ROCKY MOUNTAIN DIPTERA -
BIOLOGIC AND TAXONOMIC ASPECTS.

by

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GLOSSARY OF TERMS.
This paper is based upon observations and collections made during the two regular Biological Survey field trips in the summers of 1913 and 1914 under the direction of Professor S.J. Hunter. The collections were made at Rock River in southeastern Wyoming, upon the banks of the Madison River and Beaver Creek in south-western Montana; and at Creede Colorado. The location of the places are shown in the accompanying sketch. The altitudes of the places are 6180, 6300, 8844 feet respectively. From the localities and the altitudes the material is seen to be western and boreal.

There is always more or less interest shown by taxonomists and others in the study of northern and western material. The collection mentioned above was quite large so that it
was necessary to select some special group with which to work. The diptera made a considerable part of the material taken and it became my task to prepare a report upon the species later. The report is included in this paper.

I am indebted to many men for the use of their helpful literature in determining the flies set down in this paper, also for the help rendered in both the classification and verification of many species from various families. I am especially grateful to J.W. Aldrich, J.S. Hine, A.L. Melander, M.C. Van Duzee, Chas. P. Alexander, O.A. Johannsen and others.

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The aim of any key making systematist is to place the material with which he is working into a system such that one coming after him can pick out the forms with greater ease and certainty. My desire has been to acquaint myself with the Diptera of the localities and help others know Diptera.

The beginner in any phase of taxonomy usually has trouble in understanding the characters and their application,
because the author of the key, which he is trying to use, assumes a knowledge beyond the possession of young students. In the preparation of this paper it has been one of the writer's objects to give to the beginning student a paper that will help him get well started. The explanation of the characters are intended to be simple enough for the new student of Diptera and yet thorough enough to be used by more advanced students.
DIPTERA IN GENERAL

Taxonomic Position.

The Dipterous insects belong to one of the many orders of the class Insecta. (Some authors give only six orders of insects while others give as many as thirty). The insects are the six legged mostly air breathing Arthropods with a distinct head, thorax, and abdomen. The name Hexapoda is often used instead of Insecta. This is a word of Greek origin meaning six legs or feet. The Phylum Arthropoda is one of the sub-kingdoms of the animal kingdom.

The Phylum is characterized by being \( ^{\text{bilaterally}} \) symmetrical, heteronomously segmented, and having jointed appendages and an exoskeleton composed of chitn usually. The forms breathe by means of lungs, brancheae, or by tracheae, and sometimes by the general surface. The heart is usually tubular, and dorsal in position. Most forms are oviparous and a few are hermaphroditic. The eyes are usually present and are either compound or simple. Many forms present remarkable changes of form during growth - this change is called metamorphosis.

Parker and Haswell give these characters for the class Insecta. "The class of Insects (comprising the Cockroaches, Grasshoppers, Dragon-flies, Butter-flies, House-flies, Beetles, and Bees, with their many allies) though it is a very extensive one including as it does a larger number of species than any of the other class of Arthropods is yet characterized by a remarkable degree of uniformity, no such extremes of modification occurring as are observed in the class Crustacea".

"Characteristic of all the members of the class is the
presence of three clearly defined regions -- the head, thorax, and abdomen. There are present on the head, antennae, mandibles, and two pairs of maxillae, the jaws being variously modified in the various orders. All Insects have three pairs of legs (some have the front ones almost rudimentary), and most have either one or two pairs of wings likewise borne on the thorax; the abdomen is not provided with paired appendages."

"The various systems of internal organs attain a very high grade of structure in all the higher groups of Insects. In most the development is complicated by the occurrence of a strongly marked metamorphosis. Insects are terrestrial or aerial, only a few living on the surface of fresh or salt water; but many are aquatic throughout their larval condition."

Insects are often remarkable for the high grade of their intelligence as compared with the members of many other classes of the animal kingdom. This manifests itself mainly in the great number of instincts, often of a remarkable character, having to do with the protecting and rearing of the young; and in some cases leading to the formation of communities and consisting of individuals of various different kinds for mutual support and protection.

Kellogg says this concerning the Diptera. "The order Diptera is so large and includes insects that differ so in form and habit that it is difficult to formulate any general account of it. The name is very descriptive of the most outstanding characteristic, namely, their possession of two wings. All Diptera have two wings except a few that have no wings at all. The back wings have been replaced by a pair of pedicled knobs called
halters, which seem to be used in connection with steering or
directing the flight. The wings are rather clear and built on
rather supporting veins. The flies do not have true biting mouth
parts as do many insects, but they have either piercing mouth
parts for blood sucking etc., or they have a lapping set of
mouth parts for lapping up sugar etc., as do the house flies.
They eat nothing solid; everything that is not liquid must be
pulverized or dissolved in the saliva before it can be taken in-
to the digestive tract."

The metamorphosis of Dipterous insects is complete.
All young hatch from eggs either after or before they are laid
and live for a shorter or longer time as a maggot. Then a quies-
cent or pupal stage is passed through. In this stage the insect
is enclosed in a case or old skin that it makes for itself.
After a longer or shorter period, ranging from hours to months,
the adult fly emerges and blows up its wings. The life histories
of most flies are comparatively short, some of them running
through a generation in a few days.

Numbers.
The diptera or flies are indeed very numerous in com-
parison to any other order of animals. It has been said that
from one-half to three-fourths of all the living animal proto-
plasm is contained within the shells of Arthropods. Again it is
estimated that the class insecta predominates over all other
animals put together in both numbers and bulk of tissue. Then
within the class of insects the order Diptera is said to be by
far the largest.

That the members in the Dipterous order are more numer-
ous than those of any other is very evident to any careful observer. They are everywhere. One cannot think of a single place accessible to man where Diptera are not more or less numerous.

There are more than 40,000 known species from different parts of the world. Doubtless there are many thousands that are yet unknown. Every year men throughout the world interested in the work are finding and describing scores of new flies. Some think that the number of Dipterous species will run around 50,000.

Economic Importance.

The economic importance of Diptera can not readily be overestimated. Judging from the large number of Dipterous species it is evident that there must be many different modes of life, and many forms of matter, both living and dead, upon which the various members must live.

Flies are classed either as being detrimental or beneficial to man. The importance of one class is not much greater than that of the other. There are parasites in this order upon both beneficial and harmful individuals of other orders. There are many flies that have to do largely with the fertilization of plants by the process of cross fertilization. In this category would come the flower pollenising flies of the Syrphidae and other families.

Many of the Syrphidae maggots are predaceous upon injurious forms of insect life. They are known to eat many species of the Aphidae which are injurious in most all instances. Certain species of this family live almost entirely upon the plant lice.
Doubtless those many forms found living in the wet boggy places feed freely upon mosquito and other larvae commonly found in such places.

The most prolific internal parasites upon injurious insects probably belong to the family Tachinidae of the Diptera. A large portion of the members of this family live almost entirely within the larvae and the pupae stages as parasites. The army worms, for example have many many parasites, but the most deadly are the Tachinidae flies. These lay from a dozen to fifteen eggs on the caterpillar, the maggots from them enter the body and absorb the juices thereby soon killing the host.

Probably the worst enemies of the grasshoppers also are fly parasites. Here the line of attack upon the host is the same as in the case of the army worm. The maggots simply eat out the insides of the hoppers until they die from the injuries.

There are many insects that do injuries to man and his crops, but none are more important from this angle than the Diptera. Only a few of the more important and conspicuous ones will be spoken of here and these but briefly.

It was found that there is no group of plants considered by Sanderson in his Economic Entomology as being injured by insects which are not affected by Dipterous pests. Certain plants are injured but slightly while others are injured to a very great extent. Grass lands are injured by Tipulid flies working upon the roots; by other flies boring into the stems; and still others destroying the seed parts. Other crops are also affected similarly.

Fruits are affected by certain flies laying their eggs
upon them. Later the young fly maggots bore inside the fruit and spoil it for sale or use. The apple maggot or railroad worm, Ragoletis pomonella (Walch), does great damage in this way. It has long been known as the worst pest of the apple in the North Eastern states; and is now quite injurious in Canada, New York, and the states further west. The fruit is injured by small maggots which burrow through the flesh of the apples, leaving discolored streaks through them. They often become so numerous that the entire pulp is honeycombed and breaks down into a soft yellowish mass held together by the skin. Sweet and sub-acrid varieties are most injured, but where the pest develops unchecked and becomes very numerous, winter sorts are also seriously injured. Cherries are affected in much the same way by R. cingulata (Loew).

The stems of raspberries are bored into and cut off by being girdled upon the inner surface of the bark by a maggot Phorbia rubivora (coq.). This insect sometimes causes galls by boring into the stems further away from the tip where the old wood is. Currants and gooseberries are injured before getting ripe by the currant fly, Epochra canadensis (Loew). It is a very widely distributed native insect and does some little damage throughout the United States.

One of the most serious pests of the cabbage plant is the cabbage root maggot Pegomia brassicae (Bouche'). The adult fly lays her eggs upon the stems of the young plants or upon the soil close by. The maggots work upon the cabbage, cauliflower, radishes, turnips, wild mustard, and other cruciferous plants eating the bark off just under the soil so the plants fall over and wilt.
Seeds planted in the Spring are very subject to the attack of flies. The maggots work upon the seeds and cause them to decay and fail to germinate. If they do come up they are very weak and unfit to withstand natural adverse conditions often present.

The maggots of the greenhouse black fly Sciara are very harmful to plants growing under glass. Not only the greenhouse plants are affected, but the private house plants are often killed by these insects. The housewife does not even know what is doing the work. She sees the adult flies and blames them directly for the injury. The control of these flies is very difficult and no satisfactory recommendations can be made for their destruction. The life history is very short and the flies reproduce very rapidly on this account. The damage done consists in the roots of the plants being eaten off by the maggots.

Then too the Diptera are of much interest economically from the fact that they annoy and actually parasitize the higher animals. The biting flies and mosquitoes all annoy live stock as well as man. Some localities are almost uninhabitable for man or beast on account of these insect annoyers. It is estimated that the cattle industry alone suffers a loss of 500,000,000 dollars caused by insects annually.

The Oestridae or bat flies are parasitic in the larval stage upon horses, cattle, sheep, and other live stock. The numbers of the Nycteribiidae and Sterblidae are almost exclusively parasitic upon bats etc. The Hippoboscidae are parasitic upon birds and many mammals. These latter parasites are often encountered by those handling birds, especially the raptorial birds.
They are short winged flies of short rapid flight which seek to hide in the beard and hair of the collector.

