma, Hispaniosòma**, palæarc.) ....**HAPLOBAINOSOMÁTIDÆ**

Coxæ of front gonopods prominent, forming a simple or two-parted elevation. (**Craspedosòma, Oxydáctylon, Macheirióphoron, Ceratosòma**, palæarc.) .... **CRASPEDOSOMÁTIDÆ**

45. Coxæ of the ninth pair of legs with glands; tarsi of the third to seventh pairs of legs almost always bearing papillæ.....46
Coxæ of the ninth pair of legs without glands; tarsi usually without papillæ 48

46. Body composed of 32 somites; tergites with prominent lateral expansions. (**Diplomarágna, Syntelopodeùma,** palæarc.).
DIPLOMARÁGNIDÆ
Body composed of 28 or 30 somites; tergites without or with very slight lateral expansions 47

47. Hind gonopods two-jointed; second pair of legs on the sixth and eighth somites modified into accessory gonopods, not resembling walking legs. (**Chordeùma, Chordeumélla, Microchordeùma, Orthochordeumélla,** palæarc.)
CHORDEÙMIDÆ
Hind gonopods three- to five-jointed; second pair of legs on the sixth somite normal, similar to the other walking legs. (**Orobainosòma, Brachybainosòma,** palæarc.).
OROBAINOSOMÁTIDÆ

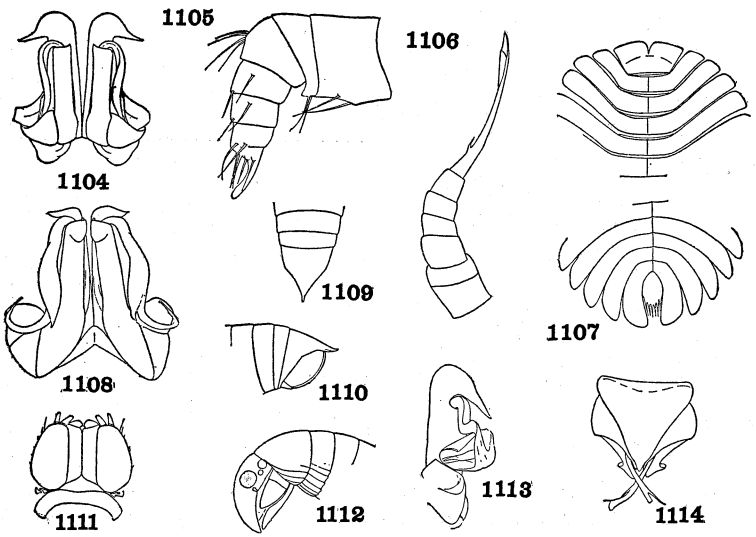
48. First pair of legs of the eighth somite highly modified, reduced to two- or three-jointed stumps; vertex of male bearing one or two tufts of hairs. (**Metopídothrix, Schedotrígona,** indo-austr.) ..... **METOPIDOTHRÍGIDÆ**
First pair of legs of the eighth somite normal, not modified or reduced; vertex of male without tufts of hairs. (**Conotŷla, Trichopétalum, Zygónopus,** nearc.; **Apodígona,** neotrop.; **Japanosòma,** palæarc.) ..... **CONOTŶLIDÆ**

49. Promentum present as a separate sclerite in front of the mentum (as in Fig. 1102); ocelli numerous. (Superfamily LYSIOPETALÒIDEA) 50
Promentum absent; one or two ocelli at each side of the head. (Figs. 1111, 1112). (STEMMIULÒIDEA). (**Stemmiùlus, Prostemmiùlus, Diopsiùlus,** ethiop.) .. **STEMMIÙLIDÆ**

50. Second pair of legs of female completely formed, similar to the other walking legs; tracheal pockets of gonopods small, fused to the gonopod. (**Cállipus,** palæarc.) .... **CALLIPÓDIDÆ**
Second pair of legs of female greatly reduced, the segments beyond the coxæ not developed; tracheal pockets of gonopods large, not fused to the gonopod..... 51

51. Gonopods very long, slender and strongly bent. (**Dorypétalum, Silvéstria, Cyphocállipus, Dorycállipus,** palæarc.).
DORYPETÁLIDÆ

Gonopods not noticeably long, not bent. (**Lysiopétalum, Apfelbéckia, Broelemánnia, Callipodélla,** palæarc.).
LYSIOPETÁLIDÆ



Figs. 1104–1114. **Diplopoda**

1104. **Diaporus,** gonopod (Chamberlin) Spirostreptidæ.
1105. **Siphonophora,** anterior gonopod (Chamberlin) Siphonophoridæ.
1106. **Siphonophora,** posterior gonopod (Chamberlin) Siphonophoridæ.
1107. **Platydesmus,** anterior and posterior ends of body (Chamberlin) Platydesmidæ.
1108. **Gymnostreptus,** gonopods (Chamberlin) Spirostreptidæ.
1109. **Paraiulus,** posterior end of body of male (Chamberlin) Blaniulidæ.
1110. **Paraiulus,** side view of posterior end of body of male (Chamberlin) Blaniulidæ.
1111. **Prostemmiulus,** gnathochilarium (Chamberlin) Stemmiulidæ.
1112. **Prostemmiulus,** head and first tergite (Chamberlin) Stemmiulidæ.
1113. **Orthoporus,** gonopod (Chamberlin) Spirostreptidæ.
1114. **Rhinocricus,** gonopods (Chamberlin) Rhinocricidæ.

52. Stipites meeting for a distance along the median line, separating the promentum from the mentum (Fig. 1101). (Superfamily JULÒIDEA) 53

Stipites not meeting along the median line, widely separated by the mentum or promentum; promentum if present in contact with the mentum 54

53. Both pairs of gonopods lying in cavities; first pair of legs of male greatly reduced; body above usually with some longitudinal striation (**Julus**) ..... **JÙLIDÆ**

Gonopods free, not sunk in depressions; first pair of legs of male usually four- to six-jointed; tergites without any longitudinal striation. (Figs. 1109, 1110). (**Blaniùlus, Choneiùlus,** palæarc.; **Nopoiùlus,** holarc., neotrop.; **Paraiùlus,** Am.; **Uroblaniùlus,** nearc.) ..... **BLANIÙLIDÆ**

54. Promentum absent; mentum large, triangular, extending between the prebasilare and stipites which it separates widely (Fig. 1103); last joint of legs of male generally padded, but not the fourth and fifth joints. (Superfamily SPIROBOLÒIDEA)..55

Promentum present or absent; mentum surrounded at the sides by the stipites which extend backwards and lie in contact with the prebasilare. (SPIROSTREPTOMORPHA).....59

55. Hind gonopods connected to each other at base by the sternite and membranes; pores of repugnatorial glands usually opening on the anterior portion of the tergites. (TRIGONIULÍDEÆ) 56

Hind gonopods not united at base, sternite completely absent; pores of repugnatorial glands almost always opening on the posterior portion of the tergites. (SPIROBOLÍDEÆ) 58

