LIBRARY
OF THE
UNIVERSITY
OF ILLINOIS

570.5
ILL

V.18
cop. 2

NATURAL
HISTORY

JAN 31 1951

The person charging this material is responsible for its return to the library from which it was withdrawn on or before the **Latest Date** stamped below.

Theft, mutilation, and underlining of books are reasons for disciplinary action and may result in dismissal from the University.

UNIVERSITY OF ILLINOIS LIBRARY AT URBANA-CHAMPAIGN

JUN 11 1974

JUN 14 1974

MAR 21 1984

L161—O-1096

ILLINOIS BIOLOGICAL MONOGRAPHS

VOLUME XVIII

PUBLISHED BY THE UNIVERSITY OF ILLINOIS
URBANA, ILLINOIS

EDITORIAL COMMITTEE

JOHN THEODORE BUCHHOLZ

FRED WILBUR TANNER

HARLEY JONES VAN CLEAVE

570.5
ILL
v. 18
cop. 2

TABLE OF CONTENTS

- No. 1. Generic Relationships of the Dolichopodidae (Diptera) Based on a Study of the Mouth Parts. By SISTER MARY BERTHA CREGAN, R.S.M.
- No. 2. Studies on *Gregarina blattarum* with Particular Reference to the Chromosome Cycle. By VICTOR SPRAGUE.
- No. 3. Territorial and Mating Behavior of the House Wren. By S. CHARLES KENDEIGH.
- No. 4. The Morphology, Taxonomy, and Bionomics of the Nemertean Genus *Carcinonemertes*. By ARTHUR GROVER HUMES.

Digitized by the Internet Archive
in 2011 with funding from
University of Illinois Urbana-Champaign

ILLINOIS BIOLOGICAL MONOGRAPHS

Vol. XVIII

No. 1

PUBLISHED BY THE UNIVERSITY OF ILLINOIS
UNDER THE AUSPICES OF THE GRADUATE SCHOOL
URBANA, ILLINOIS

EDITORIAL COMMITTEE

JOHN THEODORE BUCHHOLZ
FRED WILBUR TANNER
HARLEY JONES VAN CLEAVE

GENERIC RELATIONSHIPS OF THE
DOLICHOPODIDAE (DIPTERA)
BASED ON A STUDY OF THE MOUTH PARTS

WITH THIRTY PLATES

BY
SISTER MARY BERTHA CREGAN, R.S.M.

CONTRIBUTION FROM THE ENTOMOLOGICAL LABORATORIES OF THE
UNIVERSITY OF ILLINOIS
No. 214

THE UNIVERSITY OF ILLINOIS PRESS
URBANA
1941

CONTENTS

Acknowledgments	6
Introduction	7
Materials	8
Methods of Procedure	9
Family Characteristics, Habitats, and Food Habits	10
Subfamilies of the Dolichopodidae	14
Classification of Aldrich (1905)	14
Classification of Lundbeck (1912)	15
Classification of Becker (1922)	15
Classification of Curran (1934)	17
Mouth Parts of the Dolichopodidae	17
Langhoffer's Study	17
Other Studies	18
Lateral Aspects of the Entire Mouth Parts	20
Clypeolabral-Pharyngeal Region	21
Epipharyngeal Armature	22
Hypopharynx	24
Labium	25
Pseudotracheae	27
Relationship of the Genera Based on the Present Study	29
Summary	31
Bibliography	33
Plates	37
Index to Genera	68

ACKNOWLEDGMENTS

THE WRITER wishes to express gratitude to Professor W. P. Hayes, for his interest and guidance in the preparation of this work. She also wishes to thank the following gentlemen, for specimens received: Dr. R. E. Snodgrass and Dr. C. F. W. Muesebeck, of the United States Bureau of Entomology and Plant Quarantine; Dr. C. H. Curran, of the American Museum of Natural History; Dr. F. C. Harmston, of Utah State Agricultural College; and Mr. B. Berger, a graduate student in the Department of Entomology, University of Illinois.

Thanks are also due to Mr. A. S. Windsor, General Biological Supply House, Chicago, without whose help many specimens would not have been available.

INTRODUCTION

A REVIEW of the literature on the mouth parts of Diptera shows that exhaustive morphological studies have been made on only a few species such as that on *Culex* by Dimmock (1881, 1882) and on the proboscis of *Musca* by Kraepelin (1882, 1883). Comparative studies of the mouth parts of many genera and families are presented by Menzbier (1880), Langhoffer (1901), Becher (1882), Meinert (1882), Smith (1890), Kellogg (1899), Wesché (1904), Peterson (1916), and Frey (1921). So far as the family Dolichopodidae is concerned (with the exception of Langhoffer's work, 1901), only scattered references to the study of the mouth parts are to be found in Becher (1882), Smith (1890), Wesché (1904), Lundbeck (1912), Snodgrass (1922), and Williams (1939).

Interest in Langhoffer's grouping (1901) of the Dolichopodidae on the basis of mouth parts, and the work of Snodgrass (1922) on the mouth parts of *Melanderia mandibulata* Aldr. prompted this investigation. The writer was curious to ascertain if the groupings of the American genera on the basis of mouth parts would conform to those of Langhoffer.

According to previous investigators, Loew (1864), Packard (1870), Kleine (1907), Williston (1908), Lundbeck (1912), Howard, Dyar, and Knab (1912), Malloch (1917), Lutz (1918), Aldrich (1922), Comstock (1924), Imms (1934), Curran (1934), Snodgrass (1935), Tillyard (1936), and Williams (1938), all adult Dolichopodidae are predaceous. The trophi, therefore, are not only able to seize the prey, but also to hold and to grind it. The masticated food is then transferred to the mouth aperture, which is located between the bases of the labrum and the hypopharynx. A pharyngeal sack (Figs. 192, 193), lying on the inner wall of the pharynx and connected with the mouth aperture, conveys the food to the oesophagus.

In order to reach a correct interpretation of the structure of the mouth parts, each part, regardless of the systematic position of the various genera accorded by previous workers, was carefully studied, and then compared with other similar parts. On the basis of the comparative study of all the parts the type groupings described below were established.

The adult feeding mechanism of the dipterous family Dolichopodidae forms a compact group of structures projecting downward from the clypeopharyngeal region of the head. Some of these parts are retracted, and they require preparation and dissection before their structures can be observed. Four different types of mouth parts were found to occur in the family. These I have termed: (1) the labralate, or Diaphorus, type; (2) the epipharyngeal two-prong,¹ or Medeterus, type; (3) the

¹Snodgrass (1922, p. 149) uses the word *prong* in describing *Melanderia mandibulata* Aldr.

epipharyngeal four-prong, or Melanderia, type; and (4) the epipharyngeal plate,² or Dolichopus, type.

All types are made up of the labrum, with a strongly developed epipharyngeal armature³ and an apodeme, hypopharynx, paired maxillary palpi, and a labium, which bears a pair of labella at its distal end. On each labellum five or six radiating pseudotracheae are present.

The terms applied to the various parts are those commonly used in entomological literature. Regarding the terms of the labrum, the nomenclature of Snodgrass has been followed. The drawings are all freehand sketches and mostly made under high dry or oil immersion lenses. An attempt has been made not only to show the characteristic features involved in the isolated part, but also to show the relation of all the parts to one another.

MATERIALS

CURRAN (1934) in his "North American Diptera" lists sixty-two genera in the family Dolichopodidae; of these, thirty-two have been secured by the writer and dissected for the investigation. The males and females of many species have been observed. The following representatives of the various genera have been studied; those from which drawings have been made are indicated by an asterisk.

Aphrosylus praedator Wheel., female* (Figs. 14, 39, 71, 98, 142a, 142b, 173)

Argyra albicans Lw., female* (Figs. 29, 54, 86, 113, 158, 189)

Campsicnemus nigripes V.D., female and male* (Figs. 15, 52, 84, 111, 143, 174)

Campsicnemus thersites Wheel., male

Chrysotus choricus Wheel., male* (Figs. 16, 34, 66, 105, 144, 175)

Chrysotus obliquus Lw., female

Condylostylus sipho Say, female* (Figs. 1, 45, 77, 97, 129, 160)

Diaphorus leucostomus Lw., male* (Figs. 17, 33, 65, 103, 145, 176)

Diostracus prasinus Lw., male and female* (Figs. 9, 43, 75, 121, 137, 168)

Dolichopus bifractus Lw., male

Dolichopus consanguineus Wheel., female

Dolichopus cuprinus Wied., female and male

Dolichopus longipennis Lw., female

Dolichopus plumipes Scop., female

Dolichopus ramifer Lw., male and female* (Figs. 27, 64, 96, 115, 155, 186, 191, 192)

Dolichopus scapularis Lw., male and female

Dolichopus vittatus Lw., female

Gymnopternus barbatulus Lw., male* (Figs. 10, 62, 94, 122, 138, 169)

Hydrophorus aestuum Lw., male and female

Hydrophorus sodalis Wheel., male and female* (Figs. 13, 51, 83, 128a, 128b, 141, 172)

Hygrocleuthus consanguineus Wheel., female and male* (Figs. 28, 63, 95, 116, 156, 187)

Hypocharassus pruinosus Wheel., male and female* (Figs. 8, 49, 81, 118, 136, 167)

Laxina calcarata Lw., female and male* (Figs. 2, 44, 76, 101, 130, 161)

Laxina patibulatus Say, female and male

²Langhoffer (1901, p. 843) uses the word *platta*.

³Snodgrass (1935, p. 317), in *Principles of Insect Morphology*, states: "The posterior surface of the dipterous labrum is smooth and presents no structure of any kind to be specifically termed an epipharynx. The writer sees no reason for following the usual custom of calling the elongated labral lobe of Diptera a labrum-epipharynx."

- Liancalus hydrophilus* Aldr., female and male
Liancalus similis Aldr., male* (Figs. 23, 53, 85a, 85b, 114, 151, 182)
Medeterus aldrichi Wheel., male* (Figs. 6, 37, 69, 110a, 110b, 134, 165)
Medeterus vittatus V. D., male and female
Melanderia mandibulata Aldr., male* (Figs. 32, 50, 82, 119, 159a, 159b, 190)
Mesorhaga sp., female* (Figs. 31, 47, 79, 125)
Millardia intentus Aldr., male and female* (Figs. 12, 41, 73, 126, 140, 171)
Neurigona carbonifer Lw., male and female* (Figs. 18, 36, 68, 100, 146, 177)
Neurigona pectoralis Lw., female and male
Neurigona rubella Lw., female and male
Pelastoneurus vagans Lw., male and female* (Figs. 24, 60, 92, 123, 152, 183)
Peloropecodes acuticornis V. D., female and male* (Figs. 20, 55, 87, 117, 148, 179)
Plagioneurus univittatus Lw., male and female* (Figs. 19, 58, 90, 112, 147, 178)
Rhaphium effilatus Wheel., female and male* (Figs. 7, 35, 67, 102, 135, 166)
Scellus exustus Walk., male
Scellus filiferus Lw., male and female* (Figs. 26, 40, 72, 127, 154, 185, 193)
Scellus monstrosus O. S., male and female
Sciapus scintillans Lw., male and female* (Figs. 4, 46, 78, 124, 132, 163)
Sympycnus frontalis Lw., female
Sympycnus lineatus Lw., male* (Figs. 22, 61, 93, 106, 150, 181)
Syntormon cinereiventris Lw., female and male* (Figs. 21, 59, 91, 104, 149, 180)
Tachytrechus angustipennis Lw., male and female* (Figs. 25, 57, 89, 109, 153, 184)
Teuchophorus spinigerellus Zett., female* (Figs. 30, 56, 88, 107, 157, 188)
Thinophilus ochrifacies V. D., female and male* (Figs. 11, 48, 80, 120, 139, 170)
Thrypticus willistoni Wheel., female and male* (Figs. 5, 38, 70, 108, 133, 164)
Xanthochlorus helvinus Lw., female* (Figs. 3, 42, 74, 99, 131, 162)

METHODS OF PROCEDURE

DRIED, pinned specimens were used for study. In order to make the investigation as comprehensive as possible, one or more of the representative species of each genus were used. Males and females were examined; but the mouth parts of only one sex in each species are figured since there are no great sexual differences in the mouth parts.

After each specimen was properly labeled, the head was removed and placed on a piece of cotton, which was plugged into a three-inch piece of glass tubing, resembling a small vial. When the desired number of vials had been prepared, they were placed, cotton end downward, in a beaker which contained a ten per cent solution of potassium hydroxide. After the solution had arisen in each vial, and each head was properly enveloped, the other end of the vial was also plugged. This precaution was taken to prevent the entrance of foreign matter. The specimens were left in the solution for twenty-four hours. The vials were then transferred to another beaker and washed in three or four changes of distilled water, in order to remove the potassium hydroxide. Each head was then transferred by means of a camel's hair brush to a deep-welled culture, or hanging drop, microscope slide. Dehydration was carried on in 30, 50, and 75 per cent alcohol. The mouth parts were dissected from the head in 75 per cent alcohol and further dehydrated in 85 per cent, 95 per cent,

and absolute alcohol. The specimens were then cleared in xylol and mounted in glycerine. When the study of the toto mouth parts had been completed, the individual mouth parts were then dissected in glycerine under a binocular microscope. The parts were placed separately on regular microscope slides and again mounted in glycerine. The parts were then studied with the aid of a compound research microscope. Some structures were so minute that high-power dry lenses, and often oil-immersion lenses, had to be used.