Diptera are also the responsible carriers of our most dreadful diseases from one person to another, from beast to man etc. There have been many books written upon the insect borne diseases. Insects are coming to be recognized more and more as disease carriers and Diptera are found to carry or transmit a large percentage of these diseases.

Malaria is an insect borne disease. The Anopheles mosquito is responsible for this disease as shown below. The mosquito sucks the disease producing parasite into its body with the blood of the malaria patient. Here the Protozoan parasite (Plasmodium, one of three or more species) lives and multiplies until finally it migrates to the salivary glands of the mosquito. Then it is an easy matter for the mosquito to inject the parasite into a well human body along with the saliva that is forced into the wound made for sucking blood. Some other Dipterous carried diseases are tuberculosis, anthrax, plague, infantile paralysis, yellow fever, and possibly pellagra.

The field of experimental research in Entomology offers no larger opportunities for establishing now unknown facts than in the solution of many Dipterous problems. There are many problems connected with the control of crop pests which need men of ability to solve them. The medical field offers problems of much importance also.
AREAS USED IN CLASSIFICATION OF DIPTERA

Mouth Parts.

The oral parts of a dipterous insect are arranged for sucking and are spoken of collectively as the sucker, beak, or proboscis. They are either inserted at the end of a more or less prolonged cylindrical portion of the head called the snout (rostrum) or project from a wide aperture which often occupies a great part of the under surface of the head. The common fleshy root of the oral parts is connected by a membrane with the borders of the mouth. This membrane often has a fold of quite a horny consistence, and is then called the clypeus. It is either entirely concealed by the anterior border of the mouth, and is then usually movable; or it projects over it as a ridge, and is then usually immovable (as in culicidae). The largest of the oral parts in most of the Diptera is the fleshy under lip (labium), consisting of the stem and knob formed by the two suctorial flaps. Besides the under lip the palpi are most perceptible and must be noticed in the description of species. The remaining mouth parts are usually rather small and stunted, having the form of bristles or horny stylets. They are considered as being the tongue, under jaws, upper jaws, and upper lip, and certain prolongations of the chitinous epipharynx or hypopharynx.

These latter parts are not now particularly valuable for the separation of species. They may become more important with further study. The writer attempted to work out a system of classification using the mouth parts more fully than they had been used. The field is so large that much more study must be given before very valuable deductions can be safely made.
As a basis for work in such study the paper of Alvah Peterson, "The Epipharynx and Hypopharynx of the Diptera" will be found very good. In this paper he discusses the mouth parts of all the Dipterous families and gives sketches to compare their size, shape, etc./Mr. Peterson's paper can be obtained from publications of the University of Illinois.

Chaetotaxy.

The term chaetotaxy is applied to the usage of various hairs and bristles in the classification of insects (the Diptera and Hymenoptera especially). The various Diptera taxonomists have given different standards of importance to the usage of the chaeta in their works. Loew is said to have almost missed their significance of value in his works upon the Diptera, although he used them to a very slight degree. Osten Sachen proposed the use of the term chaetotaxy to designate the sciences of the arrangement of the bristles; and he published an epoch making paper in 1881. He made the arrangement of bristles almost fundamental as indices in some instances, especially so when he would locate the Apioceridae with the Asilidae almost solely upon their chaetophorous character. Girshner extended the system more widely to include the calypterate diptera. Others also have made more or less use of the chaeta in taxonomy.

Although evolutionally chaetophorous characters are of recent origin they are not of great use in the separation of tribes, genera, and species. The macrochaeta of the head, thorax and legs are used to a great advantage. The variously located bristles also help in some cases in separating the superfamilies and families. The chaetophorousness of Diptera finds its greatest
development in the Tachinidae. Here it is largely used by some as a basis for making separation of species.

The chaeta are of sufficient constancy in size, numbers and location to be used a great deal more in taxonomy than they are today. The hairs are not used at all in many groups of flies for separating even species. They seem of more value than other characters often commonly used. The observations of many lead to the conclusion that the hairy characters are among the most constant ones.

Townsend and Gary Hough in their paper upon certain of the bristly flies have used the chaeta to a very high degree with remarkable success. Their works take up the size, location, numbers, etc. of the chaeta upon the various areas of the body, particularly the thorax and abdomen. The treatment of the material in this manner seems very satisfactory, because a student using their works can be reasonably sure of the species.

Wings.

The wing venation of the order is quite constant as a rule. The plans or schemes of venation among the different families are different. The veins are used all the way through the forms of taxonomy in various ways. With some families the venation is not much used after the family itself is determined, while in other cases it is used in determining the genera, and in many the species as well.

It seems reasonable that considerable attention in the taxonomy of Diptera should be given to the wings because the specialization here is high. The hind pair has been transformed from wings used in flight to sense organs, thus concentrating
the whole burden of flight in the front pair. The time required for this transformation was long enough to allow the venation characters to become well fixed and attain constancy. There are a few venation characters, however, that can not be relied upon in the taxonomy of certain restricted groups.

The halters are thought by some to have been changed into auditory organs. The nerve leading to the halters is said to be next in size to that of the optic nerve, which is the largest nerve in the Dipterous body. They have not been used for criteria of separative value to any great extent.

The tegulae are not clearly understood in function. They may be for protecting the highly sensitive halters. From the shape of them it seems that they are remarkably well suited for the collection of sound waves. They are used to a considerable degree in the classification of the higher divisions. The Acalypterate and Calypterate Diptera have been separated from one another largely by the vestigial nature of the tegulae or the rather large size. However this criterion of separation is not adequate for various reasons.

Genitalia

The using of special restricted areas or organs in a comparative way for separation of groups is now looked upon with greater favor than formerly. Many workers have tried to work out systems of classification using certain restricted areas largely. At present certain men who determine Sarcophagidae have very different opinions as to the value of the organs in the male as a basis for separation. Before accepting specimens for determination one man will almost require that the genitalia be pulled
out to stick away from the body, while another will criticize the collector if they are pulled out.

**ILLUSTRATIONS**

Following are a few illustrations setting forth some of the areas used in taxonomic dipterous literature which may be more or less vague in the mind of the student.

The above is a wing sketch from Walton with one system of nomenclature upon it.

The next sketch is of a Tabanus wing with other systems of nomenclature applied.
TABANUS WING.
Explanation of veins and areas of body.

Sketch of Tabanus.

Comparative system of venation from Williston.

Auxiliary vein -- --- --- II --- --- --- Mediastinal
First longitudinal ---- III --- --- Subcostal.
Second longitudinal ---- III --- --- Radial.
Third longitudinal ---- III --- --- Cubital.
Fourth longitudinal ---- V --- --- Discoidal.
Fifth longitudinal ---- V --- --- Postical.
Sixth longitudinal ---- IX --- --- Anal.
Anterior branch of third vein III
Anterior intercalary ---- V
Posterior intercalary ---- VII.
Costal cell ---- 2nd I --- --- Costal.
Subcostal cell ---- II --- --- Mediastinal.
Marginal cell ---- III --- --- Subcostal
First submarginal cell ---- III --- --- Cubital.
Second submarginal cell ---- III ---
First basal cell 2ndIII
Second basal cell V
Anal cell VIII
First posterior cell IIIf
Second posterior cell V
Third posterior cell 2nd V2
Fourth posterior cell V3
Fifth posterior cell VII.
Discal cell 1st V2
Axillary cell IX
Sketches from Walton showing location of areas and bristles upon the thorax of a fly.

A. HC. humeral callus; Pp. propleura; Mp. Mesopleura; Ptp. pteropleura; Stp. Sternopleura; Hyp. Hypopleura; Up.cal. upper calypter; Lw.cal. lower calypter; Sc. scutellum; NP. notopleurals; Sa. supraalar row; PA. post alars; Sc. scutellars; Pt. pteropleural bristles; Hp. hypopleural row; Sp. sternopleurals; Mp. mesopleural row; PB. propleural bristles.
B.

Dc. dorso centrals; Ac. acrosticals; H. humerals; Ph. post-humerals; Pr. prescutellar row; DS. discal scutellars; PA. post alars; IA. intra alars; SA. supra alar row; Np. notopleurals; PS. pre suturals.

Sketch showing areas on anterior part of head.
O. ocellar plate; F. frontalia; P. parafacials; C. cheek; E. Eye; L. lumula; A. antennal ridges; Fp. mesofacial plate; Fa. facilia; Ep. epistoma; Cl. clypeus. 
Heavy line - ptilinal suture.
DISCUSSION OF CATEGORIES OF CLASSIFICATION

Family, Genus, Species, etc.

Before giving a list of the Families, Genera, and Species found at the three places before named it seems advisable to put together under a separate discussion various definitions of these categories. A genus is said to be based upon arbitrary points of separation with whoever happens to be working with the specimens. The same might be said of the family and in many cases the species as well, for the variation among a species is often remarkable.

It is noticed that in the classification of the genus Bombus (Hymenoptera) that Franklin often gives a species with much variation in it, while Coquillet divides the species on the varietal characters into different species. This same thing is found to occur among all systems of classification in both the animal and plant kingdoms.

A family is said by Smith to be a division of classification including a number of genera agreeing in one or a set of characters and so closely related that they are apparently descended from one stem. A genus is said to be a group of species agreeing with one another in the broad features of their organization but differing in detail, such differences being relatively constant and the species composing the group infertile with one another. A dictionary definition of a species is this; a species is a classificatory group of animals or plants, subordinate to a genus, and having members that differ among themselves only in minor details of proportion and color, and are capable of fertile interbreeding indefinitely.
The conception of a species is a most vital one in biology and has been the subject of much animated controversy. Some physiologists deny the objective existence of species, while almost all taxidermists and most naturalists and evolutionists consider the species being a real biologic unit, having definite and provable existence.

David Starr Jordin used the following simile in speaking of a species; "A species is an island, a genus an archipelago in the sea of death. The species is clearly definable only as its ancestors and cousins have disappeared, only in the degree that the stages in its development are represented in our records. The genus is a group of species, an archipelago of islands, and there may be every conceivable degree of width or breadth of channel which seems to separate one island or group of islands from one another. Any island genus or species may disappear before the rising tide of life. Or the channel may be so narrow and shallow that even between the rolling waves of the sea of opinion the species are connected as one."