56. Coxæ of hind gonopods completely chitinized.....57

Coxæ of hind gonopods consisting of two rod-shaped thickenings meeting at a right angle with a membranous portion between them. (**Trigoniùlus, Eucárlia, Cherástus,** ethiop., indoaustr.; **Mystálides,** ethiop., malay.; **Allopocóckia,** neotrop.). **TRIGONIÙLIDÆ**

57. Front gonopods short and broad. (**Pachýbolus,** ethiop.; **Microspiróbolus, Caríbolus,** neotrop.; **Trachelomégalus, Eucentróbolus,** malay.). ..... **PACHYBÓLIDÆ**

Front gonopods long and slender. (**Spiromìmus, Pỳgodon,** ethiop.) ..... **SPIROMÍMIDÆ**

58. Hind gonopods consisting of only a single joint, the coxa not distinctly separated or vestigial; first tergite more or less narrowed laterally. (**Spiróbolus,** holarc.; **Tylóbolus,** nearc.; **Messicóbolus,** neotrop.; **Pseudospiroboléllus,** indomal.; **Spiroboléllus,** austromal.) ..... **SPIROBÓLIDÆ**

Hind gonopods distinctly two-jointed; first tergite broadly rounded at the sides. (Fig. 1114). (**Rhinócricus,** neotrop., austromal.; **Polyconóceras, Dinematócricus,** austromal.; **Eurhinócricus, Cubóbolus,** neotrop.) ..... **RHINOCRÍCIDÆ**

59. Mentum broadly triangular; its anterior angle lying far behind the front margin of the stipites. (Superfamily SPIROSTREPTÒIDEA) 60

Mentum elongate-triangular, its anterior angle extending far forward, dividing the gnathochilarium completely to its anterior margin; first pair of legs of male modified. (Superfamily CAMBALÒIDEA) 62

60. Both sternites of the gonopod-bearing segment present, in spite of the atrophy of the hind gonopods. (ODONTOPYGÍDEÆ). (**Odontopỳge, Haplothỳsanus, Prionopétalum, Spinotársus,** ethiop.) ..... **ODONTOPÝGIDÆ**

Sternite of the posterior part of the gonopod-bearing segment and the gonopod absent. (SPIROSTREPTÍDEÆ) 61

61. End of the gonopod flattened, almost always bearing on the edge a row of long, curved bristles; last somite without any spinose projection. (Fig. 1104, 1108, 1113). (**Spirostréptus, Gymnostréptus, Diáporus, Orthóporus, Scaphiostréptus, Allóporus,** neotrop., ethiop.) ..... **SPIROSTRÉPTIDÆ**

End of the gonopod not thus flattened, without such bristles; anal segment almost always with a tail-like projection. (**Harpagóphora,** ethiop.; **Poratóphilus,** ethiop., neotrop.; **Thyropỳgus,** ethiop., indomal.; **Rhynchopróctus,** malay.). **HARPAGOPHÓRIDÆ**

62. Promentum present, separated from the mentum. 63

Promentum not separated from the mentum; repugnatorial pores present on the fifth somite. 65

63. Promentum divided into two halves by a longitudinal suture. . 64

Promentum not divided by a longitudinal suture. (**Cámbala, Sámichus,** austr.; **Nannolène, Epinannolène,** neotrop.; **Julomórpha,** widespr.). (Including *NANNOLÉNIDÆ* and *EPINANNOLÉNIDÆ*) ..... **CAMBÁLIDÆ**

64. Repugnatorial pores absent on the fifth somite; hind gonopods three-jointed; front ones one-jointed, without bristles. (**Pericámbala,** ind.) ..... **PERICAMBÁLIDÆ**

Repugnatorial pores present on the fifth somite; hind gonopods wanting, the front ones two-jointed, the second joint strongly bristled. (**Pseudonannolène,** neotrop.). **PSEUDONANNOLÉNIDÆ**

65. Posterior portion of tergites smooth; hind gonopods absent. (**Physiostréptus, Holopodostréptus,** neotrop.).
PHYSIOSTRÉPTIDÆ

Posterior portion of the tergites with stout longitudinal carinæ or tubercles; hind gonopods present. (**Cambalópsis, Cambalomórpha, Trachyiùlus,** ind.). (*TRACHYIÙLIDÆ*).
CAMBALÓPSIDÆ

66. Sternites always, and pleurites often, free, *i.e.* connected by membranes with the adjacent parts 67

Tergites, pleurites and sternites completely coalesced; body cylindrical. (**Siphoniùlus,** malay.) ..... **SIPHONIÙLIDÆ**

67. Mentum and adjacent maxillary sclerites (gnathochilarium) consisting of a single plate or of several indistinctly defined pieces 68

Gnathochilarium possessing most of the parts typical of the Diplopoda (as in Fig. 1101). (Fig. 1107). (**Platydésmus,** N. Am.; **Fiòria, Dolístenus,** palæarc.) ..... **PLATYDÉSMIDÆ**

68. One or several ocelli at each side of the head; body not constricted on the base of each somite 69

Ocelli absent; body constricted at the base of each somite; repugnatorial pores opening on keels or tubercles. (Figs. 1105, 1106.) (**Siphonóphora,** indoaust., ethiop., neotrop.; **Siphonorhìnus,** malay., neotrop.) ..... **SIPHONOPHÓRIDÆ**

69. Repugnatorial pores opening on the lateral lobes of the tergites; tergites divided by a median suture; head completely concealed by the first tergite. (**Siphonocrýptus,** malay.).
SIPHONOCRÝPTIDÆ

Repugnatorial pores opening on the body of the tergites, far from the lateral margin; tergites without median suture; head partly free and visible. (**Polyzònium, Orsíboe,** palæarc.; **Siphonòtus,** austromal., neotrop.; **Burínia,** ethiop.).
POLYZONÌIDÆ

LITERATURE ON BOTH DIPLOPODA AND CHILOPODA (MYRIAPODA)

ATTEMS, C. Die indo-australischen Myriapoden. Arch. f. Naturg. Jahrg. 80A, Heft 4, pp. 1–398 (1914).

Chilopoda and Diplopoda in Kükenthal's Handbuch der Zoologie, **4**, Lief. 1–4, pp. 17–402 (1926).

The Myriapoda of South Africa. Ann. South African Mus., **26**, pp. 1–431 (1928).

Die Myriapodenfauna von Albanien und Jugoslavien. Zool. Jahrb. Abth. f. Syst., **56**, pp. 269–356 (1929).

Leptodesmidæ und andere Polydesmiden. Zoologica, Heft 79, 149 pp. (1931).

BOLLMAN, C. H. Myriapoda of North America. Bull. U. S. Nat. Mus., No. 46 (1893).

CHAMBERLIN, R. V. The Chilopoda and Diplopoda of the West Indies. Bull. Mus. Comp. Zoöl. Harvard, **62**, pp. 151–262 (1918).