FAMILY CHARACTERISTICS, HABITATS, AND FOOD HABITS

THE FAMILY Dolichopodidae is one of the higher families of the Brachycera series of the suborder Orthorrhapha. They are tiny, attractive, slender flies having hemispherical, elongated heads, generally wider in the female than in the male. The eyes are large, hairy, and more or less oval in shape, and in the living specimens they are a metallic green, with reddish or purplish reflexes. The three-segmented antennae are inserted near to each other, above the middle of the eyes. The third segment of the antennae is sometimes elongated in the male. A dorsal or apical arista is also present. The maxillary palpi are flat and are unsegmented. They are usually bristled and generally rest on the protruding mouth structures. The flies are iridescent green or blue-green in color. Some species, however, are brown, yellow, and sometimes black. The brisk, restless, little creatures have legs that are much longer than is usual in the families belonging to the series. Hence the name Dolichopodidae (long-footed) is applied to the family.

The venation of the wing is so peculiar that it in itself is sufficient to distinguish the Dolichopodidae from their nearest allies. The absence of a cross vein between the discal cell and the second basal cell is very evident. Cells M and 1st M_2 are therefore not separated, but united to form one large single cell. The anal cell is short, the sixth vein is also short or absent, and the fourth vein is usually straight or gently curved. The characteristic venation is sufficient to distinguish the family.

Sexual dimorphism is quite pronounced in this group of flies. Secondary sexual characteristics of the male occur in the tarsi, tibiae, femora, wing apex, in the third joint of antennae, arista, and palpi. The hypopygium may be large, or small and concealed. The males are therefore easily distinguished. According to Curran (1934, p. 216), the females are often difficult to name, as they present less striking characteristics than the males. Lutz (1918, p. 252) states that the number of described species of Dolichopodidae is increasing rapidly, and the end is not yet in sight.

The members of this family are commonly distributed. They are

generally found in the neighborhood of water. Miall (1934) tells us that "the naturalist, in search of aquatic insects, cannot fail to find them almost daily and hourly, sometimes in swarms, sometimes singly. They come to rest on the grasses, herbs, or bushes near to water, on stones in the beds of streams, or even on the surface of the water itself. Some rival the pond-skaters (Gerridae, Hemiptera) in the agility with which they dart to and fro upon the surface of rapid streams; others hover incessantly in the spray of waterfalls."

Several genera of this brilliantly colored, raptorial group haunt the surf and breakers of the seashore. *Hydrophorus*, "the water skater" (Williams, 1939, p. 307), is found in maritime marshes bestraddling the water of muddy shallows or exploring the oozy ground of their vicinity. It propels itself entirely by strong simultaneous strokes of its far-spreading middle legs. The name *Hydrophorus* was bestowed upon these insects, because of the ability of many of the species to run, even upon agitated water (Loew, 1864, p. 211). *Thinophilus* (Schiner, 1862), *Melanderia* (Aldrich, 1922), and *Hypocharassus* (Williston, 1908) live principally along the shores of the sea. The small, shiny, species of *Sympycnus* are also seashore lovers. *Syntormon* (Parent, 1938) may be found on the wet rocks of brackish waters. The gregarious species of *Aphrosylus* are seen flitting about in the spray of the breakers, among seaweed. The name of this genus has reference to the habit of these species of pursuing their prey along the shores of a surging sea (Loew, 1864, p. 148).

The beautiful, silvery species of *Argyra* establish themselves in the vicinity of fresh water brooks. The females are often found resting on leaves. The name of this genus has reference to the beautiful, silvery luster of most of the species (Loew, 1864, p. 124). The lively species of *Tachytrechus* are found often resting on the boards of dams, near clear, sandy brooks (Schiner, 1862). The name of the genus, meaning "I run," has reference to the habit of many species of running along sandy and muddy banks (Loew, 1864, p. 110).

The terrestrial individuals of Dolichopodidae may be found on tree trunks, meadow-grass, leaves of shrubs, damp localities, and rocks. *Sciapus*, *Neurigona*, and *Medeterus* are found on tree trunks. *Diaphorus* may be found on the leaves of shrubbery in company with the agile little species of *Chrysotus*. The name of the genus *Chrysotus* has reference to the gold-green color of many species (Loew, p. 172). *Scellus* is collected by beating about the grass of low meadows (Aldrich, 1907). *Plagioneurus* is collected in similar places (Wheeler, 1899). The beautiful, yellow genus *Xanthochlorus* is found in damp places on high vegetation, and on low shrubs (Schiner, 1862). *Gymnopternus* is found, with the oldest and largest genus, *Dolichopus*, in damp places, on banks of brooks, and near water puddles. *Liancalus* prefers the rocks in cold, wet

places (Williston, 1908). *Rhaphium* is found on the leaves of plants of forest rivulets (Schiner, 1862).

The species of *Campsicnemus* are widely distributed. Many occur on paths and on the leaf-littered forest floor; others walk or skate upon the surface of puddles, and others still are found on the leaves of plants, where they may be exposed to sunlight. In humid regions small numbers patronize the stems of bananas (Williams, 1938). The name of this genus was given because the males of many species are distinguished by the peculiar curvature of the middle tibiae (Loew, p. 193).

This large family of carnivorous flies, as adults, prey on other insects. According to Comstock (1924) the flies prey upon weaker insects. Miall (1934) says at least one species of *Dolichopodidae* preys upon certain species of *Podura*, and it is probable that many flies, freshly hatched from a variety of aquatic pupae, fall victims to these swift and destructive enemies. Lutz (1918) maintains that the adults are all predaceous, capturing chiefly the minute, soft-bodied flies. Packard (1870) describes the flies as predatory on other insects. Aldrich (1922) states they capture the smaller, weaker flies, and in their favorite haunts at the edge of the water they pick up small chironomid and other dipterous larvae, as well as oligochaete worms.

Williams (1938) states that *Collembola* seem to be the chief food of *Campsicnemus funipennis* Parent, which also feed on drosophilids attracted to decaying bananas. Gründberg (1910) described the flies as robbers on small insects.

Howard, Dyar, and Knab (1912) say that Dr. Paul Osterhout, of Panama, has observed flies of the family *Dolichopodidae*, well known for their predaceous habits, attacking mosquito larvae. They quote the following from his letter to the Surgeon General of Public Health and Marine Hospital Service: "A short time ago, in passing through the outskirts of the town, I saw a large swarm of small flies seemingly very much occupied about a small pool of water standing in a wagon track (the track had been undisturbed for several days from the appearance), so I stopped to see what the commotion was about and I saw hundreds of these flies and thousands of mosquito larvae. I remained for some time watching the commotion and saw several of the flies catch the larvae and drag them to the dry earth and devour them."

DeLeon (1935), speaking of *Medeterus aldrichi*, says: "Many miscellaneous records mention the finding of larvae and pupae under bark of trees and the observing of adults feeding on some smaller insects . . . *Medeterus aldrichi* is the most important predator of the mountain pine beetle (*Dendroctonus monticolae* Hopk.) infesting lodgepole and western white pine. It probably destroys 40% - 50% of the brood of this beetle."

Bishop and Hart (1931, p. 152) make the following statement: "In a small gravel pool which derived its water by seepage or overflow from an

adjacent hay meadow, mosquito larvae were extremely abundant. While collecting in this pool our attention was caught by a number of small, metallic-green flies that drifted lightly over the surface of the water or ran rapidly from one resting place to another. On the surface of the pool, the flies were observed to turn first in one direction then another without discernible movement of the legs or wings though the turns seemed well directed and often placed them in position above a mosquito larva or pupa at the surface film. Such movements on the part of flies often cause a precipitous retreat of all the larvae in the vicinity but seldom quickly enough to prevent one of their number being seized and hoisted squirming above the surface. Usually the captive was devoured on the spot, but at times carried away bodily to some convenient perch. After observing the capture of larvae in the field, a number of flies were confined with larvae and pupae in a cheesecloth covered jar partially filled with water. Here the hunting operation could be observed at short range and we saw several captures. The fly in captivity either glided over the surface or suddenly pounced down upon a larva and continued in its flight to a resting place, the mouth parts of the fly alone being involved in seizing the larvae . . . . 93 larvae were devoured in seven days by two small flies . . . . The flies captured while feeding on the surface of the pool were determined for us by Dr. O. A. Johannsen, of Cornell University, as *Dolichopus renidescens*, *Dolichopus nigricauda*, and *Dolichopus walkeri*."

Doane (1907, p. 139), describing the food habits of *Scellus virago* found on the glistening, white, thinly-encrusted salt area bordering San Francisco bay, states: "In its running about it would come close enough to one of the little Agromyzids (*Rhinoessa parvula* Lw.), that were quite abundant here, pounce upon it and suck its blood. The unfortunate little fly is held and manipulated by the forelegs of its captor, and after being turned over a few times, evidently in order that the blood may be sucked from different parts, the empty skin is dropped to the ground and blown about by the wind, while the vampire goes in search of another morsel."

Williams (1938), describing the food of *Hydrophorus*, makes the following comment: "It seems that this inhabitant of the sun-beaten lowlands requires occasional refreshment for it will stoop or teeter so as to bring the mouth down to moisture, while food may be wetted in the same manner. No doubt the fly eats many kinds of small organisms floating on water, and it is very fond of 'bloodworms' (the larva of the mosquito-like midge *Chironomus hawaiiensis* Grims) . . . . The bloodworms and flies into which they develop were abundant in and about these shallows. A wandering *Hydrophorus* fly seized with her tongue-like organ, or labella, a bloodworm that, despite its comparatively large size and vigorous struggles, was hoisted clear out of water and soon quieted.

A little later, a second *Hydrophorus* stooped down and grasped a blood-worm extricating it from the mud with a final heave. In one of these cases the fly laid hold of the victim with a foreleg—in the laboratory both forelegs were frequently employed to hold small wounded flies.”

The writer observed some specimens of *Dolichopus ramifer* Lw., while in captivity in an environment where they had plenty of food, extract tiny annelids from the damp soil. These squirming morsels were held by means of the labella. The fore tibiae aided in holding when the worms became too active. The annelids disappeared in a very short time. They evidently had been all consumed since no remains were visible.

SUBFAMILIES OF THE DOLICHOPODIDAE

THE GENERA of this family have been grouped into subfamilies by various authors:

Classification of Aldrich.—The American genera have been grouped by Aldrich (1905) into the following twelve subfamilies. In a note at the beginning of his work, he says: “The arrangement in subfamilies, much of the synonymy, and some notes, are the result of my own study of the family, which has been a favorite with me for fourteen years.”

I. AGONOSOMINAE Psilopodinus Agonosoma Mesorhaga Leptorhethum	VI. XANTHOCHLORINAE Achalculus Chrysotimus Xanthochlorus Xanthina
II. DIAPHORINAE Diaphorus Asyndetus Chrysotus Eutarsus Teuchophorus Campsicnemus	VII. THINOPHILINAE Thinophilus Diostracus Hypocharassus Phylarchus
III. RHAPHIINAE Argyra Leucostola Porphyrops Rhaphium Nematoproctus Syntormon	VIII. MEDETERINAE Medeterus Peloropecodes Thrypticus Coeloglutus
IV. SYMPYCNINAE Parasyntormon Sympycnus Nothosympycnus Anepsiomyia	IX. HYDROPHORINAE Hydrophorus Scellus Liancalus
V. NEURIGONINAE Neurigona	X. PLAGIONEURINAE Plagioneurus
	XI. APHROSYLINAE Aphrosylus

XII. DOLICHOPINAE

Dolichopus	Polymedon
Gymnopternus	Sarcionus
Hercostomus	Pelastoneurus
Paraclius	Leptocorypha
Tachytrechus	Orthochile

Classification of Lundbeck.—The classification of Aldrich has been criticized by Lundbeck (1912), who follows the subfamily divisions of Kertész (1909). Why he does so is suggested in his remarks which follow: "The subdivisions of family of Dolichopodidae in subfamilies is at present not satisfactory, at all events with regard to the palaearctic fauna. In the Kat. paläarkt. Dipt. the family is divided into four subfamilies. With regard to the American fauna Aldrich (A Cat. of North Am. Dipt., Smiths. Misc. Coll. XLVI, 1905) has divided the family into not less than twelve subfamilies; these are, I think, good and natural, but the author has given no diagnosis of them. As I have only examined the Danish genera and species more closely, I have thought more advisable at present to keep the subfamilies given in the Kat. paläarkt. Dipt., though I am well aware, that some of them are no doubt somewhat heterogeneous. I have only made few alterations . . . I have placed Thrypticus and Acropsilus . . . in the Hydrophorinae, the former near Medeterus, the latter near Thinophilus and Schoenophilus. The experienced Dipterologist, Mr. T. Becker in Liegnitz, to whom I am indebted for many valuable hints, works at present with the Dolichopodidae, and we may hope soon to have from his hand a new and more satisfactory arrangement of the family in subfamilies."