Kellog shows the changeability of species which are apparently fixed by this simile. "But the objects we do know do not endure. Only the shortness of human life allows us to speak of species or even of individuals as permanent entities. The mountain chain is no more nearly eternal than the drift of sand. It endures beyond the period of human observation; it antedates and outlasts human history. So may the species of animals or plants outlast and antedate the life history of one man. Its changes are slight even in the history of the race. Thus the species, through the persistence of its type among its changing
individuals, has come to be regarded as something which is beyond modification, unchanging so long as it exists."

"As a flash of lightning in the duration of the night, so is the life of man in the duration of nature. When one looks out on the storm at night he sees for an instant the landscape illuminated by the lightening flash. All seems at rest. The branches in the wind, the flying clouds, the falling rain, are all motionless in this instantaneous view. The record on the retina takes no account of the change, and to the eye the change does not exist. Brief as the lightening flash in the storm is the life of man compared with the great time record of life upon earth. To the untrained man who has not learned to read the records, species and types in life are enduring. From this illusion arose the theory of special creation and permanance of types, a theory which could not persist when the facts of change and the forces causing it came to be studied in detail."

So it is with species forming. The process is very slow. That species are not absolutely constant but changing may be seen from the study of variation among the members of a single species when a large number of specimens from various localities are at hand. To the human eye and record the moving or changing forms seem motionless or fixed.

Bauer and von Bergenstaum give something of their views concerning Dipterous species by saying. "It is a fundamental principal in the development of the whole dipterous stock that, from the lowest (Orthorrhapha nematocera) to the most differentiated or highest (Cyclorrhapha schizometopa), the actual value of the genus, and the systematic series generally, become less and less. This proposition seems applicable to all groups
of animals --- in all cases the most recent forms are more closely related and more difficult to characterize than the older ones ---. The cause lies in the numerous intermediate forms occurring in a group of animals which has just reached its period of greatest prolificness."

As many authors have pointed out it is futile to attempt a classification of the highest flies along any other lines than the separation into many restricted categories. Also that the classification of all animals must be based on the entire development -- not on the adult alone. The imago characters are important for the genera and species; those of the earlier stages are more important for the families and higher categories, even up through order and classes. In studying early stages, it may be found that some characters will occasionally serve for generic separation, but care must be taken to be sure that the characters are important enough for generic valuation.

Townsend in speaking of the Muscoidean flies says, "Generic values are not necessarily uniform throughout the organic work. It is useless to set a standard whereby animals generally shall be gauged by a certain fixed measure of difference. This holds good even in different superfamilies of the same order or suborder of insects. The demands of the group in hand must be considered in each case. A superfamily in the multiform stages of development, contingent upon it being still in the process of evolution, demands a less generic value than an older and well established superfamily whose forms have become fixed through a long period of conformity to their environment. If this be conceded, it becomes impossible to treat the younger
superfamilies as those of the Muscoidean group by any satisfactory system."

Again the difficulties as to genera can be largely overcome by the erection of a sufficient number of genera to accommodate all the intermediate. But who can tell exactly what is a species in nature? It is clear that we must have a definition that will answer to the term. In large assemblages of insects, where intergrades and undergrades have not been lost, there is no such thing as a species in the generally accepted sense. No sharp specific distinction can be drawn in such cases. The term is a necessary conception in taxonomy, however, and it is to be noted that the only reason for its employment is the necessity for being able to distinguish between assemblages of individuals that are unlike. Therefore it seems clear that the only course to pursue is to give a name to every assemblage that can be distinguished from other assemblages.

The term species might be used in a very restricted sense. It is proposed by some to use, for those genera or species that are called typical forms, the term type. The additional genera and species to be intercalated between the typical ones it is proposed to term atypic. There would be present then typic species and atypic species for the accommodation of the typical species and intergrades. This scheme accords with the facts, which do not conveniently admit of the employment of subgenera and subspecies. The term atypic species will be used for recognizable assemblages of individuals grouping around typic species. The term "form" may be used interchangeably as referring to either one or the other.

Townsend continues by saying that the conviction is
constantly growing among biologists that we really do not comprehend species. Multitudes of insect forms have been confused under one specific name since Systematic Entomology began. ---

The scientific conception of the invertebrate species is gradually growing less vague and more constricted. There is practically no doubt that in most groups of insects, the Coccidae excepted, there are many times more forms that will eventually be termed species than have heretofore been recognized. Without doubt, bunching is more infinitely harmful to a system of classification than splitting. Splitting, even if injuriously done, does not give rise to actual error, but bunching produces all kinds of error in the bionomic literature, which errors moreover are irremediable except through a restudy of the specimens originally referred to.

Dr. S.W. Williston said in speaking of the taxonomic groups among the Muscoidean flies. "Species, Genera, and even Families, show such slight plastic differences that only the most patient study will define their limits. At the present time there is a decided tendency to base the classification of even the higher groups upon apparently trivial characters. Most naturalists have long since abandoned the idea that genera, or even families, represent anything else that the convenience or classification, and recent writers on the family are probably right in seizing upon any characters that will satisfactorily group the vast number of specimens irrespective of the relative values. But it is very probable that, in the proposal of so many genera in such rapid succession, many characters have been employed which future research will show to be entirely
inadequate. We yet know very little about individual variations in the families or the real value of many of the characters used. The absence or presence of a bristle may be found to represent a group of species, but we should first learn how constant the character is in the species."

Kellogg in speaking of the large number of insect species used the following passage. "After one has classified an insect in its proper order there remains first, the determination of the family (each order being composed of from one to many families), then the genus (each family comprising one to many genera), and finally the particular species of the genus (each genus including one to many species). This ultimate classification to species however, will be possible to the amateur in comparatively few cases. There are so many species of insects (about 300,000 are known) that it would require many shelves of books to contain the descriptions of them all. As a matter of fact, in only a few orders have the description of the species been brought together in manuals available for the general students. For the most part the descriptions are scattered in scientific journals printed in various languages and wholly inaccessible to the amateur. There are less than 1000 different species of birds in North America; there are more than 10,000 known species of beetles. Now when one recalls the size of the systematic manuals of N. A. birds, and realizes that ten such volumes would include only the insects of one order, it is apparent that complete manuals of N. A. insects are yet out of the question. Except in the case of the most familiar, wide spread, and really recognizable insect species we must
content ourselves with learning the genus, or the family, or with the most obscure, slightly marked, and different members of certain large groups, as the beetles and the moths, simply the order of our insect specimens."

It is evident that for the most part the specimens in an amateur collection (or in most professional entomologist's either) will have to be determined by the men who make a specialty of certain small groups. The species are so numerous and varied that but few professionals try to be authorities in more than a few families of one or two orders.

From these quotations and generalizations the reader may have a better idea of the state of affairs concerning the various views of categorical values. In this field of biology as in all fields evidence to prove most any statements can be cited. The difficulties over taxonomic values will probably never be entirely eliminated.
SPECIAL STUDIES.

The Syrphidae have received special attention during the course of this present study. This one family is indeed very large. Williston has published a large volume giving a partial list of the N.A. species along with many descriptions of species and taxonomic keys. For reference this is the best single book that has been found during this study. There are many references to the genera and species given in Aldrich's catalog of N.A. Diptera. Here it is found that the Syrphidae have been written upon in many languages.

The most distinctive character of the family is the usual presence of a lighter or heavier thickening of the wing membrane which makes the wing appear to have a distinct longitudinal vein between the third and fourth longitudinal veins or the veins III and V of Comstock.* This vein is present in most all members of the family and is called the spurious vein. This is shown in the figure below drawn from the wing of an Eristalis.

Williston in his N.A. Syrphidae gives the following characters for the family. "Small to rather large flies. Head hemispherical, often elongate or produced in the lower part as broad or a little broader than the thorax. Face moderately broad, bare, or clothed with dust or short pile, excavated in profile under the antennae and projecting below or with a

*Sometimes absent in Chrysogaster, Volucella etc.
distinct convexity near the middle part; never with longitudinal furrows or lateral ridges, usually convex transversely, sometimes with a median ridge. Oral opening large, proboscis rarely much elongated, usually but little projecting, and when at rest, concealed within the mouth; palpi one-jointed; labrum epipharynx, hypopharynx, maxillae and labium present. Front never excavated, often swollen, sometimes with a more or less elongate process which bears the antennae. Antennae usually porrect, approximate at their base, three jointed; the third joint more especially of varied shape, usually flattened and with a dorsal bristle, either bare or plumose; very rarely the third joint is not flattened, and is provided at the tip with a thickened style. Eyes large, bare or pilose, in the male usually contiguous between the base of the antennae and ocelli. Ocelli always present. Thorax comparatively large and robust, moderately arched above; scutellum large, usually convex, often translucent, rarely with spines on its border. Tegulae of moderate size. Abdomen composed of five or six visible segments, rarely with only four. Hypopygium usually not prominante. Shape of abdomen variable; slender, linear, clubbed, short, oval and all intermediate forms. Legs usually weak, sometimes strong; the hind femora not infrequently moderately or much thickened, the hind tibiae not rarely arcuated and compressed, metatarsi rather long, coxae short, the hind coxae, femora, and tibiae, more especially in the male, in not a few species, armed with spurs, protuberances, or spines; the front and middle tibiae and tarsi rarely flattened, or with structural variation. Macrochaetae rarely present in
any part of the body; the body generally thinly pilose or nearly bare, but sometimes clothed with thick pile. Wings comparatively large, when at rest folded together over the abdomen, or half open; third longitudinal vein never forked, frequently with a more or less deep curvature on the outer part; marginal cell open or closed, the fourth vein terminates in the third vein at or before the tip; neither of the intercalary veins present; anal cell always closed before the border of the wing; anterior cross-vein before or beyond the middle of the discal cell."

The Stryphidae are a most interesting group from the standpoint of a collector. They are found (The adults) in every sort of place imaginable — where the sun shines the brightest as well as in the deepest shades. They have been found by the writer on some of the perpetually snow covered mountains in the western states. They are abundant upon the low
plains of eastern Kansas and occur plentifully at the sea shores. Their habitat is indeed a very wide one with reference to altitude and cold.

It seems natural to expect that the species would grade into one another gradually as localities and altitudes change. This is often found to be the case. Sometimes a species, the specimens of which are from widely differing localities, would be broken up into two if the intermediate forms were not present. However in some cases there seems to be little or no variation. Certain species of Eristalis have been taken from the lowest plains to the highest mountains with the specimens being so nearly alike that the differences are often times not distinguishable.