The Myriapoda of the Australian Region. Bull. Mus. Comp. Zoöl. Harvard, **64**, pp. 1–269 (1920).

COOK, O. F. The Myriapoda of Northwestern North America. Pap. Harriman Alaska Exped., **8**, pp. 49–77 (1910).

LATZEL, R. Die Myriapoden der Oesterreichisch-Ungarischen Monarchie. Vienna, Alb. Hölder (1880–84).

UNDERWOOD, L. M. The North American Myriapoda. Entomologica Americana, **1**, pp. 141–151 (1885).

VERHOEFF, K. W. Results of Dr. E. Mjöberg's Swedish Sci. Exped. to Australia. Ark. Zool., **16**, No. 5, 142 pp. (1924).

WOOD, H. C. Myriapoda of North America. Trans. American Philos. Soc., **13**, pp. 137–248 (1865).

LITERATURE ON DIPLOPODA

ATTEMS, C. System der Polydesmiden. Denkschr. math.-naturw. Kl. Kais. Akad. Wiss. Wien, **67**, pp. 1–262 (1898); *ibid.*, **68**, pp. 1–186 (1899).

Ueber paläarktische Diplopoden. Arch. Naturg. Jahrg. 92A, No. 1, pp. 1–144; No. 2, pp. 145–256 (1927).

Diplopoden des Belgischen Congo. Polydesmoidea. Rev. Zool. Bot. Afr., **17**, pp. 253–378 (1929).

BRÖLEMANN, H. W. Essai de Classification des Polydesmiens. Ann. Soc. Entom. France, **84**, pp. 523–608 (1916).

Blaniulidæ. Arch. Zool. Paris, **61**, pp. 99–453 (1923).

CARL, J. Die Diplopoden-Fauna von Celebes. Rev. Suisse Zool., **20**, pp. 75–206 (1912).

CHAMBERLIN, R. V. Julidæ and Isobatidæ of North America. Proc. Biol. Soc. Washington, **34**, pp. 81–84 (1921).

The Millipedes of Central America. Proc. U. S. Nat. Mus., **60**, art. 8, pp. 1–75 (1922).

COOK, O. F. and G. N. COLLINS. Craspedosomatidæ of North America. Ann. New York Acad. Sci., **9**, pp. 1–100 (1895).

POCOCK, R. J. Diplopoda in Biologia centrali-Americana, pp. 41–217 (1904–10).

VERHOEFF, K. W. Die Diplopoden Deutschlands. 8 parts, 640 pp. Leipsig (1910–14).

CLASS **CHILÓPODA**

Body long, comparatively or very narrow, of nearly even width and dorsoventrally depressed; nineteen or more, sometimes many more body segments. Fifteen or more pairs of legs, inserted at the sides of the body and widely separated by sternal plates; never more than a single pair to any body segment; legs six- or seven-jointed, with a single apical claw. Head bearing a pair of long, many-jointed antennæ (14 joints or more); eyes composed of groups of ocelli, sometimes massed to form two apparently faceted eyes. Mandibles and two pairs of maxillæ present; appendages of first body segment greatly enlarged, forming a pair of large six-jointed poison-fangs (toxicognaths). Last two pairs of legs often greatly modified and directed backwards. Respiration through spiracles, the latter paired and located on the pleuræ or unpaired and located along the dorsal line. Genital ducts usually opening on the penultimate body segment. A widespread, moderately large group, of active carnivorous habits. Centipedes.

The system adopted here follows that of Attems in his recent account of " The Myriopoda of South Africa. "

1. Nineteen body segments with fifteen pairs of legs; not more than seven segments bearing spiracles, the tracheæ not anastomosing; newly hatched animals with seven pairs of legs. (Subclass ANAMÓRPHA) 2

   Twenty-five or more body segments with 21 or more pairs of legs, sometimes many more; nine or more pairs of spiracles, the tracheæ anastomosing; newly hatched animals with the full number of legs present in the adult. (Subclass EPIMÓRPHA). 6

2. Spiracles unpaired, seven in number; placed on the middle dorsal line near the posterior border of the tergites; eyes compound, with faceted surface; tracheæ not branched. (Fig. 1116). (Order SCUTIGEROMÓRPHA). (**Scutígera, Thereuónema, Parascutígera, Thereuópoda,** mainly tropical or subtropical). ..... **SCUTIGÉRIDÆ**

   Spiracles paired, placed on the pleuræ between the tergites and the coxæ; eyes not compound; single ocelli or groups of ocelli or eyes absent; tracheæ branched. (Order LITHOBIOMÓRPHA) 3

3. Tergites of the leg-bearing segments alternately long and short, except at the middle of the body; those corresponding to legs 2, 4, 6, 9, 11 and 13 (not counting the jaws as legs) much smaller than the others. (Suborder LITHOBIOMORPHÍDEA).... 4

Tergites of the leg-bearing segments not noticeably different in size, except the one bearing the jaws, which is shorter; in front of segments 4, 6, 8, 9, 11 and 13 with a greatly reduced, intercalary segment. (Suborder CRATEROSTIGMORPHÍDEA). (**Craterostígmus**, austr.) ..... **CRATEROSTÍGMIDÆ**

4. From one to five of the posterior pairs of legs with coxal glands opening by pores, legs usually spinose; ocelli, when present, placed near to the margin of the head. (Superfamily LITHOBIÒIDEA).....5

No coxal glands opening by pores; legs without spines; ocelli widely separated from the margin of the head. (Superfamily CERMATOBIÒIDEA). (**Cermatòbius**, ind.). **CERMATOBÌIDÆ**

5. Tibiæ of all legs without a spinose projection externally at tip. (Fig. 1117). (**Lithòbus**, holarc., ethiop.; **Monotarsòbius**, **Alokòbius**, **Polybóthrus**, palæarc.; **Garíbius**, nearc.; **Australòbius**, palæarc., indoaustr.; **Bothrópolys**, holarc., austromal.) ..... **LITHOBÌIDÆ**

Tibiæ of legs 11–14 with a spinose, tooth-like projection externally at tip. (**Hénicops**, austr.; **Paralamýctes**, **Anopsòbius**, neotrop., ethiop., austr.; **Zygethòbius**, Am.). . **HENICÓPIDÆ**

6. Antennæ with 17–20 or more joints; four ocelli on each side, or more; 21–23 leg bearing segments; 9, 10, 11 or 19 pairs of spiracles. (Order SCOLOPENDROMÓRPHA).....7