Classification of Becker.—For the purpose of comparison with the arrangements previously made and with those worked out in the present study, Becker's (1922) classification of the genera in nearctic and neotropical regions is given:

I. DOLICHOPODINAE

Dolichopus Latr.
 Hygroceleuthus Lw.
 Hercostomus Lw.
 Paraclius Big.
 Pelastoneurus Lw.
 Sarcionus Aldr.
 Stenopygium Becker
 Tachytrechus Walk.
 Polymedon O. S.
 Macellocerus Mik.
 Psilichium Becker
 Sybistroma Meig.
 Leptocorypha Aldr.
 Gonioneurum Becker

II. PLAGIONEURINAE

Plagioneurus Lw.

III. HYDROPHORINAE

Hydrophorus Fall.
 Scellus Lw.
 Liancalus Lw.
 Thinophilus Walk.
 Diostracus Lw.
 Hypocharassus Mik.
 Syntomoneurum Becker
 Phylarchus Aldr.
 Peodes Lw.

IV. APHROSYLINAE

Paraphrosylus Becker

V. MEDETERINAE

Medeterus Fisch.
 Thrypticus Gerst.

VI. RHAPHIINAE Rhaphium Meig. Porphyrops Meig. Xiphandrium Lw. Syntormon Lw. Eutarsus Lw. Achalcus Lw. Peloroepodes Wheel. Systemus Lw. VII. NEURIGONINAE Neurigona Rond. VIII. DIAPHORINAE Diaphorus Meig. Lyroneurus Lw. Chrysotus Meig. Coeloglutis Aldr. Asyndetus Lw. Argyra Meig. Leucostola Lw. Achradocera Becker Symbolia Becker Xanthina Aldr.	IX. STOLIDOSOMINAE Stolidosoma Becker X. CAMPSICNEMINAE Campsicnemus Halid. Sympycnus Lw. Subsympycnus Becker Hyptiochaeta Becker Calyxochaetus Big. Chrysotimus Lw. Xanthochlorus Lw. Anepsiomyia Bezzi. Teuchophorus Lw. XI. CHRYSOSOMATINAE Condyllostylus Big. Megistostylus Big. Mesorhaga Schin. Leptorhethum Aldr. Sciapus Zell. XII. Genus <i>incertae sedis</i> Anchineura Thoms.

This arrangement by Becker is based mostly on the following external characters and shows that the mouth parts have been given no consideration:

Dolichopodinae.—The first joint of the antennae is pubescent on the dorsal surface.

Plagioneurinae.—The hypopygium lies completely imbedded in the sixth abdominal segment. The shape and arrangements of the organs of the hypopygium are remarkable and find no analogy in this family.

Hydrophorinae.—No special characteristics are given by Becker, but this statement is translated from his work: "Of our palearctic genera we can name four which America shares with us: Hydrophorus, Scellus, Thinophilus, and Liancalus. Besides, America has three genera which do not occur with us: Diostracus (Lw.), Hypocharassus (Mik.), and Syntomoneurum n. genus. Also are listed: Phylarchus (Aldr.), a new genus placed in the Thinophilinae by Aldrich, and Peodes (Lw.), which is mentioned by Bigot; furthermore, Peloroepodes (Wheel.) is found in Kertész' catalogue with the Hydrophorinae, in Aldrich's catalogue with the Medeterinae. I can place this latter genus only with the Rhaphiinae."

Aphrosylinae.—The palearctic species have almost a totally bare thorax on which stand only four pairs of dorsal medial bristles; the coxae have short thorn-like bristles, and the trochanters carry two strong, diverging bristles. The antennae of the American species are quite small. Those of the male are much smaller than those of the female.

Medeterinae.—No characteristics are given, but Becker states that the only American genera in this subfamily are Medeterus and Thrypticus.

Rhaphiinae.—According to Becker this group is represented in the palearctic zone by ten different genera; but at the present time the American fauna has fewer genera. Besides our three main genera, Rhaphium, Porphyrops, and Syntormon, only Xiphandrium and Achalcus and perhaps Peloroepodes are to be included here.

Neurigoninae.—No characteristic is given for this group and only one genus, Neurigona, is placed in it.

Diaphorinae.—*Diaphorus* (Meig.), *Chrysotus* (Meig.), *Asyndetus* (Lw.), *Argyra* (Macq.), and *Leucostola* (Lw.) occur in North America. *Lyroneurus* (Lw.), and the two new genera, *Achradocera* and *Symbolia*, are established in South America. No characteristics were given.

Campsicneminae.—Thirteen genera of this group are recognized in the palearctic region, while only eight genera are found in the nearctic and neotropical regions. These are: *Sympycnus* (Lw.), *Chrysotimus* (Lw.), *Anepsiomyia* (Bezzi), *Teuchophorus* (Lw.), *Subsympycnus* (Beck.), *Hyptiochaeta* (Beck.), and *Calyxochaetus* (Big.). The dominating genus is decidedly *Sympycnus*.

Chrysosomatinae.—Five different genera belong here. The dominating genus is *Condylostylus*. It has a dorsal antennal bristle. In most species the wings show two diagonal stripes connected on the front margin. *Sciapus* has a very limited number of species and is very similar to *Condylostylus*. The genus *Leptorhethum*, established by Aldrich (1893), is closely related to *Sciopus* and differs only through a narrower head and a less deepened frons. A fourth genus, *Mesorhaga*, was introduced by Schiner in 1862. The members of this genus have the third antennal joint drawn out in the shape of a cone without any visible separation from the long, apical, antennal bristle.

Classification of Curran.—The family Dolichopodidae is called by Curran (1934) "Dolichopidae" and "long-headed flies." He does not group the genera into subfamilies and recognizes sixty-two American genera. He comments: "The American species were revised by Becker but so many new forms have been described since that this work will furnish only a basis for the study of the family."

MOUTH PARTS OF THE DOLICHOPODIDAE

AMONG the previous studies of the mouth parts of this family, the work of Langhoffer (1901) deserves first consideration because he proposed a grouping of the genera which prepared the way for the present study.

Langhoffer's Study.—The importance of the mouth parts as diagnostic characters in a natural arrangement of the genera of the Dolichopodidae was first indicated by Langhoffer in 1901 when he proposed the four following groups:

First Group (Type *Hydrophorus*). Here are classified forms in which two long hooks or tusk-like prongs project beneath the labrum (Langhoffer, Fig. 1, p. 843). The following genera are placed in this group: *Medeterus* Zitt., *Hydrophorus* Fall., *Liancalus* L., *Tachytrechus* Walk., *Psilopus* F., *Thinophilus* Zitt., *Aphrosylus* Lw., *Campsicnemus* Fill., *Machaerium* Lw., *Xanthochlorus* W., *Sympycnus* Meig., *Chrysotus* Meig., *Argyra* F.

Second Group (Type *Dolichopus*). The epipharyngeal armature is less strongly chitinized than in the first group, and it is a light-brown color under the microscope. It consists of two longitudinal denticulated plates, which are placed under the labrum and end in tooth-like structures (Langhoffer, Fig. 2, p. 843). Here are grouped: *Dolichopus* Deg., *Gymnop-*

ternus Fill., Syntormon F., Hygroceleuthus Hal., Teuchophorus Kow., Diaphorus Meig.

Third Group (Type Porphyrops). The epipharyngeal armature in this group is long, narrow, and richly set with tooth-like bristles (Langhoffer, Fig. 3, p. 844). It is very much weaker than in the first two groups. Only one genus is put in this group: Porphyrops Lw.

Fourth Group (Type Orthochile). All the mouth parts of this group are long and narrow, even the maxillary palpi. Under the labrum are narrow, weak "mandibles," rounded at their distal ends. There are no tooth-like bristles, only here and there a few small setae (Langhoffer, Fig. 4, page 844). Two genera are placed in this group: Neurigona Rond. and Orthochile Lw.

Other Studies.—The mouth parts of this family have also been studied to some extent by the following investigators: Becher (1882), Smith (1890), Wesché (1904), Lundbeck (1912), Snodgrass (1922), and Williams (1939). Their findings will be reviewed here before the present writer's observations are presented.

Becher (1882, p. 148) described the mouth parts as follows: The proboscis is short and strong, and projects only slightly out of the oral cavity; but the distal parts can be moved against each other, as in other families. The maxillae appear to be absent, and only the palpi seem to exist. These are oval in form, with a long bristle at the tip. They rest on the proboscis. The labrum does not serve here, as elsewhere, as a covering of the upper parts, but it is a true chewing apparatus. In consequence of its great movement, and its form, it is used in the grinding of food. This can be observed in the living animal. Since the Dolichopodidae actually chew their food—small insects—the labrum is in constant action. A short dagger-like stylet lies under the labrum. It is broad at its proximal end, where the duct of the salivary glands opens into it. The labium consists of a medianly divided mentum and the lateral chitinous rods (stipes) of the upper plate. These rods go to the labella. The labella are capable of movement one upon the other. In this way they crush the insects that get between them. The effect of this grinding power is increased because the inner lips carry five or six radiating, grinding panels. In *Medeterus* the proboscis is thicker than in *Dolichopus*. The form is similar to *Dolichopus*. The species of *Orthochile* have a long *Empis*-like proboscis. Becher shows a lateral view of the entire mouth parts of *Dolichopus aeneus* Deg. in his Plate III, Fig. 16. In this same plate, Fig. 15a is a lateral view of the hypopharynx of *Medeterus* sp., and Fig. 15b is a cephalic view of the same structure.

Smith (1890, p. 344) recorded the following: "Some specimens of a *Dolichopid* prepared for examination proved failures, owing to the lack of differentiation in the mounted material, and only a very unique char-

acter of the galear envelope was noted. Instead of pseudo-trachea, or the wrinkled structures often representing it, we find here a series of geminate tubercles decreasing in size from the margin and ending in the membrane. I have not seen this appearance in any other species, and could not study more than the one species of the family from the lack of material." His one figure (p. 335) pictures only four pseudotracheae in a Dolichopid.

Wesché (1904, pp. 28-47) divided the Diptera into eight groups. He placed the family Dolichopodidae in the fourth group because of the following characteristics: The mandibles are fused into the labium; all parts of the maxillae, except the stipes and cardines, are aborted; the palpi present are labial; the tracheae of the paraglossa (labella) are only moderately developed. Furthermore concerning the mouth parts of this family, he made the following statements:

"The mouth parts of the Dolichopodidae possess one feature which separates them from all other families in Diptera: the tracheae on the paraglossa are of the most curious description. Under high powers, each one of them appears to be made up of a number of sub-rectangular semi-transparent cells, which decrease in size as the tracheae approaches the edge of the labellum; at its extremity is a very short, blunt hair inserted in a minute cylinder. In *Medeterus truncorum* Mg., it has another appearance, rather granular and less differentiated. In most genera of this family the cardines of the maxillae are very anteriorly placed—the points on which the palpi are usually situated (close to the base of the labrum) are quite at the extremity of the paraglossae, and have feathered processes at the extremities, which are probably the remains of the maxillary palpi. The mentum has a central rod, which ends in a point between the paraglossae; this rod has a median suture, and is homologous with the paired rods found in *Bibio*, and the ventral apodeme in *Tipula*, and represents the mandibles. This character is found in several families, and marks them off from the Muscidae, where the mandibles are on the dorsal side of the labium. The labrum is elaborately toothed and haired, and covers a powerful hypopharynx, with a deep channel, connected with a suctorial trachea, the true pharynx. The palpi are single-jointed, with a few long hairs, but with no central sense-organs such as is seen in the second joint of *Bibio* and of most Nemocera.

"One interesting specialization is found in *Orthochile nigrocerula* Ltr., which has an elongated labium, a totally different arrangement of the cardines, and a general similarity to the mouth parts in the Muscidae. This lengthening of the labium probably enables the insect to reach the nectaries of flowers; most of the other species are raptorial, haunt marshy spots, and feed on minute insects and Gastropods."

Wesché's Plate VI, Figs. 9, 10, 11, 12, 13, and 14, show labrum, hypopharynx, labium, and paraglossa of *Dolichopus griseipennis* Stan.,

in ventral aspect. The pseudotracheae and labial palpi are in dorsal aspect. The trophi of *Orthochile* Mg. are shown in his Plate VII, Fig. 1.

Lundbeck (1912) gives general descriptions of the proboscis, hypopharynx, and maxillary palpi of *Tachytrechus*, *Argyra*, *Rhaphium*, *Xanthochlorus*, *Medeterus*, *Dolichopus*, *Thinophilus*, and *Neurigona*. He does not figure these mouth parts.