From the family Syrphidae the genus Chrysotoxum was taken for special study in variation upon some of the widely scattered species, and for detailed observation upon the present used characters of separation so as to be able to suggest new and better ones for key making.

The genus Chrysotoxum is placed in the sub-family Chrysotoxonae. The group is small, but still the characters used for separation of species are not so satisfactory as those used among many groups. The following key taken from Osten Sachen sets forth the different genera of the sub-family.

CHRYSOTOXINAE

Table of the European Genera of Chrysotoxinae.

1 (6) Arista dorsal.
2 (7) Middle cross-vein beyond the middle of the discal vein; open; ans. Third joint of the antennae very short. -- SPHECOMYIA
3. (2) Middle cross-vein before the middle of the discal cell
third joint of the antennae usually the longest.

4. (5) Antennae placed on a long peduncle; abdomen with a broad
reddish yellow band. — — PSARUS. Fig. 1.

5. (4) Antennae placed on the prominent frons, abdomen black
with yellow bows. — — CHRYSTOTOXUM. Fig. 2.

6. (1) Style terminal — — — — — — CALLICERA. Fig. 3.

The Genus Chrysotoxum is characterized by there
usually being dorsal arista upon the antennae; marginal cell
open; anterior cross vein of wing distinctly before the middle
of the discal cell, almost always rectangular. Antennae elongate with arista bare. Mesonotum with yellow lateral stripes. Large species usually with the abdomen always crossed with distinct yellow arctuate bands. Eyes pubescent?

The spurious vein is distinct and comparatively wide and heavy. In common with several other genera the third longitudinal vein distinctly curves into the first.

Miegen gives following in Illiger’s Magazine, ii, 259, 1803. "The Chrysotoxum flies are rather large, thinly pilose, or nearly bare species, black with bright yellow markings on head, thorax, and abdomen. Head as broad or scarcely broader than the thorax. Antennae elongate, longer than the head, porrect, situated upon an obtuse prominence; first two joints of nearly equal length, the third elongate, spindle shaped, before the middle with a thin, small, bare arista. Face broad, descending somewhat below the eyes, below the antennae gently excavated in profile, and with an obtuse tubercle on lower third. Eyes pilose (in some exotic species bare) contiguous in the male. Abdomen more than twice as long as the thorax, beyond the middle broader than the thorax, elliptical, strongly arched, with thin lateral borders; hypopygium usually concealed. Legs comparatively weak, hind femora elongate, hind metatarsi as long as the remaining joints together. Third longitudinal vein of the wings with a distinct curvature into the first posterior cell; first posterior cell closed near the border of the wing; small cross-vein a little before the middle of the discal cell, a little oblique."
S.W. Williston adds, "Face and cheeks yellow, the former with a black stripe running from the base of the antennae to the oral margin, the cheeks also with a black stripe from the eye to the mouth. Antennae black; frontal triangle with a black spot above the base of the antennae; front in female black, but little shining; on each side, with a yellow interrupted stripe; in the middle with a pair of slender, whitish pollinose stripes; obsolete behind. Scutellum yellow, across the disk more or less translucent dark colored. Pleurae with one or more yellow spots. Abdomen black, but little shining; second segment with an arcuated, interrupted cross-band; each of the following with an arched, anterior cross-band, and the posterior border, yellow. Legs yellow, sometimes the femora more or less blackish at the base. Wings nearly hyaline, with an anterior brownish border."

There are but but comparatively few species in the genus Chrysotoxum. This supposedly would make it relatively easy to get good characters of separation for all of them. It seems however that no one species is very sharply defined from any other. There need to be new characters worked for the separation into species. Also the descriptions of species in some cases are so closely allied to one another that a specimen may fit in either or both. Then again the variation in a single species is very wide. So wide in fact that it appears that new species should be set off.

In studying the genus Chrysotoxum and one part of this genus has always been more or less of a problem, of the following literature taken from the literature are hard to describe satisfactorily for certain separation. The quite dull and enough matter is represented in it a whole
lengths of the joints of the antennae offer characters of some value, but surely they are not so reliable as some authors lead one to think. In a rather large series of specimens all set in the same species C. derivartum, a very considerable variation in the length of the third joint was found. This variation is shown along with certain other characters of the species below.

In studying the genus Chrysotoxum use was made of most of the following literature taken from the Aldrich catalogs of N.A.Diptera and elsewhere. The list of references is quite full and enough material is represented in it to enable
one making a study of the group to do thorough reading.*

J.M. Aldrich Catalog of the North American Diptera.

**CHRYSOTOXUM**

MEIGEN, Illig. Mag., II, 259, 1803; Syst. Bechr., III, 166, 1822.

SCHINER, Fauna Austr., I, 252, 1862.

WILListon, Synop. N.A. Syrph., 13, 1886, table of species etc.

CHAGNON, Et. Prelim. les Syrph., 73, 1901.

Verrall, Brit. Flies, VIII, 641, 1901.

Zetterstedt, Scan. Dip.

derivatum Walker, List, III, 542.--Martin Falls, Canada.

Bigot, Annales, 1883, 323 (vilosulum).--Wash. (Will.)


Snow, Kans. Univ. Quart., I, 24, oc. and notes.--Col.


N.M.--Coq.

flavifrons Macquart, Dipt. Exot., II, 2, 17.--Newfoundland.

WILLISTON, Synop. N.A. Syrph., 17; would drop.


Giglos-Tos, Ditt. del Mess., 1, 39.--Mex.

Snow, Kans. Univ. Quart., III, 227, oc. in N.M., and notes.

laterale LOEW, Cent., V, 42.--Nebr.

WILLISTON, Synop. N.A. Syrph., 14, transl. orig. desc.--N.Y.


N.J.--Smith Cat.

nigritum Fabricius, Ent. Syst., IV, 292 (Syrphus); Syst. Antl., 183 (mulio).--Jamaica.


pubescens LOEW, Wien. Ent. Monatsch., IV, 84; Cent. V, 43 -- Ill.

WILLISTON? Synop. N.A. Syrph., 15, transl. orig. desc.--N.Y.


Hunter, Canad. Ent. XXVIII, 91, desc.

* It was decided to postpone further publication upon variation until better opportunities for study presents itself. At which time it may be possible to attempt a revision of the genus. Specimens of Chrysotoxinas are taken any place desired for study.
Then also reference may be made to the following.

C.W. JOHNSON, Psyche, XIV, 1907, 77-79.
E. W. JOHNSON, Psyche, XIV, 1907, 77-79.
Fasciolatum DeG. (Not Meigen) and others.
METCALF, Syrphidae of Ohio, Bull. I, Ohio Biol. Surv., 80, 1913 (3 sp.)
JONES, Jour. N.Y. Ent. Soc., XV, 88, list of two sp. from Nebraska.
GIBSON, 39th Report Ent. Soc. Ont., 110, two sp. in Canada.
OSBURN, Canad. Ent. XXXVI, 216, oc. of derivatum in B.C.
WASHBURN, Dipt. of Minn. 2 sp.
Kansas Lists - Snow, Tucker, Crevecour.
FAMILY KEY.

This key is based directly upon those of Bruse and Melander, and Williston. There are but few other characters given than those found in the keys mentioned. The characters of the families given in both are here grouped together and simplified to help the student in his work.

1. Flies of leathery or horny structure, living parasitically upon warm blooded vertebrates in the adult condition; viviparous, the newly born larvae well developed, ready for pupation; flat like, often wingless.

(Pupipara) 84

Flies of softer structure, not ectoparasitic upon warm blooded vertebrates, rarely viviparous, usually winged. 2

2. Antennae usually elongate, longer than the thorax. Generally composed of 8-16 free joints and rarely with a differentiated style or bristle, anal cell rarely narrowed in the margin of the wing, discal cell usually absent, second vein often forked; calyptera absent; palpi usually elongate 4-5 joints,
rarely absent; body very rarely with bristles. For the most part delicate flies. (Nematocera) 3

Antennae usually three jointed, the third joint however often complex or bearing a differentiated style, arista or bristle. Anal cell, if present closed or much narrowed in the margin of the wing; discal cell almost always present, second vein never forked, palpi short or composed of two joints; body often with bristles. Mostly less delicate flies. (Brachycera) 18

A. ORTHORRHAPHA

B. NEMATOCERA.

Anal cell rarely narrowed in the margin, if present; discal cell present only in many Tiphilidae and the Rhyphidae; second longitudinal vein often furcate, the third very rarely if ever; palpi usually more or less elongate, composed of from one to five, usually four joints, rarely absent; antennae usually elongate and verticillate, generally filiform, rarely pectinate, composed of from 6-39 joints, usually from 8-16, the joints of the flagellum homomorphin and usually freely articulate with each other, a style or arista very rarely differentiated. For the most part slender, delicate flies.

3. At least nine veins reach the margin of the wing, discal cell often present, second and fourth
veins forked.

4

Less the nine veins terminate in the margin of the wing. Usually no discal cell

10

4. Costa continuing around the hind margin of the wing, ocelli almost always wanting.

5

Costa much thinned beyond the tip of the wing; a single pad between the tarsal claws; ocelli present; males holoptic; wings usually spotted; antennae 12-16 jointed. Rhyphidae

5. Veins bare or nearly so, if hairy: the pronotum has a V-shaped suture; legs very long and slender; body and wings elongate; male eyes not meeting above.

6

Veins, including the hind margin, very hairy or scaly, mesonotum without a transverse suture.

7

6. Mesonotum without a transverse suture; second vein strongly arched forward; third vein rising from the second near the middle of the wing; usually not blood sucking flies. Dixidae

Mesonotum with a more or less distinct transverse suture; female with a conical ovipostitor
7. Wings ovate or pointed, with numerous longitudinal veins and without apparent cross veins; veins very hairy; tibiae without terminal spurs. Small or minute, moth-like flies; the wings folding roof-like when at rest.

Psychodidae

Wings tomentose, narrowed, fringed on the hind margin, with cross veins, second and third veins separate at an acute angle; tibiae with terminal spurs; antennae of the male usually beset with whorls of dense plumosity. Mosquitoes.

Culicidae

8. Suture of mesonotum distinctly V-shaped; two anal veins present.

Culicidae

9. Last joint of palpi whip-lash like, much longer than the three preceding put together; antennae with rarely more than thirteen joints; auxiliary vein ending in the first vein by an abrupt cur-
nature at the tip, not connected with the first by a cross
vein.