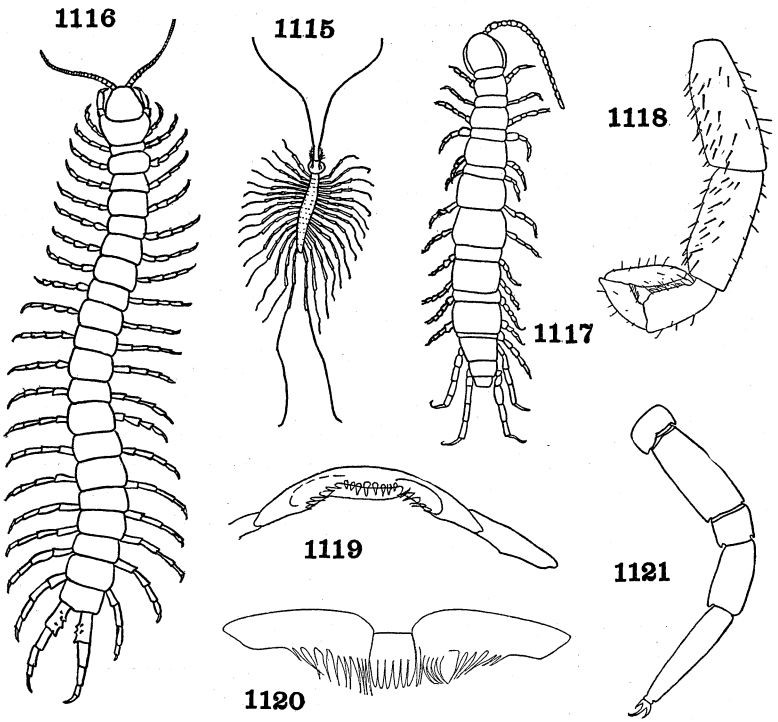
Antennæ 14-jointed; ocelli absent; 31–170 leg-bearing segments; all leg-bearing segments except the first and last with a pair of spiracles. (Order GEOPHILOMÓRPHA).....8

7. Eyes present, very rarely (*Mimops*) indicated only by a pale spot; tarsi two-jointed; sternites usually with a pair of longitudinal grooves, never with transverse groove. (Fig. 1115). (**Scolopéndra**, **Rhysídia**, tropicopol.; **Cùpipes**, palæarc., ethiop., ind.; **Pseudocrýptops**, ethiop., ind.; **Collària**, palæarc., neotrop.; **Echmostígmus**, palæarc., indoaust.). **SCOLOPÉNDRIDÆ**

Eyes absent; tarsi of legs 1–19 almost always one-jointed; sternites usually with a single median groove, never with a pair of grooves, often with a transverse groove. (Fig. 1118). (**Crýptops**, cosmop.; **Otocrýptops**, widespr.; **Trigonocrýptops**, palæarc., ethiop., neotrop.; **Scolopocrýptops**, palæarc., Am.; **Newpórtia**, neotrop.) ..... **CRYPTÓPIDÆ**

8. Mandible with several pectinate lamellæ and with or without a dentate lamella 9

Margin of mandible simple, beset with one row of teeth; mandible with or without a dentate lamella 11



Figs. 1115–1121. **Chilopoda** and **Symphyla**

1115. **Scolopendra** (Newport) Scolopendridæ.
1116. **Scutigera** (Howard) Scutigeridæ.
1117. **Monotarsobius.** Lithobiidæ.
1118. **Cryptops,** last leg (Chamberlin) Cryptopidæ.
1119. **Soniphilus,** labrum (Chamberlin) Soniphilidæ.
1120. **Suturodes,** labrum (Chamberlin) Geophilidæ.
1121. **Scutigerella,** leg (Ewing) Scutigerellidæ.

9. Mandible with one dentate lamella in addition to the pectinate lamellæ; labrum consisting of one piece; antennæ short, thick at base and gradually tapering, the basal joints with short hairs, but without long bristles. (**Himantàrium**, palæarc., ethiop.;

Mesocánthus, palæarc., ethiop., indomal.; **Haplóphilus**, **Bothriogáster**, palæarc.) ..... **HIMANTARÌIDÆ**

Mandible with pectinate lamellæ, but without any dentate lamella in addition 10

10. Labrum consisting of one piece, not especially broad; coxæ of first maxillæ completely fused. (**Òrya**, palæarc.; **Orphnæus**, tropicopol.; **Ctenòrya**, ethiop.; **Paròrya**, nearc.). . . **ORŸIDÆ**

Labrum tripartite; one small median tooth and two broad lateral pieces with strong edges at the sides of the cephalic pleuræ; coxæ of first maxillæ meeting at the median suture. (**Mecistocéphalus**, ethiop., indoaustr.; **Prolámmonyx**, **Dicellóphilus**, palæarc.; **Árrup**, nearc.; **Tygárrup**, neotrop.). **MECISTOCEPHÁLIDÆ**

11. Mandible with one dentate lamella; labrum consisting of one piece; antennæ filiform or clavate. (**Schendỳla**, holarc., neotrop., mal.; **Escáryus**, holarc.; **Nannóphilus**, ethiop., neotrop.; **Ballóphilus**, ethiop., austromal.; **Schendylùrus**, palæarc., ethiop., neotrop.) ..... **SCHENDÝLIDÆ**

Mandible without a dentate lamella 12

12. Coxæ of the first maxillæ fused, each bearing a median process and a one- or two-jointed apical portion 13

Coxæ of the first maxillæ completely separated, bearing a conical second joint; claws of anterior legs with a strong tooth. (**Neogeóphilus**, **Evallogeóphilus**, neotrop.). **NEOGEOPHÍLIDÆ**

13. Labrum consisting of a single piece; antennæ generally flattened at the base and tapering 14

Labrum consisting of three parts, rarely more or less fused (Fig. 1119), the median piece sometimes partially fused with the lateral pieces; coxæ of the last legs not enlarged 15

14. Coxæ of the last pair of legs much enlarged, extending forward at the sides sometimes to the antepenultimate leg-bearing segment; paratergites (one or several rows of small plates between the tergites and the row of pleurites that bear the spiracles) generally present. (**Gonibrégmatus**, austromal.; **Eucrátonyx**, indoaustr.; **Himantosòma**, indomal.; **Macronicóphilus**, neotrop.) ..... **GONIBREGMÁTIDÆ**

Coxæ of the last pair of legs not enlarged, not extending in front of the last leg-bearing segment; paratergites absent. (**Sogòna**, **Timpìna**, nearc.; **Garrìna**, neotrop.) ..... **SOGÓNIDÆ**

15. The median piece of the labrum, if present, not fused with the lateral pieces; in the middle the two larger and ventrally directed

teeth lacking. (Fig. 1120). (**Geóphilus,** widespr.; **Eurýtion,** ethiop., neotrop., austr.; **Scolióplanes,** holarc.; **Polygonàrea,** austr., ethiop.; **Aphílodon,** ethiop., neotrop.; **Hènia,** palæarc.; **Pachymèrium,** holarc., neotrop., ethiop.) . . **GEOPHÍLIDÆ**

The median piece of the labrum at least partly fused with the lateral ones; two larger teeth in the middle, directed more or less ventrally. (Fig. 1119). (**Soníphilus, Poáphilus,** nearc.). **SONIPHÍLIDÆ**

LITERATURE ON CHILOPODA

See also Literature on Myriapoda, p. 597

ATTEMS, C. Myriapoda. Geophilomorpha. Das Tierreich, Lief. 52, 388 pp. (1929).