Snodgrass (1922, pp. 148-152), in describing the mouth parts of *Melanderia mandibulata* Aldr., points out that the labella have a very unusual development. Each labellum possesses a movable lobe, the terminal part of which is thick, strongly sclerotized, and produced into a large tooth-like structure. These structures are turned inwardly toward each other and give the appearance of mandibles. He says, "*Melanderia* possesses, besides its pseudo-mandibles, other mouth structures of interest which, however, are not visible externally. There are four great prongs depending from the epipharynx, in addition to the usual hypopharynx, which is a strongly developed, decurved appendage projecting from the lower lip of the mouth within the anterior enclosure of the labium." Six drawings of the different aspects of these structures are figured in his Plate XIV, p. 151. In his *Principles of Insect Morphology* (1935, p. 315), Snodgrass also states, "The only truly, biting flies are certain species of Dolichopodidae in which the terminal lobes of the labium are strongly sclerotized and jaw-like in form and action."

Williams (1938) does not discuss the mouth parts of the Dolichopodidae but illustrates the head of *Campsicnemus*. His Fig. 18 is a lateral aspect of the head, with labella removed. In this figure he calls the epipharyngeal prongs "maxillae" and "mandibles" respectively. The hairy membrane cephalad of the prongs, and projecting downward, is termed a "labrum-epipharynx." The region proximad of the "labrum-epipharynx" is called the clypeus.

Lateral Aspects of the Entire Mouth Parts.—The lateral aspects of the entire feeding mechanism of the different genera of Dolichopodidae studied by the writer (Figs. 1 to 33) present the same general gross features as stated above, with the exception of *Melanderia mandibulata* Aldr. (Fig. 32), already described above by Snodgrass. Typically this mechanism is composed of a large, sclerotized, clypeolabral-pharyngeal region, and a labium. The proximal ridges of the pharynx (Fig. 1, *ph*) are deeply invaginated and end in two projections, the cornuae (Fig. 1, *cu*). The clypeus (Fig. 1, *c*), anterior to and fused with the pharynx, is always pubescent. The labrum (Fig. 1, *l*), distad of the clypeus, is usually rounded. It sometimes possesses a membranous flap-like projection as in *Laxina* (Fig. 44). The maxillary palpi (Fig. 1, *mx.p*, and Fig. 191), are oval in shape. The exact point of insertion is difficult to determine because at one time they seem attached to the clypeolabral region, and at another,

to the labium. They lie on a membranous region between labium and the clypeolabral region (Fig. 191). The hypopharynx (Fig. 1, *hyp*), caudad of the pharynx, has a large salivary bulb (Fig. 1, *s.b*) at its proximal end. The salivary duct (Fig. 1, *s.d*) extends from this bulb to the apex of the hypopharynx. The labium (Fig. 1, *la*) is located caudo-ventrad of the hypopharynx. It is composed of a proximal sclerotized area, the theca (Fig. 1, *t*), and two semimembranous, pilose labella (Fig. 1, *lab*). Pseudo-tracheae (Fig. 1, *ps*) are generally present in each labellum.

Clypeolabral-Pharyngeal Region.—The clypeolabral-pharyngeal region (Figs. 33-65) consists of clypeus (Fig. 33, *c*), labrum (Fig. 33, *l*), pharynx (Fig. 33, *ph*), epipharyngeal armature (Fig. 33, *ep.a*), an apodeme (Fig. 33, *ap*), and a hypopharynx (Fig. 33, *hyp*). In *Diaphorus* (Fig. 33) the labrum is semitubular and very much elongated. The cornuae are also long. The apodeme is very slender. The salivary bulb at the proximal end of the hypopharynx is rather large. *Chrysotus* (Fig. 34) has this region similar to that of *Diaphorus*, but the cornuae are wider. In *Rhaphium* (Fig. 35) the apodeme is absent, but there is a sclerotized projection extending from the caudal region of the clypeus to the labrum. The hypopharynx is as long as the epipharyngeal prongs. The labrum is not as long as in *Diaphorus* (Fig. 33), and the cornuae are truncate. The cornuae of *Neurigona* (Fig. 36) are very small and pointed. The labrum is short and the apodeme broad. The hypopharynx is much longer than the prongs.

The clypeolabral-pharyngeal regions of *Medeterus* (Fig. 37) and *Thrypticus* (Fig. 38) differ from the former genera because the prongs are longer and stronger. Both genera have long apodemes and are quite similar, but the prongs and hypopharynx of *Thrypticus* are at right angles to the pharynx. *Aphrosylus* (Fig. 39) has a more compact clypeolabral-pharyngeal region than the preceding genera. The apodeme is very wide, and does not extend beyond the clypeopharyngeal ridges. The hypopharynx is quite long and has a distinct salivary duct leading to the apex. The clypeolabral-pharyngeal regions in *Scellus* (Fig. 40) and in *Millardia* (Fig. 41) are very much alike. The cornuae of both are large and high. The apodemes are very wide and their proximal ends are far beyond the clypeopharyngeal ridges. The hypopharynx in each is longer than the epipharyngeal prongs. *Scellus* has a truncate and piliferous labrum. The cornuae of *Xanthochlorus* (Fig. 42) are truncate. The apodeme is not broad. Each epipharyngeal prong has a lateral tooth-like structure. In *Diostracus* (Fig. 43) the prongs have developed a lateral projection to the labrum. The cornuae are rounded. The labrum is longer than that of *Xanthochlorus*.

Four connected epipharyngeal prongs have developed in *Laxina* (Fig. 44). The labrum has a long, membranous hairy flap at the distal

end. The apodeme is very short and the hypopharynx long. The arrangement of these structures in *Condylostylus* (Fig. 45) is like that of *Laxina*, but the apodeme is small. In *Sciapus* (Fig. 46) and *Mesorhaga* (Fig. 47) there is also an arrangement similar to *Laxina*, but in *Sciapus* the labrum shows a sclerotized prolongation. The anterior pair of prongs in *Thinoophilus* (Fig. 48) have broken up into two pairs of tooth-like structures, which are fused with the labrum by a prolongation from the anterior pair. The apodeme is broad and extends far beyond the clypeopharyngeal ridges. The posterior region of the epipharyngeal armature of *Hypocharassus* (Fig. 49) has developed into a pair of prongs. The anterior region has become a very efficient lacerating implement. This region has also a pair of prongs, to which is attached broad plate-like processes, possessing a series of small teeth and denticulated edges. The apodeme is broad. *Melanderia* (Fig. 50) has a not very well differentiated labral region; but it has four well-developed prongs in separable pairs pending from the epipharyngeal area. The hypopharynx is prominent and very long. The apodeme is large and flat. The epipharyngeal arrangement in *Hydrophorus* (Fig. 51) and in *Campsicnemus* (Fig. 52) is very similar. The apodemes are very large and rounded at their proximal end. The hypopharynx of the former genus shows a lateral, wing-like flap near the distal end. The anterior, epipharyngeal prongs in *Liancalus* (Fig. 53) end in two blade-like structures in the labral membrane. The hypopharynx is narrow and very long. The proximal regions of the prongs of *Argyra* (Fig. 54) and of *Peloropecodes* (Fig. 55) are plate-like. The clypeopharyngeal region of the latter is wider than that of the former. In *Teuchophorus* (Fig. 56) the hypopharynx is very long, the apodeme is narrow, and the cornuae are truncate. *Tachytrechus* (Fig. 57) has wide cornuae. The apodeme is broad. The epipharyngeal structures are more plate-like than in the preceding genera. *Plagioneurus* (Fig. 58), except for the small cornuae, has a similarly constructed region. The epipharyngeal armature of *Syntormon* (Fig. 59) consists of denticulated plates. The hypopharynx is very long. *Pelastoneurus* (Fig. 60) has a very compact clypeopharyngeal region. The labrum is truncate, and the hypopharynx is very long. In *Sympycnus* (Fig. 61) the labrum is more pointed than in *Pelastoneurus*. The hypopharynx is long and the apodeme short. In *Gymnopternus* (Fig. 62) the hypopharynx is more rounded at the apex than that of *Sympycnus* (Fig. 61). *Hygroceleuthus* (Fig. 63) has a longer hypopharynx than either *Gymnopternus* or *Sympycnus*. *Dolichopus* (Fig. 64) has a larger apodeme than *Hygroceleuthus*, and the hypopharynx is also longer.

Epipharyngeal Armature.—The epipharyngeal armature of the Dolichopids (Figs. 65-97) shows modifications in its development. There are present six different forms, which the writer describes as: (1) labrum

elongated with two short prongs, (2) labrum not elongated with two longer prongs, (3) four connected epipharyngeal prongs, (4) four disconnected epipharyngeal prongs, (5) labrum plate-like with four connected prongs, and (6) labrum plate-like with two prongs. The elongated labrum is found in *Diaphorus* (Fig. 65) and *Chrysotus* (Fig. 66). In both genera the short tooth-like prongs are fused with the elongated labrum. *Rhaphium* (Fig. 67), *Neurigona* (Fig. 68), *Medeterus* (Fig. 69), *Thrypticus* (Fig. 70), *Aphrosylus* (Fig. 71), *Scellus* (Fig. 72), *Millardia* (Fig. 73), *Xanthochlorus* (Fig. 74), and *Diostracus* (Fig. 75) make up the two-pronged type with a short labrum. The prongs in *Rhaphium* seem to clasp the labrum. Those of *Neurigona* are very slender and delicate. In *Medeterus* and *Thrypticus* they are long, strong, undenticulated prongs. In *Aphrosylus*, *Scellus*, and *Millardia* the prongs are denticulated. The prongs of *Xanthochlorus* are decidedly denticulated along the right margin, and there is one prominent tooth-like structure on the left margin of each prong. *Diostracus* has prongs similar to those of *Xanthochlorus*.

In the group with four connected prongs are placed *Laxina* (Fig. 76), *Condylostylus* (Fig. 77), *Sciapus* (Fig. 78), *Mesorhaga* (Fig. 79), and *Thinophilus* (Fig. 80). The prongs in *Laxina*, *Condylostylus*, *Sciapus*, and *Mesorhaga* are very similar. In all four genera, the posterior pair of prongs is about twice as long as the anterior pair. *Mesorhaga* has a projecting structure on each one of the anterior pair of prongs, which is connected with the labrum. The anterior prongs of *Thinophilus* form a denticular prolongation to the labrum. *Hypocharassus* (Fig. 81) and *Melanderia* (Fig. 82) belong to the type with four disconnected prongs. *Hypocharassus* (Fig. 81) has four acuminate, denticulated prongs carried on one basal plate. The anterior pair consists of plate-like structures, having a series of small teeth. *Melanderia* has four tusk-like prongs, carried on two basal plates. No denticulation is present on the prongs.

In the group with four connected prongs and a plate-like labrum are placed *Hydrophorus* (Fig. 83), *Campsicnemus* (Fig. 84), *Liancalus* (Figs. 85a and 85b), *Argyra* (Fig. 86), *Peloropecodes* (Fig. 87), and *Teuchophorus* (Fig. 88). In *Hydrophorus* the posterior pair of prongs is broad and denticulated, while the anterior pair is short and fused with the labrum. The posterior pair of prongs of *Campsicnemus* is long and denticulated. The anterior pair has a dentate outer edge on each plate. They are fused with the labrum for some distance and end in two short prongs. The posterior pair of prongs of *Liancalus* is similar to *Campsicnemus*, but the anterior pair ends in two blade-like structures (Fig. 85b) in a hairy membrane which encloses a denticulated area. The prongs of *Argyra* are almost similar to those of *Liancalus*, but they are more plate-like. The anterior prongs are dentate along the outer edges and are fused

with the labrum. Peloropeodes and Teuchophorus have a more plate-like armature than the preceding genera. The posterior prongs are still pronounced, but the anterior pair is fused with the labrum.

The group with a plate-like labrum and two prongs is represented by Tachytrechus (Fig. 89), Plagioneurus (Fig. 90), Syntormon (Fig. 91), Pelastoneurus (Fig. 92), Sympycnus (Fig. 93), Gymnopternus (Fig. 94), Hygroceleuthus (Fig. 95), and Dolichopus (Fig. 96). In Tachytrechus the plates are dentate on the anterior edges, and both posterior corners are dentiform. Plagioneurus resembles Tachytrechus, but the anterior margins of the plates are not so dentate. The plates of Sympycnus, Gymnopternus, Hygroceleuthus, and Dolichopus possess a series of small teeth on their outer surfaces.

Hypopharynx.—The long, tapering hypopharynx of the Dolichopodidae (Fig. 97) is distad of the pharynx and projects between the lobes of the labella. At its proximal end there is a large salivary bulb (Fig. 97, *s.b*), in the center of which is a dark spot, which seems to be connected with the salivary duct. This duct (Fig. 97, *s.d*) extends the length of the hypopharynx to the apex and seems to parallel a hairy cavity. The shape of the hypopharynx shows a gradual transition from a simple lanceolate type, through a series of triangular, conoidal, sub-quadrately triangular, turbinate, sub-triangular, and pentagonal types.