Tipulidae

Last joint of the palpi shorter or not much longer than the
two preceding antennae 6-16
jointed, rarely more; auxiliary
vein usually ending in the costa
and connected with the first
vein by a distinct cross vein.

limnobiidae

10. Antennae composed apparently of but two joints and a termi-
inal 9-10 jointed arista; a
small but broad second basal
cell present; small and rare
species.

Orphnephilidae

Outer part of antennae not
formed like an arista; second
basal cell absent, or, if
present, narrow.

11

11. Wings with a secondary spi-
der-web-like venation; slender
and long-legged species. Rare.

Belpharoceridae

Wings without such secondary
venation.

12

12. Second basal cell present;
 antennae usually shorter than
the thorax, rather stout,
without marked constrictions between the joints; eyes of male rather large and holoptic, ocelli almost always present.

Bibionidae

Second basal cell wanting. 13


Thorax not strongly arched above; antennae long and slender, the joints longer than broad, rarely flattened; body slender. 14

14. Tibiae with apical spurs, coxae usually long; 2-3 ocelli almost always present, in the former case one situated near each eye and sometime indistinct eyes separated. Mycetophilidae

Tibiae usually without apical spurs; often no ocelli; coxae at most only moderately long. 15
15. Wings with usually three longitudinal veins present, the last forked and no apparent cross veins; usually hairy; costa continuing around the hind margin of the wing; eyes usually separate; minute delicate species.  Cecidomyiidae

More than three longitudinal veins present, costa but weakly continued on the hind margin of the wing: males usually holoptic.  Chironomidae

16. Antennae slender, 5-6 joints, often more or less constricted, and often bushy llomose in the male; legs slender, the femora sometimes thickened; abdomen slender; wings mostly narrow; none holoptic. Some blood suckers. Mostly delicate gnats.

17. Hind margin of wings slightly thickened; tibial spurs

18. Hind margin of wings not thickened; tibial spurs

19. Antennae heavier, joints rarely constricted, at most verticillate; wings usually more ovate; eyes kidney shaped, meeting on the vertex; ocelli distinct.
distinct; antennal joints longer than broad; eyes narrow above the front. Sciaridae

Hind margin of wing not thickened; antennal joints shorter than broad; eyes comparatively broad above the front. Scatopsidae

BB. BRACHYCERA.

Anal cell closed before the border of the wing or distinctly narrowed in the border; if absent or very short the antennae composed of two or three simple joints with or without a style or arista. Palpi rarely elongate, never with more than one freely articulated joint, that is two-jointed or one-jointed or absent. Antennae: (a) elongate, composed of distinctly separable joints, the joints of the flagellum homomorphous and sometimes as many as thirty in number; (b) composed of not more than ten closely united joints without style; (c) the so called third joint is complex, that is, composed of from 4-8 segments or annuli, the distal or arista; (d) composed of three simple joints (sometimes apparently two), with or without a differentiated, one to three-jointed, style or arista. Second vein of the wing never furcate, the third often, discal cell almost always present.

18. Antennae composed of two or three simple joints, the distal one not annulated nor segmented, usually with a 1-3 jointed terminal or dorsal arista or terminal style. 24
Antennae usually of one of the (three) types shown.

19. Empodia undeveloped or bristle-like; front concave between the eyes in both sexes; antennae elongate, the flagellum composed of two or three joints, without apparent style.

29. Empodium developed pulvilliform. Body not bristly; flagellum of antennae with numerous, distinct joints; or forming the complex apparently third joint, with or without the differentiated style or bristle.

20. Squamae rather large; third antennal joint composed of 4-8 annuli; head widely hemispherical; third longitudinal vein forked; five posterior cells present; males holoptic; females fitted for blood sucking.

Tabanidae

Squame rather small or vestigial; for the most part seen about flowers; (the occiput convex).

21. Tibiae without spurs or with only a slight spur.
The middle tibiae at least with distinct spurs; second submarginal cell, not wide; fourth posterior cell usually open.

23

22. Wing veins not crowded anteriorly; third antennal joint composed of seven annuli with a terminal style or arista; second submarginal cell widely triangular; fourth posterior cell closed; gigantic, tropical flies. Acanthomeridae

Wing veins crowded anteriorly, the posterior ones often weak; scutellum often spined; no vein on the hind margin of the wing; prefurca arising opposite the base of the small and anteriorly placed discal cell; four or five posterior cells, the fourth rarely if ever closed.

Stratiomyidae

23. Face flat or produced, the facial orbits and cheeks not sutured; eyes of the male not meeting. Xylophagidae

Facial orbits and cheeks separated from the central part; eyes of males meeting. Coenomyiidae
24. Antennae apparently two jointed; with a three-jointed arista; wings, when present, with several stout anterior veins running into the costa and and other weak ones extending obliquely across the wing; hind legs long, their femora compressed; antennae situated low down. Small, hunchbacked, quick running flies. **Phoridae**

Antennae almost invariably with three readily distinguishable joints.

25. Empodia developed pulvilliform.

26. Empodia wanting, vestigial, or linear.

27. Squamae very large; thorax and abdomen flattened inflated; head very small as compared with the greatly hump-backed body; posterior veins not parallel with the hind margin of the wing; antennae variable; eyes of both sexes broadly contiguous.

**Cyrtidae**

Squamae of moderate size or small; Venation intricate, the third and fourth veins often
coalescent for a short distance; head as wide as the depressed thorax; first basal cell very long; usually hairy flies.

**Nemistrinidae**

27. Third longitudinal vein forked; two or more submarginal cells present. 28

Third vein not forked, but one submarginal cell. 35

28. Arista or style of antennae always terminal when present 29

Arista dorsal. **Empididae**

29. Front distinctly hollowed out between the eyes; eyes of males never holoptic; basal cells large; mostly large heavy flies. 30

Front plain or convex; males often holoptic. 31

30. Body without bristles; proboscis with fleshy labella at tip; neuration complex, the fourth vein curves forward to terminate before the tip of the wing, the stalk of the second and third vein short, palpi small or wanting; antennae with a clubbed style. **Mydàidae**

Body with bristles; proboscis
without labella at tip, horny and rigid, suited for sucking, venation normal, fourth vein not curved forward, prefurca long, palpi usually prominent. Mostly large and bristly.

Asilidae

31. Five posterior cells in the wings; basal cell large. 32

Not more than four posterior cells, except in a few bombyliidae.

32. Body, or at least the scutellum bristly; antennae with a very short style; fourth vein terminates before the tip of the wing; eyes separate; male sex organs prominent; palpi broadened at the tip.

Apioceridae

Body usually pilose rather than bristly; fourth vein terminates beyond the tip of the wing; males often holoptic with sex organs small; palpi not broadened at tip.

Therévidae

33. Antennae without a style; fourth vein ending in or before the tip of the wing; proboscis
hidden; three posterior cells, the first narrosed or closed; body bare. Scenopinidae

Third antennal joint usually with a terminal bristle; three or four posterior cells; the fourth vein extends beyond the tip of the wing.

34. Body usually very furry, though rarely quite fragile and bare; Anal cell (usually) narrowly open or closed near border of the wing; a small style usually present.

Bombyliidae

Not furry; anal cell (if present) closed remote from border of wing; discal cell not rarely absent; third vein sometimes forked. Empididae

35. Wings pointed, no cross veins save at base; second basal cell short, second vein ending almost at the tip of the wing; face with oral vibrissae; eyes separate. Lonchopteridae

Wings not pointed.

36. Anal cell elongate, acute, closed toward or near the border of the wing; second basal
cell usually long.

- Anal cell, if present, short, closed remote from the border of the wing, not acutely produced in a narrow, lobe like prolongation.

37. Second basal cell confluent with discal cell, or the discal cell absent; auxiliary vein usually vestigial or indistinct; anal cell often absent.

38. Second basal cell separated by a cross vein from complete discal cell; auxiliary vein anal cell usually complete.

39. For the most part brilliantly colored, predaceous flies; proboscis almost always fleshy; abdomen with 5-6 segments including the large inflexed genitalia of the male; third vein never forked; usually metallic green. Dolochopódidae

- Not brilliantly colored predaceous flies.

39. Eyes sometimes holoptic; head small; the proboscis usually rigid; arista usually terminal; abdomen typically with seven segments, male genitalia never
inflexed, third vein sometimes
forked. Empididae

Eyes never contiguous; proboscis usually not rigid; arista
almost dorsal.

AA. CYCLORRHAPHA.

A frontal lunule above the base of the antennae; third
antennal joint always simple, not annulated or complex, with a
terminal or dorsal arista, rarely with a terminal style; third
vein never furcate; never more than three complete posterior
cells present. Empodia never developed pulvilliform.

40. Anal cell elongate, acute,
usually closed toward the wing
margin, but at least longer than
the second basal cell which is
generally long; frontal suture
rarely distinct. 41

Anal cell, if present short,
closed far from the wing margin,
not acutely produced except rare-
ly with a lobiform prolongation,
second basal cell much shorter
than the third posterior cell
except in the abnormal neuration
of some Pupipara; frontal lunule
and suture almost always distinct;
never more than three posterior
cells; marginal and submarginal
cells never closed; third anten-
nal joint almost always with a
dorsal arista; bristles of body and legs usually distinct. 44
41. Proboscis very rarely elongate; eyes of male usually meeting.

Proboscis elongate and slender, often folding near its middle; face usually with a groove or grooves under the antennae; front broad in both sexes; antennae with terminal style or dorsal arista; no bristles; ovipositor very long. Usually stubby or wasp like flies. Conopidae

42. First posterior cell open, no extra vein between the third and fourth veins; rather small, and dull colored species. 43

Between the third and fourth longitudinal veins and subparallel with them a spurious longitudinal vein; or, when rarely absent, the first posterior cell is closed remote from the border; first posterior cell closed, head never bristly, which are rarely present elsewhere; arista almost always dorsal, rarely a terminal style. Usually bright colored flower flies. Syrphidae
43. Hind metatarsa enlarged and ornamented, especially in the males; males holoptic; arista terminal; head and thorax with bristles. Platypézidae

Hind legs not dilated; arista dorsal; head large composed chiefly of the eyes, the front in the males narrowed or the eyes contiguous; rather large flies. Pipunculidae

44. Head movably separated from the thorax, legs not broadly separated; not ectoparasitic; but rarely producing undeveloped young larvae.