Chilopoda, Scolopendromorpha. Das Tierreich, Lief. 54, 308 pp. (1930).

BAILEY, J. W. Chilopoda of New York State. Bull. New York State Mus., No. 276, 50 pp. (1928).

CHAMBERLIN, R. V. Chilopoda of California. Pomona Journ. Zoöl. Entom., **2, 3, 4** (1910–12). (Three parts).

The Chilopoda of Brazil. Bull. Mus. Comp. Zoöl. Harvard, **58**, pp. 151–221 (1914).

The Centipedes of Central America. Proc. U. S. Nat. Mus., **60**, Art. 7, pp. 1–17 (1922).

The Ethnopolidæ of North America. Bull. Mus. Comp. Zoöl. Harvard, **57**, pp. 385–437 (1925).

KRAEPELIN, K. Revision der Scolopendriden. Jahrb. Hamburg Anst., Beiheft 2, Mitt. Mus. Hamburg, pp. 1–276 (1903).

POCOCK, R. I. Chilopoda. Biologia centrali-Americana, pp. 1–40 (1896).

VERHOEFF, K. W. Chilopoda. Bronn's Tierreich, **5**, Abth. 2, Lief. 83–99, pp. 83–537 (1915–18).

CLASS **SÝMPHYLA**

Small, delicate elongate species with thin unpigmented integument. Body long, composed of fifteen to twenty-two similar segments; twelve pairs of short, five-jointed legs. Mouthparts consisting of a pair of mandibles and two pairs of maxillæ. Antennæ many-jointed, the joints short, more or less moniliform. Cerci stout, lanceolate, one-jointed or very indistinctly annulated. Respiration by tracheæ opening by a single pair of spiracles on the head.

1. Fifteen tergites; first pair of legs much smaller than the others. .2
   Twenty-two tergites; first pair of legs almost as large as the others. (**Geophilélla**) ..... **GEOPHILÉLLIDÆ**

2. An intercalated segment without legs present behind the fourth, sixth and eighth segments only; posterior margin of tergites rounded, the corners rarely angulate; first pair of legs fully half as long as the others. (Figs. 11, 1121). (**Scutigerélla, Hanseniélla, Tasmaniélla**) ..... **SCUTIGERÉLLIDÆ**

An intercalated legless segment present behind segments four, six, eight, ten and twelve; posterior margin of tergites angulate laterally; first pair of legs usually imperfect and less than half as long as the others. (**Scolopendrélla, Scolopendrópsis, Symphyléla**) ..... **SCOLOPENDRÉLLIDÆ**

LITERATURE ON SYMPHYLA

HANSEN, H. J. The Genera and Species of the Order Symphyla. Quart. Journ. Micr. Sci., **47**, pp. 1–101 (1903).

LATZEL, R. Die Myriapoden der Oesterreichisch-Ungarischen Monarchie. Vienna, Alb. Hölder (1880–84).

GLOSSARY OF SPECIAL TERMS.[1]

This glossary is intended to include only such terms as are not easily understood from the figures referred to in the keys, and other words only when their meaning in the keys might not be readily ascertained from an ordinary English dictionary.

Abdòmen, the hindermost of the three main body divisions.

Acróstichal bristles, one, two or several longitudinal rows of minute bristles along the center of the mesonotum of some flies (*cf.* dorsocentral bristles).

Acùlea (**-eæ**), one of the numerous minute spines on the wing membrane of certain Lepidoptera.

Acùleate, (*a*) furnished with a sting; (*b*) beset with aculeæ.

Adventítious, not regular; accidental or additional.

Ædæagus, the male intromittent organ.

Álula (**-læ**), a small lobe, borne at the base of the wing (Diptera).

Amphipneùstic, having the first and last pairs of spiracles open and functioning.

Ànal, pertaining to the last abdominal segment or to the hind basal angle of the wing.

Ànal lobe, the rounded posterior part of the wing which includes the anal veins.

Ànal veins, in the typical wing the three most posterior main veins.

Ánnulated, incompletely divided into ring-like joints.

Ánnulus (**-li**), a ring or band.

Antecóxal sclerite, a part of the metasternum in front of the hind coxæ (Coleoptera).

Anténna (**-næ**), a pair of jointed sensory appendages of the head above the mouthparts.

Adfróntal plates, a pair of long oblique sclerites on the front of the head extending upwards from the base of the antennæ and meeting medially above (larvæ of Lepidoptera).

Antenòdal crossveins, crossveins along the costal border between the base and the nodus (Odonata).

Apneùstic, having all the spiracles closed and not functioning.

Appendículate cell, a small indistinct cell just beyond the apex of the marginal cell (Hymenoptera).

[1] Where the plural form is unusual the differing termination is given in parentheses added to the last common letter of the root.

Ápterous, wingless.
Árcuate, arched like a bow.
Árculus, a basal crossvein between the radius and cubitus (Odonata).
Arèola (**-læ**), **areóle**, a small closed cell in the forewing, enclosed by radial veins (Lepidoptera).
Arísta, a bristle-like process at or near the end of the antennæ (Diptera).
Aròlium (**-ia**), a terminal pad of the foot between the claws.
Àtrium (**-ia**), a cavity or enlarged entrance.
Atténuated, gradually tapering.
Auxíliary vein, the subcostal vein of Diptera, anterior to the radius.
Axílla (**-læ**), a triangular sclerite on each side of the scutellum (Hymenoptera).
Bàsal cells, the two cells proximal to the anterior crossvein and the discal cell (Diptera).
Bìfid, split into two parts.
Bìlobed, divided into two lobes.
Calamístrum, one or two rows of curved spines on the upper margin of the metatarsus of the hind legs (Araneida).
Calýpteres, small membranous disks under the base of the wings (Diptera).
Cámerostome, the opening through which the beak is extended in certain Acarina.
Campodèiform, having the form of Campodea (Thrysanura), said of certain active carnivorous larvæ.
Cápitate, with a distinct knob at the tip.
Cárapace, the more or less fused dorsal sclerites of the cephalothorax (Arachnida). Also any fused series of sclerites covering a part of the body.
Cárinate, ridged, or furnished with a raised line or keel.
Cáruncle, a fleshy papillate or sucker-like appendage at the tip of the tarsus in certain Acarina.
Caudal filaments or setæ, thread-like processes terminating the abdomen.
Cell, a space in the wing bounded by veins.
Cephalothòrax, the combined head and thorax in Arachnida.
Cérci, a pair of appendages near the end of the abdomen.
Chætosèma, a series of short bristles on the head of certain Lepidoptera.
Cheek, the lateral part of the head between the eyes and the mouth.
Chèlate, pincers-shaped, having two opposable claws.

Chelíceræ, the first or most anterior pair of appendages in the Arachnida.

Chîtin, the horn-like material forming the hard parts of the body wall.

Clàvate, clubbed or enlarged at the tip.