The lanceolate group is represented by Condyllostylus (Fig. 97), Aphrosylus (Fig. 98), Xanthochlorus (Fig. 99), Neurigona (Fig. 100), Laxina (Fig. 101), and Rhaphium (Fig. 102). In Condyllostylus the hypopharynx has a distinct salivary duct leading to the apex. It is very narrow. In Aphrosylus we see a similar condition. The hypopharynx of Xanthochlorus is oval at the proximal end, but tapers to a definite point at the distal end. The ventral surface is more modified than that of the preceding genera, and the salivary duct is not so distinct. Neurigona has a hypopharynx that is oval at its proximal end and gradually pointed at its distal end. That of Laxina is similar to Neurigona at its proximal end, but its distal end is abruptly pointed. The salivary duct is also more distinct. Rhaphium has a distinctly wider hypopharynx than any of the preceding genera.

The triangular type of hypopharynx is found in Diaphorus (Fig. 103), Syntormon (Fig. 104), Chrysotus (Fig. 105), Sympycnus (Fig. 106), Teuchophorus (Fig. 107), Thrypticus (Fig. 108), Tachytrechus (Fig. 109), and Medeterus (Fig. 110). In Diaphorus and Syntormon the hypopharyngae are similar, but Syntormon lacks the hairs at the distal end. The hypopharynx of Chrysotus is not so long as that of Diaphorus and Syntormon, and its ventral surface is more complicated. Teuchophorus has a more triangular hypopharynx than Syntormon. The distal end is also more pointed. In Thrypticus the proximal end of the hypopharynx is similar to Teuchophorus, but the apex area is acuminate and curved.

Tachytrechus has a hypopharynx having a general likeness to *Thrypticus*, but the distal end is not so narrowly curved.

The conoidal type of hypopharynx is found in *Campsicnemus* (Fig. 111), *Plagioneurus* (Fig. 112), *Argyra* (Fig. 113), *Liancalus* (Fig. 114), *Dolichopus* (Fig. 115), *Hygroceleuthus* (Fig. 116), *Peloro-peodes* (Fig. 117), and *Hypocharassus* (Fig. 118). *Campsicnemus* and *Plagioneurus* have similar hypopharyngae, but that of the latter tapers more abruptly toward the distal end. The hypopharynx of *Argyra* is very broad at the proximal end, then becomes suddenly attenuated to an elongated apex. In *Liancalus* and *Dolichopus* the hypopharyngae are narrower at the proximal end than the hypopharynx of the *Argyra*. Their ventral surfaces are also more modified. *Hygroceleuthus* and *Peloro-peodes* have the proximal ends and the ventral surfaces of their hypopharyngae more specialized than *Dolichopus*. The hypopharynx of *Hypocharassus* is very broad at its proximal end and then suddenly narrows to an elongate, triangular area. The ventral surface is more intricate than any of the preceding genera.

Melanderia (Fig. 119), *Thinophilus* (Fig. 120), and *Diostracus* (Fig. 121) have sub-quadrately triangular hypopharyngae. Those of *Melanderia* and *Thinophilus* are similar, but that of *Thinophilus* is longer. In *Diostracus* the hypopharynx is more pronouncedly sub-quadrately, more suddenly attenuated, and more sharply pointed at the distal end than that of *Melanderia* and *Thinophilus*.

The turbinate type of hypopharynx is found in *Gymnopternus* (Fig. 122) and *Pelastoneurus* (Fig. 123). Both of these genera have hypopharyngae that are very broad at the base, short, and very pointed at the apex.

The sub-triangular type of hypopharynx occurs in *Sciapus* (Fig. 124), *Mesorhaga* (Fig. 125), *Millardia* (Fig. 126), and *Scellus* (Fig. 127). These structures are rather narrow at the base and have a short tube-like apex. The hypopharynx of *Millardia* has hairs at the distal end.

A pentagonal hypopharynx is found in *Hydrophorus* (Fig. 128a). This appearance is perhaps due to the fact that there is a wing-like flap near the apex (Fig. 128b).

Labium.—The labium (Figs. 129-160) is the only part of the trophi of the Dolichopodidae usually seen on external examination of the mouth parts. With the exception of *Melanderia* (Fig. 159), this structure is regularly an elongated, bilaterally symmetrical appendage ending in two oval lobes, known as labella (Fig. 129, *lab*). The membrane (Fig. 129, *m*) investing the oral and distal surfaces of each labellum contains many sensory hairs (Fig. 129, *sh*), which are perhaps tactile in function. Sometimes the external covering of each labellum is strengthened by thin, sclerotized plates (Fig. 130, *sc.p*). Two lateral rods (Fig. 129, *l.r*.)

extend from the pseudotracheal region of each labellum along the sides of the theca. There are no labial palpi. Those figured in the drawings are maxillary palpi. The internal walls of the labella, which are normally in contact with one another, are transversed by pseudotracheae (Fig. 129, *ps*). Rudiments of the glossae (Fig. 129, *g*) are sometimes quite evident. The proximal end of the labium is known as the theca (Fig. 129, *t*). This region is shield-shaped and usually ends proximally in two long projections. Sense hairs are scattered throughout its dorsal surface.

The labium of *Condylostylus* (Fig. 129) has ribbon-like pseudotracheae. Four blade-like structures, with numerous sense organs, extend from the theca and end in the labellar membrane. In *Laxina* (Fig. 130) the glossal region forms two pairs of hairy palps. The theca is more bristled than that of *Condylostylus*. The theca in *Xanthochlorus* (Fig. 131) has a large bristle on each side. The whole labium is very pilose. *Sciapus* (Fig. 132) has a labium similar to *Laxina*, except that the glossal region is not so evident. The labium of *Thrypticus* (Fig. 133) is very elongated and narrow. In *Medeterus* (Fig. 134) the labium is larger than in *Thrypticus*. *Rhaphium* (Fig. 135) has a labium whose parts are rather difficult to interpret. The theca is small and has a series of bristles. The labella seem to form a canopy from which three or four denticulated pairs of plates descend. The pseudotracheae are peculiar and will be discussed later. In *Hypocharassus* (Fig. 136) the labium has an ear-shaped sense organ on each labellum. The boundary of the theca was rather difficult to determine. The labia of *Diostracus* (Fig. 137), *Gymnopternus* (Fig. 138), and *Thinophilus* (Fig. 139) are quite similar to *Hypocharassus*. In *Millardia* (Fig. 140) and *Hydrophorus* (Fig. 141), the theca and labella are distinct. A row of bristles appears at the distal end of the theca. Two views of the labium of *Aphrosylus* are figured (Figs. 142a, 142b). The cephalic view (Fig. 142b) shows two serrate plates with sense organs proximad of the pseudotracheae. The caudal aspect (Fig. 142a) shows hairy lobes proximad of the pseudotracheae. The labium of *Campsicnemus* (Fig. 143) is very pilose. The labella are short and broad. A bar-like structure is found at the proximal end of the theca of *Chrysotus* (Fig. 144). The labellar lobes seem to be three-folded. The glossal region is very hairy. *Diaphorus* (Fig. 145) has a pair of denticulated lobes in the region of the glossae. The labium of *Neurigona* (Fig. 146) appears to be tubular. It is rather difficult to define the boundaries of the theca and labella. *Plagioneurus* (Fig. 147) and *Peloro-peodes* (Fig. 148) have labia similar to *Campsicnemus*. The theca of *Syntormon* (Fig. 149) is sub-quadrate. The membranous areas of the labella of *Sympycnus* (Fig. 150) are larger than those of *Peloro-peodes*, and the glossae are represented by a pair of pilose lobes. The glossal

region of Liancalus (Fig. 151) is also very hairy. Pelastoneurus (Fig. 152) has finger-like structures in each labellum, and the bristles on the theca are crowded at the center of the distal end. Tachytrechus (Fig. 153) has a structure which may be the glossae at the proximal end of the theca, between the labella. Scellus (Fig. 154) has two long projections at the proximal end of the theca, and the lobes of the labella are broad and oval. The labella of Dolichopus (Fig. 155) and Hygroceleuthus (Fig. 156) are broad and very hairy. The theca and labella of Teuchophorus (Fig. 157) are equal in size. Argyra (Fig. 158) has a very large labium. Its theca is greatly indented at the proximal end and has two long proximal processes. The labium of Mesorhaga was broken in dissection and could not be studied. The labium of Melanderia (Fig. 159) has already been described.

Pseudotracheae.—There are two kinds of pseudotracheae present in the labella of this family—those with ribbon-like panels and those with sclerotized panels. Becher (1882, p. 148) first termed these pseudotracheae "Reibleisten," which I have translated "grinding panels." The panels radiate from a small sclerotized area and end pointedly in the membrane. There is a central groove in each ribbon-like panel.

Five ribbon-like panels are found in Condyllostylus (Fig. 160), and six ribbon-like panels occur in Laxina (Fig. 161), Xanthochlorus (Fig. 162), Sciapus (Fig. 163), Thrypticus (Fig. 164), Medeterus (Fig. 165), and Rhaphium (Fig. 166).

In Laxina (Fig. 161) sense organs are present between panels 2 and 3, 4 and 5, 5 and 6. Xanthochlorus (Fig. 162) has six tubulous pseudotracheae, which end rather bluntly in the membrane. The ribbons have sense organs on their apical ends. Sense organs also occur near the base of panels 1, 2, 4, 5, and 6. The central grooves of the panels are similar to Sciapus. In Medeterus (Fig. 165) the ribbons of the pseudotracheae are also tubulous, with sense pegs at the apical end of each panel. Sense organs are present between panels 1 and 2, 3 and 4, 5 and 6. The central groove of each panel is almost closed, and its edges are asperous. Sciapus (Fig. 163) has pseudotracheae almost like Xanthochlorus, but the sense organs at the proximal ends are between panels 2 and 3, 4 and 5. The central groove is very wide in some parts of the ribbons. The sclerotized area from which the panels arise is longer and wider than in Thrypticus.

The pseudotracheae with sclerotized panels are always six in number but vary in three ways: some genera (Figs. 167 and 168) are irregularly sclerotized; one genus (Fig. 169) has unpaired sclerotized areas; most others (Figs. 170 to 189) have paired (geminat), sclerotized, sub-rectangular areas.

Irregular sclerotized wrinklins, as well as sclerotized sub-rectangular areas, are found in the panels of the pseudotracheae of Hypocharassus

(Fig. 167) and Diostracus (Fig. 168). In Hypocharassus the sense organs occur medially between the panels and at the distal end of each panel. Diostracus has institia at the caudal margin of each panel and has sense organs at both proximal and distal ends.

Gymnopternus (Fig. 169) is the only genus that has the six panels arranged in pairs, with four unpaired, sclerotized, sub-rectangular areas in each panel.

Pseudotracheae that consist of six panels with geminate, sub-rectangular, sclerotized prominences in each panel occur in *Thinophilus* (Fig. 170), *Millardia* (Fig. 171), *Hydrophorus* (Fig. 172), *Campsicnemus* (Fig. 174), *Chrysotus* (Fig. 175), *Diaphorus* (Fig. 176), *Neurigona* (Fig. 177), *Plagioneurus* (Fig. 178), *Peloroepodes* (Fig. 179) and *Syntormon* (Fig. 180). *Aphrosylus* (Fig. 173) has only five panels of this kind, and its sixth panel is ribbon-like and unsclerotized. Its sense organs are at the proximal ends of panels 1, 2, 3, 4, and 5, and one long bristle-like sense hair occurs at the distal end of each panel.

Thinophilus (Fig. 170) has only a small geminately sclerotized area in each panel. There are sense pegs on the proximal ends of panels 3, 5, and 6. In *Millardia* (Fig. 171) the six panels have large solidly sclerotized areas at their proximal ends, followed by geminately sub-rectangular areas, which decrease in size towards the distal end. The proximal sense organs are on panels 1 and 3, and each of the six panels has a distal sense organ. *Hydrophorus* (Fig. 172) has an arrangement of pseudotracheae similar to *Millardia*, but the proximal sense organs are between panels 2 and 3, 4 and 5. The last panel of the pseudotracheae of *Campsicnemus* (Fig. 174) has a small unsclerotized area at its distal tip. The proximal sense organs are between panels 2 and 3, 4 and 5, 5 and 6. There is also a sense organ at the distal end of each panel. *Chrysotus* (Fig. 175) has six long narrow panels with paired oval areas in each. The proximal sense organs are between panels 1 and 2, 3 and 4. Each panel has a distal sense organ as in the preceding genera of this group. The panels in *Diaphorus* (Fig. 176) are similar to the panels of *Chrysotus*, but there is also a proximal sense organ between panels 5 and 6. *Neurigona* (Fig. 177) has a sense peg on the base of panels 1, 3, and 5 and also near the distal end of each panel. The panels in *Plagioneurus* (Fig. 178) are similar to those of *Chrysotus* and *Neurigona*, but the proximal sense pegs are between panels 1 and 2, 2 and 3. *Peloroepodes* (Fig. 179) has pseudotracheae similar to *Plagioneurus*, but the panels are much longer and there are five basal sense organs. The panels of *Syntormon* (Fig. 180) are somewhat curved at the distal ends, and the proximal sense organs lie between panels 2 and 3, 4 and 5, 5 and 6.