Head small and closely united to the thorax; legs attached to the sides of the body; ectoparasites of vertebrates; producing live young ready to pupate.

(Pupipara) 84

B'. MYODARIA.

Never more than three posterior cells present, the first of which only may be closed or narrowed in the margin; none of the longitudinal veins furcate; marginal and submarginal cells never closed; anal cell very rarely produced toward the margin of the wing. Antennae three-jointed, simple, with a bare, pubescent, pectinate or plumose arista, which is almost always dorsal in position, never thickened into a terminal style. More or less
bristly flies.

45. At least the lower calypter large; posthumeral and intraalar bristles both present; thorax with a complete transverse suture, posterior callosity present; front of male narrow or the eyes meeting, auxiliary vein always distinct, first vein never short. Calypteratae 46

Lower calypter vestigial or wanting; posthumeral bristles present only in some Scatophagidae; thorax without a complete transverse suture, posterior callosity usually absent; a visible membrane connecting the dorsal and ventral segments; front of both sexes of equal width, or if wider in the female, the widening is due to a widening of the middle strip; fourth vein nearly straight, if curved never with an appendage; often very small species. Acalypteratae 56

C. CALYPTERAEE.

Squamae well developed or of moderate size, not vestigial. Auxiliary vein always distinct in its whole course; first longitudinal vein never very short, usually of considerable length. Males often holoptic, or the front in that sex narrowed. Thorax
with complete transverse suture; posterior callosity present. Usually flies of moderate or considerable size, never very small.

46. Mouth opening small, the mouth-parts vestigial or wanting, not functional; vibrissae and bristles not present, no sternopleural bristles. (Botflies) 47

Mouth opening normal, the mouth-parts functional; usually with sternopleural bristles at least.

48

47. No hypopleural bristles or hairs; costa extending to the third vein; first posterior cell very widely open; calypters rather small. Gastrophilidae

Hypopleurae bearing hairs or bristles; costa extending to the fourth vein; first posterior cell closed or narrowed; calypters large. Oestridae

48. Both hypopleural and pteropleural bristles or hairs present in more or less vertical rows; fourth vein bending or curving forward; then three sternopleural bristle usually but one behind. (Tachinoidea) 49

Either the hypopleural bristles or both absent; ventral membrane
usually distinct; when three sternopleural bristles present two behind.

49. Facial plate more or less convexly produced nose-like below the vibrissal angles and fused with the lowest part (epistome); ventral membrane present; abdomen destitute of stout bristles.

Phasiidae

Facial plate flattened, at most slightly produced; ventral membrane not visible; abdomen bearing some stout bristles.

50. Facial plate receding and short, the cheeks very broad, vibrissae located near the middle of the face; antennae short.

Megaprosopidae

Facial plate long and very conspicuously receding, the oral margin more or less prominent, vibrissal angles near the oral margin; antennae usually long.

51. Second segment of the abdomen more or less overlapping the edges of the dorsal segment.

52. Edges of the dorsal segments overlapping all the ventral ones.
52. Hindermost posthumeral bristle located lateral to the presutural bristle; fifth ventral segment of the male with a split hind margin, sometimes strongly developed; usually metallic and with plumose arista. Calliphoridae

Last posthumeral bristle placed in front or inside of the presutural bristle; arista bare or hairy at the base. 53

53. Fifth ventral segment of the male with a straight hind margin, or entirely absent. Sarcophagidae

Fifth ventral segment of the male split to the middle. Rhinophoridae

54. No presutural intraalar bristle; second to fifth ventral segments hidden. antennae usually at or below the middle of the eye, arista usually hairy; legs usually lengthened. Dexiidae

Intraalar usually extending in front of the suture, if not the ventral segments broadly visible or the fifth ventral of the male vestigial; antennae above the middle of the eye, with a bare arista; at least two posthumeral
and three posterior intraalar bristles. Tachinidae

55. Either the hypopleural or pteropleural hairs or bristles present; basal bristles of the abdomen reduced or absent; fourth vein bending or curving forward; fifth posterior cell usually narrowed or closed; arista plumose to the tip. Muscidae

Neither the hypopleural or pteropleural bristles present; abdomen usually bristly; fourth vein usually curved back; arista sometimes bare but variable.

Anthomyiidae

CC. ACALYPTERA.

Squamae small or vestigial. Auxiliary vein often indistinct or vestigial, or closely approximated or fused with the first vein. First longitudinal vein shortened, often very short. Basal cells small, the posterior ones often indistinct or wanting. Males never holoptic, the front in this sex never markedly narrowed. Thorax without complete transverse suture; posterior callosity usually absent. Never large flies, usually small or very small.

56. Auxiliary vein distinctly separate from the first vein and ending in the costa, the first vein usually ending near the middle of the wing; anal cell present.
Auxiliary vein (or vestigial) indistinct, sometimes partly touching the first vein, the first vein usually ending much more before the middle of the wing. 71.

57. Oral vibrissae present; abdomen with more than four visible segments; eyes bare; wings rarely pictured.

58. Oral vibrissae absent.

58. Costa spinose; tibiae with spurs and preapical bristles; not very small flies; postvertical bristles convergent.

Helomyzidae

Costa not spinose, even at the Auxiliary vein; postvertical bristles divergent (or subparallel).

59. Front bristle on sides and and on the vertex.

60. Front never bristly near the antennae; abdomen somewhat elongate and usually narrower at the base; small, black scavenger flies.

Sepsidae

60. Thorax convex, face and cheeks not remarkably bristly.

Mesonotum and scutellum flattened; front, face, and cheeks
bristly; all tibiae spurred and with preapical bristles; last tarsal joint large. Sea shore flies. Phycodromidae

61. Central strip of the front (frontalia) usually well differentiated from the sides (orbits); first vein nearly half the wing length; second basal cell not minute; cross veins not close together; frontal cross-bristles absent. Scotophagidae

Central strip of the front not so; first vein about one third of the wing length; sixth vein short; second basal cell minute; cross veins sometimes close together; post vertical bristles divergent; frontal cross-bristles sometimes present. Somewhat elongate flies. Heteroneuridae

62. First posterior cell closed or narrowed in the margin; abdomen elongate; legs long or very long.

First posterior cell widely open; if narrowed the abdomen is short and the legs are not unusually long and slender.
63. Eyes large and the cheeks and posterior orbits narrow, occiput concave.  

Head more or less globular, the cheeks broad and the face retreating; proboscis short.

**Micropezidae**

64. Proboscis short; ovipositor not elongate, arista dorsal.

**Tanypezidae**

Proboscis greatly elongate and folding near the middle; ovipositor very long; arista terminal.

**Conopidae**

65. First posterior cell widely open, if rarely narrowed the femora are not thickened.  

First posterior cell narrowed; basal cells not very small; all the tibiae with preapical bristle; femora dilated, and usually the hind tibiae enlarged; scutellum usually prominent. Moderate sized, bare, southern or tropical flies.  

**Rhopalomeridae**

66. Hind tibiae with a preapical bristle, apical tibiae bristles present; ovipositor neither flat nor drawn out; usually two frontal-orbital bristles; wings some-
times pictured.

Hind tibiae without preapical bristle, middle tibiae alone with apical bristles; front femora bristly beneath; ovipositor flattened and more or less projecting; postvertical bristles divergent when present; clypeus prominent; wings usually pictured. 69

67. Postvertical bristles divergent when present; second antennal joint without a dorsal bristle; mesopleural and usually sternopleural bristles wanting; front femora not bristly beneath; anal vein reaching the wing-margin. 68

Postvertical bristles convergent; second antennal joint with a dorsal bristle; one or two sternopleural and mesopleural bristle present; lower outer edge of the front femora bearing bristles; anal vein obliterated toward the tip. Lauxaniidae

68. Clypeus well developed; vi-brissal angle very weak; more than two dorso central bristles; sternopleural bristles sometimes present. Dryomyzidae
Clypeus vestigial; not more than two dorso central bristles; rarely a single sternopleural bristle present. Tetanoceridae

69. Fronto-orbital bristles extending to the antennae; the auxiliary vein is evanescent at the tip, where it turns sharply forward at some distance before the tip of the first vein; wings almost always pictured; anal cell angular, or drawn out into a narrow acute lobe; no preapical tibial bristle. Trypetidae

Fronto-orbital bristles confined to the vertex; auxiliary vein not bent at the tip but gently curving.

70. Anal cell usually acute, the anal vein reaching the margin; ovipositor horny, more or less elongate; arista seldom plumose; wings usually pictured; usually two fronto-orbital bristles present above. Ortaliidae

Anal cross vein recurved, the anal cell never acute, anal vein small; only on fronto-orbital bristle. Lonchaeidae
71. Head laterally produced as a process bearing the eye; basal cell confluent with the discal cell; no vibrissae; front femora thickened. Diópsidae

Head not produced at the sides; eyes not stalked. 72

72. First joint of hind tarsi (metatarsus) shorter than the following joint and more or less thickened; second basal cell distinct or not; vibrissae present; front usually bristly; third antennal joint short and rounded; small dull colored species found about excrement, water, or marshes. Borboridae

Hind metatarsus longer than the next joint and slender 73

73. Legs very long and slender, the hind femora slightly swollen apically; head subspherical, the cheeks broad and the face receding; proboscis short; first posterior cell narrowed, the second basal cell complete; arista feathered; no vibrissae; tropical species. Micropézidae

Legs never very elongate; the first posterior cell is rarely
narrow, but disagreeing otherwise with the above.

74. Scutellum elongate, triangular, margined with protuberances; hind tibiae usually dilated; basal cell not very small; first posterior cell narrowed; all tibiae with preapical bristles; ovipositor folding together tele-

scope-like; femora thickened; tropical species. Rhopalomeridae

Flies otherwise.

75. Auxiliary vein becoming weak and abruptly turned forward at tip; anal cell angular or acutely lobed at its posterior distal end; wings almost always pictured. As in 69. Trypetidae

Auxiliary vein not abruptly ending a considerable distance before the end of the first vein; anal cell not acute.

76. Costa microscopically broken twice, just before the humeral cross-vein and at the end of the auxiliary vein (best seen by transmitted light); postvertical bristles convergent; no bristle above the front coxae.