Clàvus, an oblong basal part along the inner edge of the fore wings (Heteroptera, Homoptera).

Clýpeus, the sclerite bearing the labrum (Hymenoptera); a horseshoe-shaped sclerite under the margin of the mouth (Diptera).

Coárctate, with narrowed base and enlarged tip.

Coarctate pupa, a type of pupa in certain Diptera, enclosed in a hardened shell formed from the last larval moult-skin.

Cólulus, a slender or pointed organ lying in front of the spinnerets (Araneida).

Compréssed, flattened from side to side, as distinguished from depressed.

Cónnate, immovably united, fused.

Constrícted, narrowed in part.

Còrium, an elongate middle part of the fore wing (Hemiptera).

Córneous, horn-like in texture.

Córnicle, one of certain paired dorsal tubular processes on the posterior part of the abdomen of aphids.

Cósta, the front margin of the wing, considered as the first vein.

Cóstal àrea, the part of the wing immediately behind the front margin.

Cóstal cell, the space of the wing between the costa and the subcostal vein; formerly sometimes termed subcostal.

Cóxa (**-xæ**), the basal joint of the legs, sometimes quite fused with the body.

Cribéllum, a sieve-like spinning organ lying in front of the spinnerets (Araneida).

Cróchets, a series of spines on the prolegs of the larvæ of Lepidoptera.

Crossvein, any transverse vein connecting adjacent longitudinal veins.

Ctenídium (**-ia**), a comb-like row of bristles.

Cùbitus, the fifth of the main veins of the typical wing.

Cursòrial, fitted for running.

Declívity, the abruptly bent apex of the elytra (Coleoptera).

Decúmbent, bending downward.

Dentículate, with minute tooth-like projections.

Dichóptic, eyes not touching above (Diptera).

Dígitate, with finger-like processes.

Direct eyes, the anterior median pair of eyes in spiders.

Diúrnal eyes, in spiders, eyes that are dark colored.
Dórsal, pertaining to the upper surface or back of the body.
Dorsocéntral bristles, several longitudinal rows of bristles near the middle of the mesonotum, lateral to the smaller acrostichals (Diptera).
Ectopárasite, a parasite which lives on the exterior of animals.
Élytron (**-ra**), the horny fore wings, or wing covers, of beetles.
Empòdium (**-ia**), a single middle pad or bristle between the tarsal claws) (Diptera).
Epímeron (**-ra**), the posterior portion of the pleura of a thoracic segment (Insecta). The sclerite to which the basal segment of the leg is attached (Arachnida, Diplopoda).
Epíphysis (**-ses**), a lappet-like process.
Epipleùra (**-ræ**), the infolded edge of the elytra (Coleoptera).
Epistérnum, the anterior portion of the pleura of a thoracic segment.
Épistome, the part of the face just above the mouth.
Epizòic, living as external parasites of animals.
Erùciform, having the body shaped like a caterpillar.
Exùviæ, the molt, or cast skin of an insect. Recently used as exuvia, exuviæ to differentiate the molts of a single from those of several instars, as in Coccoidea.
Eye-cap, a group of modified scales overhanging the eye (Lepidoptera).
Face, the front of the head, between the clypeus and antennæ.
Fàcial plate, the central part of the face (Diptera).
Fastígium, the upper edge or median ridge of the vertex (Orthoptera).
Fèmur (**-émora**), the thigh or third division of the legs.
Fíliform, hair-like, or filamentous, longer than setaceous.
Flabéllate, with fan-like processes or projections.
Flabéllum (**-la**), a leaf-like or fan-like process.
Flagéllum, the distal part of the antenna when lash-like.
Fontanél, a small, depressed, pale spot on the front of the head between the eyes (Isoptera).
Foràmen (**-ámina**), a small opening, orifice or puncture.
Fórcipate, bearing pincers, or pincers-shaped.
Frénulum, a strong spine or spines at the front basal angle of the hind wings (Lepidoptera).
Front, the forehead, between the antennæ, eyes and ocelli.
Frontàlia, the central strip of the front (Diptera).
Fróntal lùnule, a small crescent-shaped space just above the antennæ (Diptera)

Frónto-órbital bristles, several bristles along the front next to the eyes (Diptera).

Fundàtrix, a stem-mother or female of the first generation which founds a new colony (Aphidoidea).

Fúrcula, the forked springing appendage below the end of the abdomen (Collembola).

Gáster, the rounded part of the abdomen behind the basal node or nodes in ants (Hymenoptera).

Gèna (**-næ**), the cheek.

Genículate, abruptly bent, elbowed.

Genitàlia, the external sexual organs.

Gíbbous, puffed out; hunch-backed.

Glàbrous, bald, smooth, free of hairs.

Gnathochilàrium, a plate-like structure formed by the mouthparts, exclusive of the mandibles (Diplopoda)

Gónopod, a modified leg, serving as a copulatory appendage, on the seventh or adjacent body segments (Diplopoda).

Gonapóphysis (**-ses**), each of the short conical paired egg-laying processes terminating the abdomen; also applied to certain paired genital appendages in the male.

Graduated crossveins, an oblique row of crossveins forming steps across the wing (Neuroptera).

Grávid, filled with eggs.

Gùla, the median underpart of the head lying between the mouth and posterior foramen.

Gùlar suture, a longitudinal impressed line on each side of the gula or middle piece of the throat.

Hálter, a small knobbed appendage on each side of the thorax replacing the hind wings (Diptera).

Hàmus, a distinct abrupt spur-like vein in the hind wings of some Heteroptera.

Haústellate, formed for sucking, the mandibles not fitted for chewing.

Hemélytron (**-ra**), the heavily chitinized fore wing of Hemiptera.

Heterogèneous, of more than one type, as the eyes of certain spiders.

Heterómerous, differing in the number of joints in the three pairs of tarsi (*e.g.* 5, 5, 4), or in the structure of other repetitive parts.

Holóptic, having the eyes meeting above the antennæ (Diptera).

Homónomous, similar in form, function or development.

Hùmeral angle, the basal front corner of the wing.

Hỳaline, more or less transparent.

Hypermetamórphosis, development in which two or more different types of larvæ follow one another in succeeding stages of growth.

Hypopleùral bristles, a more or less vertical row of bristles above each hind coxa (Diptera).

Hypopýgium, the last ventral plate; or the inflexed genitalia.

Hypostigmátic cell, a specialized cell located beneath the stigma of the wing of some Neuroptera.

Imàgo, the final, adult, or reproductive stage of an insect.

Inglùvial, pertaining to the crop.

Ínclinate, bent or directed toward the median line.

Ínquiline, an animal that occurs regularly in the nest or habitation of some other species.

Ínstar, any of the successive stages during metamorphosis, marked off by moltings.

Interfrontàlia, the central portion of the front of some flies when differentiated from the orbits.

Interfróntal bristles, minute bristles on the central part of the front (Diptera).