The following genera have geminately sclerotized sub-rectangular areas also but differ from the former group in the location of the sense

organs which are present at the distal end only: *Sympycnus* (Fig. 181), *Liancalus* (Fig. 182), *Pelastoneurus* (Fig. 183), *Tachytrechus* (Fig. 184), *Scellus* (Fig. 185), *Dolichopus* (Fig. 186), and *Hygroceleuthus* (Fig. 187).

The pseudotracheae of *Teuchophorus* (Fig. 188) and *Argyra* (Fig. 189) have no sense organs at either proximal or distal ends, but the panels have geminate sub-rectangular prominences as in the preceding group. *Melanderia* has no pseudotracheae, but an interdental armature occurs on the membrane surrounding each labellum (Fig. 190, *m*).

RELATIONSHIP OF THE GENERA BASED ON THE PRESENT STUDY

THE SIMILARITY in the shape and size, as well as the comparison of the structural characteristics found in the epipharyngeal armature and the pseudotracheae, in the different genera of the Dolichopodidae studied, have led to the following generic combinations. The hypopharyngeal characteristic was not considered in this classification because the transition of the hypopharynx from one shape to the other is so gradual that it is rather difficult to determine to which group each hypopharynx belongs. These groups are arranged in a series, from what I believe to be the most primitive to that which is most highly specialized as determined especially by the labrum and labial panels.

GROUP I.—Labrum elongated; two very short prongs; six panels geminately sclerotized:

Diaphorus (Figs. 65 and 176)

Chrysotus (Figs. 66 and 175)

GROUP II.—Labrum not elongated; two prongs; six panels geminately sclerotized:

Aphrosylus (Figs. 71 and 173)

Neurigona (Figs. 68 and 177)

Millardia (Figs. 73 and 171)

Scellus (Figs. 72 and 185)

GROUP III.—Labrum not elongated; two prongs; six panels irregularly sclerotized:

Diostracus (Figs. 75 and 168)

GROUP IV.—Labrum not elongated; two prongs; six panels ribbon-like and not geminately sclerotized:

Medeterus (Figs. 69 and 165)

Thrypticus (Figs. 70 and 164)

Rhaphium (Figs. 67 and 166)

Xanthochlorus (Figs. 74 and 162)

- GROUP V.—Labrum not elongated; four prongs connected; five panels ribbon-like and not geminately sclerotized:
Condyllostylus (Figs. 77 and 160)
- GROUP VI.—Labrum not elongated; four prongs connected; six panels ribbon-like and not geminately sclerotized:
Laxina (Figs. 76 and 161)
Sciapus (Figs. 78 and 163)
Mesorhaga (Fig. 79)
- GROUP VII.—Labrum not elongated; four prongs connected; six panels geminately sclerotized:
Thinophilus (Figs. 80 and 170)
- GROUP VIII.—Labrum not elongated; four prongs disconnected; six panels geminately and irregularly sclerotized:
Hypocharassus (Figs. 81 and 167)
- GROUP IX.—Labrum not elongated; four prongs disconnected; no panels:
Melanderia (Fig. 82)
- GROUP X.—Labrum plate-like; four prongs connected; six panels geminately sclerotized:
Argyra (Figs. 86 and 189)
Campsicnemus (Figs. 84 and 174)
Hydrophorus (Figs. 83 and 172)
Liancalus (Figs. 85 and 182)
Peloroceodes (Figs. 87 and 179)
Teuchophorus (Figs. 88 and 188)
- GROUP XI.—Labrum plate-like; two prongs; six panels with sclerotizations unpaired:
Gymnopternus (Figs. 94 and 169)
- GROUP XII.—Labrum plate-like; two prongs; six panels geminately sclerotized:
Dolichopus (Figs. 96 and 186)
Hygroceleuthus (Figs. 95 and 187)
Plagioneurus (Figs. 90 and 178)
Pelastoneurus (Figs. 92 and 123)
Syntormon (Figs. 91 and 180)
Sympycnus (Figs. 93 and 181)
Tachytrechus (Figs. 89 and 184)

Undoubtedly, Becker (1922) did not consider the mouth parts in his classification of subfamilies, for we find genera with the most striking structural differences grouped together. For instance the subfamily Hydrophorinae contains the following: *Hydrophorus* (Figs. 83 and 172), which belongs in my Group X; *Scellus* (Figs. 72 and 185) in Group II;

Thinophilus (Figs. 80 and 170) in Group VII; *Diostracus* (Figs. 75 and 168) in Group III; and *Hypocharassus* (Figs. 81 and 167) in Group VIII. Becker's subfamilies *Campsicneminae*, *Chrysosomatinae*, and *Rhaphiinae* also have several outstanding examples of generic groupings with great differentiation in the mouth parts.

SUMMARY

THIS STUDY deals with the modifications and relationships of the mouth parts of thirty-two representative genera of the dipterous family Dolichopodidae. The family characteristics, habitats, and food habits of these flies are considered in order to understand more fully the mouth structures. The form and structure of the mouth parts of the thirty-two genera are illustrated by 193 drawings. It is evident from a review of the literature that previous investigators, with the exception of Langhoffer, have not observed the remarkable degree of generic variability in the mouth parts of this family and have not appreciated the value of the mouth parts from a taxonomic standpoint.

After a consideration of the various striking structural differences of the trophi in the different genera of Dolichopodidae, it is apparent to the writer that the structure of the mouth parts is of real importance in a grouping of the genera into subfamilies. On the basis of this study, the writer recognizes twelve groups of genera, including intermediate and transitional groups not observed by Langhoffer, who made the only previous study of these organs. These twelve groups may be considered as subfamilies although not so named here.

It is apparent in this work that some of the generic groupings of both Aldrich (1905) and Becker (1922), which are based on other characters, correspond with those of the writer. For instance, both authors have grouped *Diaphorus* and *Chrysotus* together, also *Medeterus* and *Thrypticus*. Other groupings of these investigators, however, do not correspond to those of the writer. This is perhaps due to the fact that neither considered the mouth parts in his classification.

In the present generic groupings the labrum, the epipharyngeal armature, and the pseudotracheae are the only mouth parts considered. These structures seem to be the most important so far as relationships between the genera are concerned. They are comparatively conspicuous, and their structural differences are so pronounced that anyone can easily recognize their differences and similarities. The hypopharynx was not considered in the grouping, because a study of it shows that there is a gradual transition in form from a simple lanceolate type to a complex pentagonal type. It has not been possible, therefore, to place each type of hypopharynx in its proper group.

In the generic arrangement a consideration of the above characters necessitated a change in the groupings of Aldrich and Becker. Regardless of other external characteristics, the writer has grouped the genera on the basis of the mouth parts in sequence from what is considered the most primitive type, as found in Group I, with the labrum elongated and two very short prongs, to that which is found in Group XII, with a plate-like labrum and two well-developed epipharyngeal prongs.

BIBLIOGRAPHY

- ALDRICH, J. M.
 1893. A Revision of the Genera *Dolichopus* and *Hygroceleuthus*. Kans. Univ. Quart., 2:1-23.
 1905. A Catalogue of North American Diptera. Smiths. Misc. Coll., Vol. 46. 680 pp.
 1907. The Dipterous Genus *Scellus*, with one new species. Ent. News. 18:133-136.
 1922. A New Genus of Two-Winged Fly with Mandible-Like Labella. Proc. Ent. Soc. Wash., 24:145-148.
- BECHER, E.
 1882. Zur Kenntnis der Mundtheile der Dipteren. Denkschr. k. Akad. Wissensch., Wien, Math-naturw., 45:123-162.
- BECKER, T.
 1922. Dipterologische Studien über Dolichopodidae. Abh. Zool.-botan., Gesselsch., Wien, 13:1-395.
- BISHOP, S. C., and HART, R. C.
 1931. Notes on Some Natural Enemies of the Mosquito in Colorado. Jour. New York Ent. Soc., 39:151-157.
- BLANCHARD, E.
 1850. De la Composition de la Bouche dans les Insects de l'Order des Diptères. Compt. rend. Acad. Sci., Paris, 31:424-427.
- CARPENTER, G. H.
 1899. Insects, Their Structure and Life. Dent and Co., London. 403 pp.
 1928. The Biology of Insects. Macmillan Co., N.Y. 417 pp.
- COMSTOCK, J. H.
 1924. An Introduction to Entomology. Comstock Publishing Co., Ithaca, N.Y. 1043 pp.
- COQUILLETT, D. W.
 1900. Diptera of the Harriman Alaska Expedition. Proc. Wash. Acad. Sci., 11:389-464.
- CRAMPTON, G. C.
 1923. A Phylogenetic Comparison of the Maxillae Throughout the Orders of Insects. Journ. N.Y. Ent. Soc., 31:77-107.
 1925. A Phylogenetic Study of the Labrum of Holometabolus Insects, with Particular Reference to the Diptera. Proc. Ent. Soc. Wash., 21:68-91.
- CURRAN, C. H.
 1928. New Eastern Species of *Medeterus*. N.Y. State Mus. Bul., 274:199-204.
 1933. Some North American Diptera. American Mus. Novitates, 682:1-11.
 1934. The Families and Genera of North American Diptera. The Ballau Press, N.Y. 512 pp.
- DELEON, D.
 1935. A Study of *Medeterus aldrichi* Wh. (Diptera, Dolichopodidae), a Predator of the Mountain Pine Beetle (*Dendroctonus monticolae* Hopk., Coleo-Scolytidae). Entom. Americana, 15:59-92.
- DIMMOCK, G.
 1881. The Anatomy of the Mouth-parts and of the Sucking Apparatus of some Diptera. Dissertation. Boston. 50 pp.
 1882. Anatomy of the Mouth-parts and of the Suctorial Apparatus of *Culex*. Psyche, 3:231-241.
- DOANE, R. W.
 1907. Notes on the habits of *Scellus virago* Ald. Ent. News, 18:136-138.

- FREY, R.
 1915. Zur Kenntnis der Dipteren fauna Finnlands. 3. Dolichopodidae. Acta. Soc. Fauna-Flora, Fenn., 40:5:1-27.
 1921. Studien über den Bau des Mundes der neideren Diptera Schizophora nebst Bemerkungen über die Systematik dieser Dipterengruppe. Acta. Soc. Fauna-Flora, Fenn., 48:3:1-245.
- GILES, G. M.
 1905. Mouth-parts of the Biting Flies. Preliminary Note. Jour. Trop. Med., 8:363-364.
- GRÜNDBERG, K.
 1910. Die Süsswasserfauna Deutschlands. Heft 2a. Jena. 96 pp.
- HARRIS, W. H.
 1903. The Dentition of the Diptera. Jour. Quek. Micr. Club, 2d ser., 8:389-398.
- HEWITT, C. G.
 1908. The Structure, Development and Bionomics of the Housefly, *Musca domestica* Linn. Part 2. Quart. Journ. Micr. Sci., 52:405-545.
- HOWARD, L. O., DYAR, H. G., and KNAB, F.
 1912. The Mosquitoes of North and Central America and the West Indies. Part I. Carnegie Institution, Wash., D.C.
- HU, J. S., and FEND, H. T.
 1935. The Morphological Studies on the Mouth-parts of Some Diptera. Peking Nat. Hist. Bull., 10:117-125.
- IMMS, A. D.
 1920. Recent Research on the Head and Mouth-parts of Diptera. Ent. Mo. Mag., London, 56:106-109.
 1934. A General Text Book in Entomology (3rd ed.). E. P. Dutton and Company Inc., N.Y. 742 pp.
 1937. Recent Advances in Entomology. J. A. Churchill Ltd., London. 431 pp.
- JAMES, M. T.
 1939. The Genus *Dolichopus* in Colorado (Diptera: Dolichopodidae). Trans. Amer. Ent. Soc., 65:209-226.
- KELLOGG, V. L.
 1899. The Mouth Parts of the Nematoceros Diptera. Psyche, 8:303-306, 327-330, 346-348, 355-359, 363-365.
 1902. The Development and Homologies of the Mouth Parts of Insects. Amer. Nat., 36:683-706.
 1908. American Insects. Henry Holt and Co., N.Y. 694 pp.
- KERTESZ, C.
 1909. Catalogus Dipterorum Hucusque Descriptorum. Vol. 6. G. Wesselenyi, Budapest.
- KLEINE, R.
 1907. Die Entwicklung von Dipteren in den Brütungen von *Myelophilus piniperda* L. Berl. Ent. Zeit., 52:109-113.
- KRAEPELIN, K.
 1882. Über die Mundwerkzeuge der saugenden Insecten, Vorläufige Mitteilung. Zool. Anz., 5:574:579.
 1883. Zur Anatomie und Physiologie des Rüssels von *Musca*. Zeitschr. wiss. Zool., 39:683-719.
- LANGHOFFER, A.
 1888. Beitrag zur Kenntnis der Mundteile der Dipteren. Dissertation. Jena. 32 pp.
 1901. Mandibulae Dolichopodidarum. Verhandl. Internat. Zoologen-Congress, Berlin, 5:840-846.