77. Costa not broken near the
humeral cross-vein; mouth opening not wide; arista not feathery.

77. Anal cell wanting and basal cell usually fused with the discal cell; front often bristly; mouth opening usually very large; no oral vibrissae; clypeus large; foremost fronto-orbital bristles diverging; arista feathered, hairy, or bare; rather dull colored to black flies often found about water. **Ephydridae**

Anal cell almost always present; second basal cell usually complete; vibrissae present; mouth opening not large the center of the face convex.

78. Foremost pair of fronto-orbital bristles converging; bristles of the middle of the front less evident; arista loosely pubescent; clypeus small; occiput reaching forward under the eyes. **Milichiidae**

Foremost fronto-orbital bristles proclinate; interfrontal bristles rare; oral vibrissae; arista usually feathered; clypeus large; occiput not forming part of the
cheeks.

Drosophilidae

79. Anal and second basal cell absent; interfrontalia large; postvertical bristles convergent; usually no vibrissae, fronto-orbital or interfrontal bristles.

(Oscinidae) Chloropidae

Anal and basal cells complete.

80. Oral vibrissae present
(sometimes absent in Geomyzidae); costa almost always broken near the end of the first vein.

Oral vibrissae absent; auxiliary vein ending in the costa; clypeus small.

83

81. Postvertical bristles convergent when present; auxiliary vein independently ending in the costa; clypeus large; foremost fronto-orbital bristles directed backward; mesopleural bristles present; cilia of the calypteres loose.

Geomyzidae

Postvertical bristles divergent when present; fringe of the calypteres dense; clypeus small.

82

82. Only the uppermost fronto-orbital bristles present; auxiliary vein ending in the costa;
no mesopleural or prothoracic 

bristles; arista bare. 

Piophilidae

Lower fronto-orbital 
ent; auxiliary vein usually end-
ing in the first vein; mesopleur-
al and one prothoracic bristles 
present; arista closely pubes-
cent. 

Agromyzidae

83. Costa usually entire, at 
most slightly weakened just be-
fore the end of the auxiliary 
vein; basal cells small; post-
vertical bristles convergent; 
arista bare; densely gray dusted 
species, the abdomen usually 
marked with black or brown 
spots. 

Ochthiphilidae

Auxiliary vein more or less 
fused with the first vein; an-
tennae more or less elongate and 
decumbent; anal cell not pro-
duced; postvertical bristles di-
vergent when present; arista 
pubescent; rather slender, usual-
ly shining species with the an-
tennae often very long and hang-
ing downwards. 

Psilidae
Flies parasitic upon warm blooded vertebrates in adult condition. Leathery flies. Larvae born ready for pupation. 85 Wingless flies parasitic upon bats; head folding back upon the dorsum of the thorax. Nycteribiidae

Head sunk into the thorax but not folded back; winged or wingless species; parasitic upon birds or mammals. 86 Antennae reduced; wings with distinct parallel veins and outer cross-veins when present; claws simple; palpi leaf like, projecting in front of the head; almost exclusively parasitic upon bats.

Stéblidae

Palpi forming a sheath for the proboscis; antennae usually more elongate, the joints more or less distinctly separated; head sunk into an emargination of the thorax; wings, when present, with veins crowded more or less anteriorly, the weaker ones running outward and backward; the cross-veins short and approximated
to the base of the wing;
claw large, bidentate or tridentate; palpi not leaf-like
nor protruding in front of the head; tarsal claws strong
and often armed with a series of small teeth. Hippoboscidae
NOTE

The list of species is held for later publication on account of some of the material being undescribed and in the hands of various specialists.
Students beginning the study of Diptera feel the need of a little light upon the many different terms used. Smith's Glossary of Entomology (1906) and N.K. Jardine's Dictionary of Entomology are both very good, but of course they include much more than those terms which apply to the Diptera. Also they are not accessible to many into whose hands this paper may fall. A glossary of dipterous terms from the two above named sources and other has been included here. The terms are thought to be those that are particularly puzzling to students first taking up the Diptera in a taxonomic way.
Glossary.

Acalyptrata: those muscid flies in which alulae are absent or rudimentary.

Acetabulum: the cavity in which an appendage is articulated; especially the coxal cavity - also applied to the cup-like cavity in the sucking mouth of maggots.

Aciculae: prickles, spines.

Acrostichal bristles: two rows of bristles on the middle of the dorsum.

Acuminate: ending in a prolonged point; tapering.

Adnate: growing to be its whole length; adhering together.

Aerostats: a pair of large sacs at base of abdomen of Diptera.

Aileron: alula or squam.

Alae: the wings of insects.

Alula: the alar appendage, a libiform appendage at the base of each wing.

Aleveolate: furnished with cells.

Ambient vein: the term given to the costal nervure or vein when it completely encircles the wing.

Anal: pertaining to the last abdominal segment or to the hind basal angle of the wing.

Anal area: that portion of the wing lying between the anal nervure and the posterior margin.

Anastomosing: running into one another like veins.

Aneus: bright brassy, or golden-green color.

Annulated: incompletely divided into ring-like joints.

Antemedian: applied to leg bristles situated before the middle.
Antennal fovea: a groove or grooves in the middle of the face as though for lodgment of the antennae; bounded on the sides by the facial ridges.

Antennal process: the frontal protuberance upon which the antennae are inserted.

Anterior margin: margin on front side of wing.

Antero-dorsal: applied to leg bristles at the meeting of anterior and dorsal face.

Antero-ventral: applied to leg bristles at the meeting of anterior and ventral face.

Antilata: insects with a sucking mouth.

Apterous: wingless.

Arboreal: living on or among trees.

Arista: a slender style or bristle, chiefly confined to the antennae of Diptera.

Arolium: a terminal pad of the foot between the claws.

Athericerous: aristate.

Auxiliary incision (excision): an incision on the inner margin of wing, near base, which separates the alula from the main part.

Auxiliary vein: in Williston subcosta (Comstock)

Balancers: the poisers or halter of the wings.

Bifurcate: divided into two branches.

Brachycerous: Diptera with short, 3-pointed antennae.

Bucca: mouth cavity.

Calyptrate: those flies that have alulae or membranous scales above the halter.

Callose: furnished with calli.
Callosity: a hard thickening of a portion.
Callus metanti lateralis: the lateral callosity of the metanotum.
Capitulum: the little knob at the tip of halter of Diptera.
Carina: keel.
Cephalic bristles: specialized bristles occurring on the head.
Cereous: wax like.
Chaetotaxy: the science dealing with the arrangement and nomenclature of the bristles.
Cheek: the lateral part of the head just below the eyes.
Cilia: small hairy appendages, often movable.
Cinereus: the blue-gray color of ashes.
Clavate: clubbed or enlarged at tip.
Clypeus: that portion of the head before or below the front, to which the labrum is attached anteriorly.
Contiguous: adjoining; touching; near.
Coriaceous: thick; leather like.
Costal cell: that part of the wing lying between the anterior margin and the costal nervure.
Cruciate: shaped like a cross; applied to the bristles when they cross in direction.
Cyclorrhapha: that section of Diptera in which the adult escapes from the hardened pupal case pushing off a lid or covering.
Decussate: the crossing at an angle.
Dentate: furnished with a tooth or teeth.
Depressed: flattened down vertically; opposed to compressed.
Dichaetae: a group of brachy cerous Diptera with a proboscia consisting of two parts.
Dichoptic: eyes separated by front; not contiguous.
Dorso-alar region:

Dorso-alar region: between the transverse suture and the scutellum on one side and the root of the wing and the dorso-central region on the other side.

Dorso-central bristler: two or four longitudinal rows on the inner part of the dorsum.

Dorso-central region: bounded by two imaginary lines drawn from the scutellar bridge forward, and coinciding with a space free from bristles that exist on the outer side of the dorsal rows and is often occupied by a dorsal thoracis stripe.

Dorso-humeral region: bounded by the anterior end of thorax and transverse suture on two sides and by the dorso-pleural suture and dorso-central region on the two others.

Dorso-pleural suture: the lateral suture between dorsum and pleurum from the humeri through the base of the wing; separates the mesonotum from the pleura.

Empodium: the small process between the pulvilli.

Epistoma (or peristoma): the oral margin and an indefinite space immediately contiguous thereto.

Evanescent: vanishing; passing away.

Exemochaetus: Diptera in which there is a general absence of bristles.

Facial bristles: a series on either side of the middle portion of the face, above the vibrissae along the facilia.

Facialium + ia: that portion of the face between the lower part of the frontal fissure and the antennal foveae.

Facial ridges: the elevated lateral borders of antennal grooves.
Facial tubercle: a median convexity below middle of face.
Ferruginous: rusty brown.
Filiate: antennae that are simple, without lateral hair or dilation: thread like.
Flabs: the lobes at the tip of the dipterous mouth; labella.
Front: the space between the eyes in all dichoptic flies, limited by the upper margin of the head and the line drawn through the root of the antennae, is called the front. It may be wide or narrow, excavated of convex, etc.
Frontal fissure: the impressed line extending from the frontal lumule to the border of the mouth.
Frontal lumule: an oval or crescentic space above the base of antennae in cyclorrhapha, bounded by the frontal suture.
Frontal processes: = antennal process.
Frontal strife: the middle of the front when membraneous or discolored.
Frontal suture: separates the frontal lumule from that part of the head above it.
Frontal triangle: the triangular space in holoptic flies, between the eyes below and the base of the antennae.
Fronto-orbital bristles: in Diptera; are placed on each side of the front, just below the vertical bristles.
Fulcrum: the chitinous envelope at the base of mouth of Diptera (and Hymenopter), covering the beginning of the aesophagus; any structure that serves as a support to another.
Gena: the space between the lower border of the eye and oral margin, merging into face at front and limited by the occipital margin behind.
Glossarium: the labrum-epipharynx.
Hal ters : two small knobbed appendages arising from each side of the thorax.

Haustellate : mouth formed for sucking.

Hexachaetous : Diptera in which the mouth structures have six piercing setae.

Holoptic : whole-eyed; eyes contiguous.

Host : the individual furnishing food to a parasite.

Humeral : relating to the shoulder or humerus.

Humeral angle : the inner front corner of the wing.

Humeral bristles : those situated on the humeral callus.

Hyaline : transparent: water like in hue.

Hypopleuro : the space over the middle and hind coxa.

Hypopygium : the last ventral plate; or the inflexed genetalia.

Hypostoma : that portion of the head included between the antennae, eyes, and mouth.

Incrassate : thickened.