Interstítial, occurring between two segments, *e.g.* the trochanter, linking the coxa and femur; or coincident, as the ends of two veins.

Intra-àlar bristles, several bristles above the root of the wing lateral to the dorsocentrals (Diptera).

Jùgum, a lobe-like process at the base of the fore wings overlapping the hind wings (Lepidoptera).

Labéllum (**-la**), the expanded tip of the proboscis (Diptera).

Làbial pálpus (**-pi**), a jointed sensory appendage at each side of the labium.

Làbium, the lower lip.

Làbrum, the upper lip, lying just below the clypeus.

Laméllа (**-læ**), a leaf-like plate.

Lámellate, bearing or composed of lamellæ.

Láminate, composed of leaf-like plates.

Lánceolate, tapering at each end, spear-shaped.

Lárva (**-væ**), the growing stages of an insect having a complete metamorphosis, after hatching from the egg and before the pupal period.

Lateral, at, toward, or pertaining to the sides of the body.

Lígula, the central part of the labium, borne by the mentum (Coleoptera).

Lòra (**-ræ**), the cheek (Homoptera).

Lung-book; lung sac, a respiratory sac, opening by a slit-shaped aperture on the ventral surface of the abdomen in certain Arachnida.

Lùnule, a small crescent-shaped piece just above the antennæ (Diptera).

Macrotríchia, the larger hairs on the surface of the wings.

Mandíbulate, with jaws fitted for chewing.

Marginal cell, one or more cells near the anterior margin of the wing, below the stigma (Hymenoptera).

Mask, the extensile labium of the nymphs of Odonata which forms an organ for grasping the prey.

Maxílla (**-læ**), the second pair of appendages belonging to the mouth, behind the mandibles or jaws.

Máxillary palpus, a finger-like jointed sensory appendage on each maxilla.

Mèdia, the fourth of the principal veins of the typical wing.

Mèdial, pertaining to the media.

Mèdian, lying along the middle line of the body.

Méntum, the part of the labium bearing the movable parts.

Mèsad, lying toward the median line.

Mesepistérnum (**-na**), the anterior of the oblique side pieces of the mesothorax.

Mesonòtum, the back or upper side of the mesothorax.

Mesopleùra (**-ræ**), the space between the root of the wings and the middle coxæ, consisting of episternum and epimeron (Diptera).

Mesostérnum, the middle part of the underside of the mesothorax.

Mesothòrax, the middle of the thoracic divisions, bearing the second legs and the fore wings.

Metamórphosis (**-ses**), the series of marked external changes through which an insect passes during its development, *e.g.* egg, larva, pupa, adult. Direct development entails no such changes. Incomplete metamorphosis lacks the pupal stage. Complete metamorphosis includes a pupal stage. See also hypermetamorphosis.

Metapneùstic, having only the posterior pair of spiracles open and functioning.

Metastérnum, the middle piece of the under side of the metathorax.

Metatársus (**-si**), the first joint of any tarsus, next to the tibia, also called basitarsus.

Metathòrax, the third division of the thorax, bearing the hind legs and the hind wings.

Micrópterous, with small or vestigial wings.

Microtríchia, the smaller abundant hairs that clothe the surface of the wings in some insects.

Molt, to cut off or shed the skin.

Monîliform, resembling a string of beads.

Nàiad, the nymph of aquatic insects.

Nàsus, the drawn-out forward part of the head of crane-flies.

Nàsute, a form of worker termite in which the head bears a snout-like projection in front.

Neuràtion, the arrangement of the veins of the wings, the venation.

Noctúrnal eyes, in spiders, eyes of a pearly white color.

Node, a swelling or knot-like knob.

Nòdus, a stout crossvein at or before the middle of the costal border of the wing (Odonata).

Notauli, a pair of longitudinal furrows on the mesonotum of certain Hymenoptera, lying nearer to the median line than the parapsidal furrows when both pairs of furrows are present.

Nòtum, the dorsal surface of the body, particularly of the thorax.

Nymph, the larval or growing stage of those insects that have no pupal period.

Océllus (**-li**), the simple eyes, usually three in number, on the upper part of the head; also the simple eyes of insect larvæ and of some other arthropods.

Ócciput, the back part of the head.

Onýchium (**-ia**), a pad between the tarsal claws.

Órbit, the part of the head immediately surrounding the eyes.

Óstioles, the paired lateral openings of the heart.

Ovipósitor, the egg-laying apparatus.

Pálpus (**-pi**), one or two pairs of jointed sensitive, finger-like processes borne by the mouth. See maxillary palpus and labial palpus.

Parafàcials, the sides of the face of some flies, when differentiated from the sunken central portion and the orbits.

Parápsidal furrow, a longitudinal groove between the median line and each side of the mesonotum, lying near to the lateral margin (Hymenoptera). See notauli.

Párasite, an animal that feeds on or in some other living animal.

Paronýchium (**-ia**), a bristle-like appendage of the claws.

Péctinate, with branches like a comb.

Péndulous, hanging from one end.

Pedipálpi, pédipalps, the second of the paired appendages of Arachnida.

Peripneùstic, having a series of functional spiracles along each side of the body.

Péritreme, a chitinous plate surrounding the spiracle in certain mites.
Pétiolate, attached by a stalk or stem.
Phytóphagous, feeding on plants.
Plántula (**-læ**), a pad-like sole on the underside of the tarsi of certain insects.
Pleùrite, one of the side pieces of the body.
Plùmose, feathery.
Postèrior callósity, a swelling between the root of the wings and the scutellum (Diptera).
Postèrior cells, a variable number of cells extending to the hind margin of the wings, the first bounded inwardly by the anterior crossvein (Diptera).
Posthùmeral bristle, one or more bristles just behind the shoulder-swelling (Diptera).
Postnòdal crossveins, a series of short transverse veins next to the costal margin of the wing, beyond the nodus (Odonata).
Postscutéllum, a small transverse piece of the thorax immediately behind the scutellum.
Postvértical bristles, a pair of minute bristles behind the ocelli (Diptera).
Preápical bristle, a bristle on the outside of the tibiæ just before the apex (Diptera).
Prebasilàre, a sclerite on the underside of the head, sometimes divided medially, lying behind the mentum (Diplopoda).
Prédatory, capturing living prey.
Prefúrca, the petiole of the second and third veins (R_4 and R_5) of Diptera.
Presùtural bristle, one or more dorsocentral bristles just in front of the transverse suture (Diptera).
Probóscis, the extended trunk-like or beak-like mouthparts.
Pròclinate, inclined forward.
Proepímeron (**-ra**), that part at the rear of the side of the prothorax next the coxæ.
Prógnathous, having the mouthparts projecting forwards.
Pròlegs, the fleshy abdominal legs of certain insect larvæ.
Proméntum, a median sclerite in the gnathochilarium, lying in front of the mentum or stipites (Diplopoda).
Pronòtum, the back or upper side of the prothorax.
Propleùra (**-ræ**), the side portion of the prothorax.
Propneùstic, having only the anterior pair of spiracles open and functioning.