- LEFROY, H. M.
1923. Manual of Entomology. London. 209 pp.
- LOEW, H.
1864. Monographs of the Diptera of North America. Part II. Smiths. Misc. Coll., 171:1-360.
- LOWNE, B. T.
1892. The Anatomy and Physiology of the Blow-fly (*Musca vomitoria* Linn.). Part 3, pp. 215-350.
1893. A Reply to Some Observations on the Mouth Organs of the Diptera. Ann. Mag. Nat. Hist., 6:11:182-184.
- LUNDBECK, W.
1912. Diptera Danica. Part IV, Dolichopodidae. Copenhagen, London. 407 pp.
- LUTZ, F. E.
1918. Field Book of Insects (2d ed.). G. P. Putnam's Sons. N.Y., London. 562 pp.
- MALLOCH, J. R.
1917. Predaceous Habits in *Medeterus* and *Psilops* (Dipt.). Bul. Brooklyn Ent. Soc., 12:13-14.
- MARLATT, C. L.
1896. The Mouth-parts of Insects with Particular Reference to the Diptera and Hemiptera. Abstract, Proc. A.A.A.S., 44:154-155.
- MEINERT, F.
1880. Sur la Conformation de la Tête et sur l'Interpretation des Organes bucaux chez les Insectes ainsi que sur la Systématique de cet Ordre. Entom. Tidskrift, 1:147-150.
1882. Die Mundtheile der Dipteren. Zool. Anz., 5:570-574, 599-603.
- MENZBIER, M. A.
1880. Über der Kopfskelett und die Mundteile der Zweiflügler. Bull. Soc. Imp. Nat. Moscou, 55:8-71.
- METCALF, C. L.
1929. The Mouthparts of Insects. Trans. Ill. State Acad., 21:109-135.
- MIALL, L. C.
1934. The Natural History of Aquatic Insects. Macmillan and Co., London. 395 pp.
- PACKARD, A. S.
1870. Guide to the Study of Insects (2d ed.). Naturalist's Book Agency, Salem. 702 pp.
1903. A Textbook of Entomology. New York. 715 pp.
- PARENT, O.
1938. Quelques Diptères des Iles Hawaii. Konowia, 16:209-219.
- PETERSON, ALVAH
1916. The Head-capsule and Mouth-parts of Diptera. Ill. Biol. Monog., 3:2:1-113.
- SAUNDERS, L. G.
1899. Some Marine Insects of the Pacific Coast of Canada. Ann. Ent. Soc. Amer., 21:521-545.
- SCHINER, J. R.
1862. Fauna Austriaca. Die Fliegen (Diptera) I. Wien. 672 pp.
- SMITH, J. B.
1890. A Contribution to a Knowledge of the Mouth Parts of the Diptera. Trans. Am. Ent. Soc., 17:319-339.

- SNODGRASS, R. E.
1922. Mandible Substitutes in the Dolichopodidae. *Proc. Ent. Soc. Wash.*, 24:148-152.
1928. Morphology and Evolution of the Insect Head and its Appendages. *Smiths. Misc. Coll.*, 81:3:1-58.
1932. Evolution of the Insect Head and the Organs of Feeding. *Smiths. Rept. for 1931*, pp. 445-489.
1935. *Principles of Insect Morphology*. McGraw-Hill Book Co., N.Y. 667 pp.
- TILLYARD, R. J.
1936. *The Insects of Australia and New Zealand*. Angus and Robertson, Sydney. 560 pp.
- VAN DUZEE, M. C., COLE, F. R., and ALDRICH, J. M.
1921. The Dipterous Genus *Dolichopus* Latreille in America. *Bull. U. S. Nat. Mus.*, 116:1-304.
- VERRALL, G. H.
1904. List of British Dolichopodidae, with Tables and Notes. *Ent. Mo. Mag.*, 164:174.
- WALTON, W. R.
1908. An Illustrated Glossary of Chaetotaxy and Anatomical Terms Used in Describing Diptera. *Ent. News*, 20:307-319.
- WESCHÉ, W.
1902. Undescribed Palpi on the Proboscis of Some Dipterous Flies, with Remarks on the Mouth-parts in Several Families. *Jour. Roy. Micro. Soc.*, 1902:412-416.
1904. The Labial and Maxillary Palpi in Diptera. *Trans. Linn. Soc., London*, 9:219-230.
1904. The Mouth-parts of the Nemocera and Their Relation to the Other Families of the Diptera. *Jour. Roy. Micro. Soc.*, 1904:28-47.
- WHEELER, W. M.
1899. New Species of Dolichopodidae from the United States. *Proc. Calif. Acad. Sci. (3rd ser.)*, 2:1-85.
- WILLIAMS, F. X.
1938. *Campsicnemus fumipennis* Parent (Diptera, Dolichopodidae). *Proc. Haw'n. Ent. Soc.*, 10:120-126.
1939. Biological Studies in Hawaiian Water-Loving Insects. Part 3. *Proc. Haw'n. Ent. Soc.*, 10:281-317.
- WILLISTON, S. W.
1908. *Manual of North American Diptera (3rd ed.)*. New Haven, Conn. 405 pp.

ABBREVIATIONS USED IN PLATES

ap.....apodeme	p.....panel
c.....clypeus	ph.....pharynx
cu.....cornu	ps.....pseudotracheae
ep.a.....epipharyngeal armature	s.....sense organ
g.....glossae	sac.....sack
hyp.....hypopharynx	s.b.....salivary bulb
l.....labrum	sc.p.....sclerotized plate
la.....labium	s.d.....salivary duct
lab.....labellum	sh.....sense hair
l.r.....lateral rod	sp.....sense peg
m.....membrane	t.....theca
mx.p.....maxillary palpus	

PLATE I

Lateral Aspect of the Complete Feeding Mechanism

- FIG. 1. *Condylostylus siphon* Say, female.
 FIG. 2. *Laxina calcarata* Lw., male.
 FIG. 3. *Xanthochlorus helvinus* Lw., female.
 FIG. 4. *Sciapus scintillans* Lw., female.
 FIG. 5. *Thrypticus willistoni* Wheel., female.
 FIG. 6. *Medeterus aldrichi* Wheel., male.

PLATE II

Lateral Aspect of Complete Feeding Mechanism

- FIG. 7. *Rhaphium effilatus* Wheel., male.
 FIG. 8. *Hypocharassus pruinus* Wheel., female.
 FIG. 9. *Diostracus prasinus* Lw., female.
 FIG. 10. *Gymnopternus barbatulus* Lw., male.
 FIG. 11. *Thinophilus ochrifacies* V. D., male.
 FIG. 12. *Millardia intentus* Aldr., female.

13

HYDROPHORUS

14

APHROSYLUS

15

CAMPSICNEMUS

16

CHRYSTOTUS

17

DIAPHORUS

PLATE III

Lateral Aspect of Complete Feeding Mechanism

FIG. 13. *Hydrophorus sodalis* Wheel., female.FIG. 14. *Aphrosylus praedator* Wheel., female.FIG. 15. *Campsicnemus nigripes* V. D., male.FIG. 16. *Chrysotus choricus* Wheel., male.FIG. 17. *Diaphorus leucostomus* Lw., male.

PLATE IV

Lateral Aspect of Complete Feeding Mechanism

- FIG. 18. *Neurigona carbonifer* Lw., female.
 FIG. 19. *Plagioneurus univittatus* Lw., female.
 FIG. 20. *Peloropecodes acuticornis* V. D., male.
 FIG. 21. *Syntormon cinereiventris* Lw., male.
 FIG. 22. *Sympycnus lineatus* Lw., male.
 FIG. 23. *Liancalus similis* Aldr., male.

24

PELASTONEURUS

25

TACHYTRECHUS

26

SCELLUS

27

DOLICHOPUS

PLATE V

Lateral Aspect of Complete Feeding Mechanism

FIG. 24. *Pelastoneurus vagans* Lw., female.FIG. 25. *Tachytrechus angustipennis* Lw., female.FIG. 26. *Scellus filiferus* Lw., female.FIG. 27. *Dolichopus ramifer* Lw., female.

PLATE VI

Lateral Aspect of Complete Feeding Mechanism

FIG. 28. *Hygroceleuthus consanguineus* Wheel, male.FIG. 29. *Argyra albicans* Lw., female.FIG. 30. *Teuchophorus spinigerellus* Zett., female.FIG. 31. *Mesorhaga* sp., female.FIG. 32. *Melanderia mandibulata* Aldr., male.

PLATE VII

Lateral Aspect of Clypeolabral-Pharyngeal Region

- FIG. 33. *Diaphorus leucostomus* Lw., male.
 FIG. 34. *Chrysotus choricus* Wheel., male.
 FIG. 35. *Rhaphium effilatus* Wheel., male.
 FIG. 36. *Neurigona carbonifer* Lw., female.
 FIG. 37. *Medeterus aldrichi* Wheel., male.
 FIG. 38. *Thrypticus willistoni* Wheel., male.
 FIG. 39. *Aphrosylus praedator* Wheel., female.
 FIG. 40. *Scellus filiferus* Lw., female.
 FIG. 41. *Millardia intentus* Aldr., female.

PLATE VIII

Lateral Aspect of Clypeolabral-Pharyngeal Region

FIG. 42. *Xanthochlorus helvinus* Lw., female.FIG. 43. *Diostracus prasinus* Lw., female.FIG. 44. *Laxina calcarata* Lw., male.FIG. 45. *Condylostylus siphon* Say, female.FIG. 46. *Sciapus scintillans* Lw., female.FIG. 47. *Mesorhaga* sp., female.FIG. 48. *Thinophilus ochrifacies* V. D., male.FIG. 49. *Hypocharassus pruinosus* Wheel., female.FIG. 50. *Melanderia mandibulata* Aldr., male.

PLATE IX

Lateral Aspect of Clypeolabral-Pharyngeal Region

- FIG. 51. *Hydrophorus sodalis* Wheel., female.
 FIG. 52. *Campsicnemus nigripes* V. D., male.
 FIG. 53. *Liancalus similis* Aldr., male.
 FIG. 54. *Argyra albicans* Lw., female.
 FIG. 55. *Peloropecodes acuticornis* V. D., male.
 FIG. 56. *Teuchophorus spinigerellus* Zett., female.
 FIG. 57. *Tachytrechus angustipennis* Lw., female.
 FIG. 58. *Plagioneurus univittatus* Lw., female.
 FIG. 59. *Syntormon cinereiventris* Lw., male.

60

PELASTONEURUS

61

SYMPYCNUM

62

GYMNOPTERNUS

63

HYGROCELEUTHUS

64

DOLICHOPUS

PLATE X

Lateral Aspect of Clypeolabral-Pharyngeal Region

FIG. 60. *Pelastoneurus vagans* Lw., female.FIG. 61. *Sympycnus lineatus* Lw., male.FIG. 62. *Gymnopternus barbatulus* Lw., male.FIG. 63. *Hygroceleuthus consanguineus* Wheel., male.FIG. 64. *Dolichopus ramifer* Lw., female.

65

DIAPHORUS

66

CHRYSOTUS

67

RHAPHIUM

68

NEURIGONA

69

MEDETERUS

70

THRYPTICUS

71

APHROSYLUS

72

SCELLUS

73

MILLARDIA

PLATE XI

Lateral Aspect of Epipharyngeal Armature

- FIG. 65. *Diaphorus leucostomus* Lw., male.
 FIG. 66. *Chrysotus choricus* Wheel., male.
 FIG. 67. *Rhaphium effilatus* Wheel., male.
 FIG. 68. *Neurigona carbonifer* Lw., female.
 FIG. 69. *Medeterus aldrichi* Wheel., male.
 FIG. 70. *Thrypticus willistoni* Wheel., male.
 FIG. 71. *Aphrosylus praedator* Wheel., female.
 FIG. 72. *Scellus filiferus* Lw., female.
 FIG. 73. *Millardia intentus* Aldr., female.

PLATE XII

Lateral Aspect of Epipharyngeal Armature

- FIG. 74. *Xanthochlorus helvinus* Lw., female.
 FIG. 75. *Diostracus prasinus* Lw., female.
 FIG. 76. *Laxina calcarata* Lw., male.
 FIG. 77. *Condylostylus siphio* Say, female.
 FIG. 78. *Sciapus scintillans* Lw., female.
 FIG. 79. *Mesorhaga* sp., female.
 FIG. 80. *Thinophilus ochrifacies* V. D., male.
 FIG. 81. *Hypocharassus pruinosus* Wheel., female.
 FIG. 82. *Melanderia mandibulata* Aldr., male.