Intra-alar bristles : a row of two or three bristles between the supra-alar and dorso-central groups.

Intra-humeral bristles : occur immediately in front of the thoracis sutures, between the humeral callus and the presutural depression.

Johnston's organ ; a complex nervous structure in the basal joint of dipterous antennae.

Labellum : the lower lip; the sensitive ridgid tip of the mouth structure of certain Diptera.

Lacinia : a mouth part, forms a flat lancet-like piercing structure and is never jointed.

Lateral bristles : situated at or near the lateral margins of the abdominal segments.
Lower fronto-orbital bristles: are on the lower part of front, above the antennae, along the orbits.

Macrochaetae: the long bristles occurring singly on the body of Diptera.

Maggot: term applied to a grub when all traces of limbs have disappeared.

Malleoli: halters.

Marginal bristles: are inserted on the posterior margin of abdominal segments.

Mediproboscis: the middle third of the flexed proboscis of muscid flies.

Mesoplema: the space before the root of the wing between the dorso and sterno pleural suture.

Mesoplemal bristles: are inserted in the angle formed by the dorso-pleural and neso-pleural sutures.

Mesoplema suture: runs from the root of the wings downward and separates the meso-pleura from the pteropleura.

Metanotum: the oval arched portion behind, beneath the scutellum; best developed in flies with long, slender abdomen; e.g. Tipulidae.

Metapleura: a swollen space at the outside of the metanotum, between it, the pteropleura and the hypopleura.

Metapleural bristles: are inserted in the metapleura.

Microchaetae: small bristles, as opposed to macrochaetae, in Diptera.

Mystax: a patch of hair or bristles above the mouth, or the lower part of the hypostoma above the vibrissae.

Necrophagous: living in or on carrion.
Memocerea: Diptera with long, at least six-jointed antennae.
Occipito-orbital bristles: in Diptera; situated on posterior orbit of eye.
Occiput: in Diptera, the whole posterior surface of the head.
Ocellas' bristles: are situated close to the ocelli, usually directed forward; often absent.
Ocellar triangle: a triangle, indicated by grooves or depressions, on which the ocelli are situated.
Ocelli: simple eyes.
Ocelligerous: supplied with, or bearing ocelli.
Oligonema: having few wing veins; specifically applied in Diptera to Cecidomyids.
Omaloptera: the pupifarous flies.
Onychium, ia: small processes between the tarsal claws in many Diptera.
Orbit: an imaginary border around the eye; in Diptera the orbits are divided into vertical or superior; frontal and facial or anteria; of the cheek or inferior; occipital or posterior.
Orthorsapha: that section of Diptera in which the pupa escapes from the dorsal skin through a T-shaped opening on the back; see cyclorrhapha.
Paraderm: the limiting membrane enclosing the pronymph of Muscidae.
Pectus: the ventral portion of thorax; in Diptera is the inferior surface of the thorax between the legs.
Pencil: a little elongated brush of hair; in Diptera applied to a group of sensory hairs on the flagellum of the antennae.
Peristoma - ium: the border of the mouth or oral margin in Diptera; used as epistoma.
Phytophagous: feeding on plants.

Pile: a hairy or fur-like covering; in Diptera, applied to thick, fine, short, erect hair, growing a surface appearance like velvet.

Pollen: a dusty or pruinose surface covering which is easily rubbed off; used mostly in Diptera.

Post-alar callosities: rounded processes at the posterior lateral margin of the dorsum in Diptera.

Post-alar callus: in Diptera, a rounded swelling between the root of the wing and the scutellum.

Posterior intercalary: in Diptera, is one of the anal veins.

Post-humeral bristles: in Diptera, are usually two, inserted above the dorso pleural suture between the humeral callus and root of wing, on the bottom of the presutural depression.

Post-sutural bristles: in Diptera, dorsal bristles behind transverse suture.

Post-vertical cephalic bristles: in Diptera, are in the middle of upper part of occiput.

Pre-alar callus: a small swelling or projection before the root of wings, just back of outer ends of transverse suture, in Diptera.

Pre-furca: "The stem vein in front of a fork, that reaches back to where itself forks from another vein", in Diptera.

Pre-scutellar bristles: in Diptera, are in a transverse row in front of the scutellum.

Pre-scutellar rows: in Diptera, short rows of small bristles in front of the scutellum.
Posterior callosity: a swelling between the root of the wings and the scutellum.

Poised: halters.

Predatory: capturing living prey.

Prefurca: the petiole of the second and third veins of Diptera.

Pre-sutural bristles: in Diptera, in a trigonate depression at outer ends of transverse suture, near dorso-pleural suture.

Promuscis: rostrum; proboscis.

Propleural bristles: in Diptera, are situated immediately above the front coxa prothoracis bristles.

Pruinose: referring to a dusty or pollen covered surface.

Pseudo-trachea: the rigid and ridged grooves on the labella of Diptera, by means of which they scrape their food.

Pteropleura: in Diptera, are situated below the base of the wings behind the meso-pleural suture.

Ptilinum: in Diptera, cyclorrhapha, an inflatable organ capable of being thrust out through a frontal suture just above the root of antennae.

Pulvillus: a pair of pads beneath the tarsal claws.

Puparium: in Diptera, the thickened larval skin within which the pupa is formed.

Pupipara: series of Diptera, in which the females do not extrude the young until they have reached the stage ready to pupate.

Quiescent: not active; applied to the pupae in forms with complete metamorphosis.

Reclinate: directed backwards.
Reniform: having the form or shape of a kidney.

Salivary pump: applied to the chitinous, cup like structure at the base of the labial stylets of piercing Diptera; e.g. mosquitoes.

Scalpellus: a lancet-like piercing structure, as in some Diptera.

Scutellar bridge: in Diptera, a small ridge on either side of the scutellum, connecting it with the mesonotum.

Scutellum: a somewhat triangular or crescent shaped piece posterior upon the mesonotum.

Sessile: broadly attached - not stalked.

Setula: a small stiff bristle or seta; in Diptera, the small thorn at the end of the sub-costa.

Sinuous: S-shaped, winding back and forth.

Spurious veins: certain folds or thickenings in the wing surface which resemble a vein so nearly as to be readily mistaken and sufficiently constant to be useful in classification.

Squama: a small scale above the halters in Diptera, in this order Packard uses squama for the lobed scale and restricts alula to the lobe-like appendage. O.S. uses squama for the posterior scale alone and antisquama for the anteria.

Sternopleura: the lower part of the pleura, below the sternopleural suture and above the front coxa.

Stigma: breathing pore; a colored spot near the tip of the auxiliary vein.

Style: a bristle like appendage often found upon the antennae.

Stylo trachealis: with a long tube bearing a stigma, from the head case; as in the pupae of some Diptera.
Sub-clypeal pump: in some Diptera, the enlarged, more or less bulb-like structure at the anterior entrance of the oesophagus.

Sulcate: grooved or furrowed.

Supra-alar bristles: in Diptera, are situated, one on the post-alar callus, one on the alar frenum, the third on the edge of the supra-alar depression.

Supra-alar groove: in Diptera, a groove on the meso-thorax just above the root of the wings.

Tegulae: wrongly used for alulæ.

Tentoria: two hollow, cylindrical stripes which pass from the ventral border of the occipital foramen to the cheeks.

Tetrachaetae: applied to those Diptera in which the mouth structures consists of four longitudinal blades or piercing structures.

Thoracic dorsal bristles: the specialized bristles on the dorsum of the thorax.

Tomentum: a form of pubescence composed of matted, wooly hair; in Diptera, applied to a covering of short flattened, more or less recumbent, scale like hairs which merges gradually into dust or pollen.

Transverse suture: a transverse groove extending inwards from the root of wing and obsolete in the middle of the dorsum.

Trichostical bristles: fan-like row, situated on the meta-pleura; conspicuous in some families.

Tubulus: the slender, flexible abdominal segments forming the ovipositor Diptera.
Tympanic spiracle: the thoracic spiracle at base of wing.

Types.

The following type nomenclature is adopted from the usage and suggestions of various taxonomists of all groups, and is believed by Myron H. Sweck to be adequate for all occasions in entomological systematic work where a refined type nomenclature is desirable.

Type: a single specimen forming the basis of a description, either a unique or one selected from a series (holotype).

Allotype: a single specimen of the sex not represented by the type, and upon which the description of this secondly described sex is based, either a unique or one selected from a series.

Cotype: a specimen of the original series forming the basis of a description where no type has been selected (syntype).

Lectotype: a specimen of a cotypic series chosen after publication to take the place of a type as the standard of reference.

Paratype: a specimen of the original series forming the basis of a description remaining after a type or lectotype has been selected.

Neotype: a specimen, preferably from the original type locality, identified with a described and named species and selected to take the place of a type which has been lost or destroyed, as the standard for that species (proxytype).

Topotype: a specimen from the same exact locality as the type
of a described species, and identified with that species by any taxonomist;

Metatype: a specimen, preferably a topotype, identified as identical after comparison with the type, allotype or lectotype by the original describer of the species;

Homotype: a specimen, preferably a topotype, identified as identical after comparison with the type, allotype or lectotype by a taxonomist other than the original describer of the species;

Antotype: a specimen, a topotype or not, determined by the original describer of a species in illustration of it without having actually compared it with the type, allotype or lectotype.

Some taxonomists do not use the type, but rather the term para type and write their description from the whole series so as to include the individual variations of the various specimens.

Uncus: the curved hook directed downward from the triangular dorsal plate in the male and shielding the penis: the genital hamule.

Vertex: the upper flattened portion of the front near the margin of the occiput.

Vertical cephalic bristles: are two pairs, inner and outer, inserted more or less behind the upper and inner corner of the eye; erect, or the inner pair convergent, the outer pair divergent.

Vertical margin: the limit between front and occiput.

Vertical triangle: in male Diptera, the small triangle upon which
the ocelli are situated; limited behind by vertex, in front by eyes.

Vertical: one of the whorls of long fine sensitive hair arranged symmetrically on the joints of the antennae in certain Diptera.

Verticillate: furnished with whorls of loose hairs.

Vibrissae: a pair of bristles above the mouth at the lower end of the facial ridges.

Viviparous: bringing forth living young, not egg laying.

Vocal cords: specialized organ on the thoracic spiracles of some Diptera, by means of which they produce a humming or singing sound.

Wing cells: the areae; the closed spaces between the wing veins.
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