Propòdeum, the large apical portion of the thorax, behind the wings and scutellum (Hymenoptera).

Prosòma, an anterior clearly separated section of the cephalothorax in certain Phalangida.

Prostérnum, the middle of the underside of the prothorax.

Prothorácic bristle, a bristle above each of the front coxæ (Diptera).

Prothòrax, the first division of the thorax, bearing the front legs.

Prùinose, coated with a hoary dust.

Pseùdopod, an outgrowth or projection of the body of certain larvæ, assisting in locomotion.

Pteropleùral bristles, bristles located on the sides of the body just beneath the root of the wings (Diptera).

Ptilînum, a temporary bladder-like structure above the antennæ of certain Diptera.

Pulvíllus (**-li**), a pad beneath each tarsal claw.

Pùpa (**-pæ**), the resting stage of insects with complete metamorphosis, following the larva and preceding the adult.

Pupàrium, the oval, hardened covering of the pupa of the higher Diptera and some scale insects, formed of the larval or nymphal skin.

Pupíparous, giving birth to full-grown larvæ that are ready to pupate.

Pygídium, the last dorsal segment.

Ràdial, of or pertaining to the radius.

Ràdial cell, any cell in the wing bordered in front by a branch of the radius.

Ràdial séctor, the posterior of the two main divisions of the radius.

Ràdius, the third of the principal veins of the typical wing.

Raptòrial, fitted for grasping prey.

Rastéllum, a structure on the cheliceræ of certain spiders bearing numerous tooth-like projections.

Réclinate, pointing backward.

Recúrrent nervure, one or two transverse veins arising from the lower side of the submarginal cells (Hymenoptera).

Réniform, kidney-shaped.

Reticulate, meshed, like net work.

Ròstrum, a beak or snout.

Scape, the basal joint or joints of the antennæ.

Sclèrite, any piece of the body wall bounded by sutures.

Scòpa, a brush on the underside of the abdomen, for collecting pollen (Hymenoptera).

Scópula, a brush of hairs or bristles (Araneida).

Scrobe, a groove or furrow, especially one on the mandible or one which receives the antenna.

Scutéllum, a somewhat triangular or crescentic sclerite just behind the mesonotum.

Sérrate, toothed along the edge, like a saw.

Séssile, (*a*) broadly attached; (*b*), incapable of movement from place to place.

Sèta (-tæ), a bristle or filament.

Setàceous, bristle-like, slender.

Shagreened, having a finely roughened surface.

Sínuous, S-shaped, winding back and forth.

Small-crossvein, a short crossvein extending from the base of the discal cell to the fifth posterior cell between M and Cu (Diptera).

Spátulate, broad at tip, narrowed at base.

Spínulated, furnished with very small spines.

Spíracles, breathing pores or external openings of the tracheal system.

Spurs, movable spines, usually two, at the end of the tibiæ.

Spùrious vein, an adventitious longitudinal vein crossing the anterior (r-m) crossvein (Diptera).

Squamopygídium, a plate formed by the fusion of several apical abdominal segments (Dermaptera).

Sternauli, a pair of lateral furrows on the mesothorax below the base of the wings (Hymenoptera).

Stérnite, the ventral piece of each abdominal segment.

Sternopleùral bristles, the bristles on the triangular pleural sclerite between the front and middle coxæ (Diptera).

Stígma, a thickening on the costal border of the wings near the apex.

Stípites (sing. **stipes**), a pair of sclerites lying at each side of the gnathochilarium (Diplopoda).

Stridulàtion, a chirping or creaking noise.

Style, (*a*) a bristle-like process terminating the antennæ, thicker than the arista (Diptera); (*b*) short slender appendages on the underside of the abdomen (Thysanura).

Stỳliform, drawn out as a slender stiff process.

Subantênnal groove, a groove or grooves in the middle of the face (Diptera).

Subcósta, the second of the principal veins of the typical wing.

Submárginal cell, one or more cells lying behind the marginal cells, usually forming a second row below the anterior margin apically (Hymenoptera).

Submèdian cell, a long basal cell near the middle of the wing (Hymenoptera).

Subméntum, the basal part of the mentum.

Súlcate, grooved or furrowed.
Supraànal plate, a dorsal sclerite terminating the abdomen.
Sùture, a line separating the parts of the body wall.
Társus (**-si**), the foot, the jointed portion of the legs beyond the tibia.
Tégmen (**-mina**), the toughened fore wings of grasshoppers, etc.
Tégula (**-læ**), a small convex plate over the root of the fore wings (Hymenoptera).
Télepod, a modified leg, serving as a copulatory appendage, on one of the posterior body segments of male Diplopoda.
Télson, the last abdominal segment.
Tentòrial rods, several diverging chitinous rods within the posterior part of the head of certain dipterous larvæ.
Térgite, the dorsal piece of an abdominal segment.
Térmen, the outer, or distal margin of the wing.
Thèca, a sheath or sac-like covering.
Thòrax, the second of the main divisions of the insect body, between the head and the abdomen, bearing the legs and wings.
Tíbia (**-iæ**), the shin-joint of the legs, between the femur and the tarsus.
Triangle, a small triangular cell near the base of the wing (Odonata).
Trichobóthria, minute sensory hairs on the tarsal joints of the legs of certain spiders.
Triúngulin, the active first-stage larva of the Strepsiptera and certain hypermetamorphic beetles.
Trochánter, the small second joint of the legs between the coxa and the femur.
Trochántin, a small piece between the sternum and the front coxa (Coleoptera).
Trúncate, ending squarely with sharply cut-off edge.
Týmpanal hoods, týmpanal bullæ, a pair of tubercles or swellings at the base of the abdomen in certain Lepidoptera.
Venàtion, the course of the veins or rod-like thickenings of the wings.
Véntral, pertaining to the underside of the body.
Véntral mémbrane, the skin-like tissue connecting the tergites and the sternites (Diptera).
Véntral ségments, the sternites of the abdomen.
Vérrucose, covered with minute warts or tubercles.
Vértex, the crown of the head.
Vertícillate, provided with whorls of fine hairs.
Vestígial, small, degenerate, not functional.
Vibríssa (**-sæ**), a bristle or bristles on each side of the mouth-opening in front (Diptera).
Vivíparous, bringing forth living young, not laying eggs.

INDEX TO GENERA AND HIGHER GROUPS

Illustrations are indicated by page numbers in bold face type.

INDEX TO COMMON NAMES

Bibliography of the Neuropterida

Bibliography of the Neuropterida Reference number (r#):
10150

Reference Citation:
Brues, C. T.; Melander, A. L. 1932 [1932.??.??]. Classification of Insects. A key to the known families of insects and other terrestrial arthropods. [1st Edition]. Bulletin of the Museum of Comparative Zoology 73:1-672.

Notes:

File:
File produced for the Bibliography of the Neuropterida (BotN) component of the Global Lacewing Digital Library (GLDL) Project, 2005.