PLATE XIII

Lateral Aspect of Epipharyngeal Armature

- FIG. 83. *Hydrophorus sodalis* Wheel., female.
 FIG. 84. *Campsicnemus nigripes* V. D., male.
 FIG. 85a. *Liancalus similis* Aldr., male.
 FIG. 85b. *Liancalus similis* Aldr., male (more detailed study).
 FIG. 86. *Argyra albicans* Lw., female.
 FIG. 87. *Peloropeodes acuticornis* V. D., male.
 FIG. 88. *Teuchophorus spinigerellus* Zett., female.

PLATE XIV

Lateral Aspect of Epipharyngeal Armature

- FIG. 89. *Tachytrechus angustipennis* Lw., female.
 FIG. 90. *Plagioneurus univittatus* Lw., female.
 FIG. 91. *Syntormon cinereiventris* Lw., male.
 FIG. 92. *Pelastoneurus vagans* Lw., female.
 FIG. 93. *Sympycnus lineatus* Lw., male.
 FIG. 94. *Gymnopternus barbatulus* Lw., male.
 FIG. 95. *Hygroceleuthus consanguineus* Wheel., male.
 FIG. 96. *Dolichopus ramifer* Lw., female.

PLATE XV

Cephalic Aspect of Hypopharynx

- FIG. 97. *Condylostylus sipho* Say, female.
 FIG. 98. *Aphrosylus praedator* Wheel., female.
 FIG. 99. *Xanthochlorus helvinus* Lw., female.
 FIG. 100. *Neurigona carbonifer* Lw., female.
 FIG. 101. *Laxina calcarata* Lw., male.
 FIG. 102. *Rhaphium effilatus* Wheel., male.
 FIG. 103. *Diaphorus leucostomus* Lw., male.
 FIG. 104. *Syntormon cinereiventris* Lw., male.
 FIG. 105. *Chrysotus choricus* Wheel., male.
 FIG. 106. *Sympycnus lineatus* Lw., male.
 FIG. 107. *Teuchophorus spinigerellus* Zett., female.
 FIG. 108. *Thrypticus willistoni* Wheel., male.

PLATE XVI

Cephalic Aspect of Hypopharynx

- FIG. 109. *Tachytrechus angustipennis* Lw., female.
 FIG. 110a. *Medeterus aldrichi* Wheel., male.
 FIG. 110b. Lateral aspect of 110a.
 FIG. 111. *Campsicnemus nigripes* V. D., male.
 FIG. 112. *Plagioneurus univittatus* Lw., female.
 FIG. 113. *Argyra albicans* Lw., female.
 FIG. 114. *Liancalus similis* Aldr., male.
 FIG. 115. *Dolichopus ramifer* Lw., female.
 FIG. 116. *Hygroceleuthus consanguineus* Wheel., male.
 FIG. 117. *Peloro-peodes acuticornis* V. D., male.
 FIG. 118. *Hypocharassus pruinosus* Wheel., female.
 FIG. 119. *Melanderia mandibulata* Aldr., male.

PLATE XVII

Cephalic Aspect of Hypopharynx

- FIG. 120. *Thinophilus ochrifacies* V. D., male.
 FIG. 121. *Diostracus prasinus* Lw., female.
 FIG. 122. *Gymnopternus barbatulus* Lw., male.
 FIG. 123. *Pelastoneurus vagans* Lw., female.
 FIG. 124. *Sciapus scintillans* Lw., female.
 FIG. 125. *Mesorhaga* sp., female.
 FIG. 126. *Millardia intentus* Aldr., female.
 FIG. 127. *Scellus filiferus* Lw., female.
 FIG. 128a. *Hydrophorus sodalis* Wheel., female.
 FIG. 128b. Lateral aspect of 128a.

129

CONDYLOSTYLUS

130

LAXINA

131

XANTHOCHLORUS

132

SCIAPUS

133

THRYPTICUS

134

MEDETERUS

135

RHAPHIUM

PLATE XVIII

Caudal Aspect of Labium

- FIG. 129. *Condyllostylus siphonatus* Say, female.
 FIG. 130. *Laxina calcarata* Lw., male.
 FIG. 131. *Xanthochlorus helvinus* Lw., female.
 FIG. 132. *Sciapus scintillans* Lw., female.
 FIG. 133. *Thrypticus willistoni* Wheel., male.
 FIG. 134. *Medeterus aldrichi* Wheel., male.
 FIG. 135. *Rhapsium effilatus* Wheel., male.

136

HYPOCHARASSUS

137

DIOSTRACUS

138

GYMNOPTERNUS

139

THINOPHILUS

140

MILLARDIA

141

HYDROPHORUS

PLATE XIX

Caudal Aspect of Labium

- FIG. 136. *Hypocharassus pruinosus* Wheel., female.
 FIG. 137. *Diostracus prasinus* Lw., female.
 FIG. 138. *Gymnopternus barbatulus* Lw., male.
 FIG. 139. *Thinophilus ochrifacies* V. D., male.
 FIG. 140. *Millardia intentus* Aldr., female.
 FIG. 141. *Hydrophorus sodalis* Wheel., female.

PLATE XX

Caudal Aspect of Labium

- FIG. 142a. *Aphrosylus praedator* Wheel., female.
 FIG. 142b. Cephalic aspect of 142a.
 FIG. 143. *Campsicnemus nigripes* V. D., male.
 FIG. 144. *Chrysotus choricus* Wheel., male.
 FIG. 145. *Diaphorus leucostomus* Lw., male.
 FIG. 146. *Neurigona carbonifer* Lw., female.
 FIG. 147. *Plagioneurus univittatus* Lw., female.
 FIG. 148. *Peloropeodes acuticornis* V. D., male.

PLATE XXI

Caudal Aspect of Labium

- FIG. 149. *Syntormon cinereiventris* Lw., male.
 FIG. 150. *Sympycnus lineatus* Lw., male.
 FIG. 151. *Liancalus similis* Aldr., male.
 FIG. 152. *Pelastoneurus vagans* Lw., female.
 FIG. 153. *Tachytrechus angustipennis* Lw., female.
 FIG. 154. *Scellus filiferus* Lw., female.
 FIG. 155. *Dolichopus ramifer* Lw., female.

156

HYGROCEUTHUS

157

TEUCHOPHORUS

158

ARGYRA

159 a

MELANDERIA

159 b

MELANDERIA

PLATE XXII

Caudal Aspect of Labium

FIG. 156. *Hygrocleuthus consanguineus* Wheel., male.

FIG. 157. *Teuchophorus spinigerellus* Zett., female.

FIG. 158. *Argyra albicans* Lw., female.

FIG. 159a. *Melanderia mandibulata* Aldr., male.

FIG. 159b. Cephalic aspect of 159a.

160

CONDYLOSTYLUS

161

LAXINA

162

XANTHOCHLORUS

163

SCIAPUS

164

THRYPTICUS

PLATE XXIII

Pseudotracheae

- FIG. 160. *Condyllostylus siphonatus* Say, female.
 FIG. 161. *Laxina calcarata* Lw., male.
 FIG. 162. *Xanthochlorus helvinus* Lw., female.
 FIG. 163. *Sciapus scintillans* Lw., female.
 FIG. 164. *Thrypticus willistoni* Wheel., male.

165

MEETERUS

166

RHAPHIUM

167

HYPOCHARASSUS

PLATE XXIV

Pseudotracheae

FIG. 165. *Medeterus aldrichi* Wheel., male.

FIG. 166. *Rhapsium effilatus* Wheel., male.

FIG. 167. *Hypocharassus pruinosus* Wheel., female.

168

DIOSTRACUS

169

GYMNOPTERNUS

170

THINOPHILUS

171

MILLARDIA

PLATE XXV

Pseudotracheae

FIG. 168. *Diostracus prasinus* Lw., female.FIG. 169. *Gymnopternus barbatulus* Lw., male.FIG. 170. *Thinophilus ochrifacies* V. D., male.FIG. 171. *Millardia intentus* Aldr., female.

173

172

HYDROPHORUS

APHROSYLUS

174

CAMPSICHNEMUS

175

CHRYSTOTUS

176

DIAPHORUS

PLATE XXVI

Pseudotracheae

- FIG. 172. *Hydrophorus sodalis* Wheel., female.
 FIG. 173. *Aphrosylus praedator* Wheel., female.
 FIG. 174. *Campsichnemus nigripes* V. D., male.
 FIG. 175. *Chrysotus choricus* Wheel., male.
 FIG. 176. *Diaphorus leucostomus* Lw., male.

177

NEURIGONA

178

PLAGIONEURUS

179

PELOROPEODES

180

SYNTORMON

181

SYMPYCNUM

PLATE XXVII

Pseudotracheae

- FIG. 177. *Neurigona carbonifer* Lw., female.
 FIG. 178. *Plagioneurus univittatus* Lw., female.
 FIG. 179. *Peloropeodes acuticornis* V. D., male.
 FIG. 180. *Syntormon cinereiventris* Lw., male.
 FIG. 181. *Sympycnus lineatus* Lw., male.

182

LIANCALUS

183

PELASTONEURUS

184

TACHYTRECHUS

185

SCELLUS

186

DOLICHOPUS

PLATE XXVIII

Pseudotracheae

- FIG. 182. *Liancalus similis* Aldr., male.
 FIG. 183. *Pelastoneurus vagans* Lw., female.
 FIG. 184. *Tachytrechus angustipennis* Lw., female.
 FIG. 185. *Scellus filiferus* Lw., female.
 FIG. 186. *Dolichopus ramifer* Lw., female.

187

HYGROCELEUTHUS

188

TEUCHOPHORUS

189

ARGYRA

PLATE XXIX

Pseudotracheae

- FIG. 187. *Hygroceleuthus consanguineus* Wheel., male.
 FIG. 188. *Teuchophorus spinigerellus* Zett., female.
 FIG. 189. *Argyra albicans* Lw., female.

190

MELANDERIA

191

DOLICHOPUS

MAXILLARY PALPUS

192

DOLICHOPUS

PHARYNGEAL SACK

193

SCELLUS

PHARYNGEAL SACK

PLATE XXX

FIG. 190. *Melanderia mandibulata* Aldr.—Interdental armature.

FIG. 191. *Dolichopus ramifer* Lw.—Maxillary palpus.

FIG. 192. *Dolichopus ramifer* Lw.—Pharyngeal sack.

FIG. 193. *Scellus filiferus* Lw.—Pharyngeal sack.

INDEX TO GENERA

For alphabetic list of species used, see pages 8 and 9.

- Achalcus, 14, 16
 Achradocera, 16, 17
 Acropsilus, 15
 Agonosoma, 14
 Anchineura, 16
 Anepsiomyia, 14, 16, 17
 Aphrosylus, 11, 14, 17, 21, 23, 24, 26, 28, 29
 Argyra, 11, 14, 16, 17, 20, 22, 23, 25, 27, 29, 30
 Asyndetus, 14, 16, 17

 Calyxochaetus, 16, 17
 Campsicnemus, 12, 14, 16, 17, 20, 22, 23, 25, 26, 28, 30
 Chrysotimus, 14, 16, 17
 Chrysotus, 11, 14, 16, 17, 21, 23, 24, 26, 28, 29, 31
 Coeloglutus, 14, 16
 Condyllostylus, 16, 17, 22, 23, 24, 26, 27, 30

 Diaphorus, 7, 11, 14, 16, 17, 18, 21, 23, 24, 26, 28, 29, 31
 Diostracus, 14, 15, 16, 21, 23, 25, 26, 28, 29, 31
 Dolichopus, 8, 11, 13, 14, 15, 17, 18, 19, 20, 22, 24, 25, 29, 30

 Eutarsus, 14, 16

 Gonioneurum, 15
 Gymnopternus, 11, 15, 17, 22, 24, 25, 26, 28, 30

 Hercostomus, 15
 Hydrophorus, 11, 13, 14, 15, 16, 17, 22, 23, 25, 26, 28, 30
 Hygroceleuthus, 15, 18, 22, 24, 25, 27, 29, 30
 Hypocharassus, 11, 14, 15, 16, 22, 23, 25, 26, 27, 28, 30, 31
 Hyptiochaeta, 16, 17

 Laxina, 20, 21, 23, 24, 26, 27, 30
 Leptocorypha, 15
 Leptorhethum, 14, 16, 17
 Leucostola, 14, 16, 17
 Liancalus, 11, 14, 15, 16, 17, 22, 23, 25, 27, 29, 30
 Lyroneurus, 16, 17

 Macellocerus, 15
 Machaerium, 17
 Medeterus, 7, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 26, 27, 29, 31
 Megistostylus, 16
 Melanderia, 8, 11, 20, 22, 23, 25, 27, 29, 30

 Mesorhaga, 14, 16, 17, 22, 23, 25, 27, 30
 Millardia, 21, 23, 25, 26, 28, 29

 Nematoproctus, 14
 Neurigona, 11, 14, 16, 18, 20, 21, 23, 24, 26, 28, 29
 Nothosympycnus, 14

 Orthochile, 15, 18, 19, 20

 Paraclius, 15
 Paraphrosylus, 15
 Parasyntormon, 14
 Pelastoneurus, 15, 22, 24, 25, 27, 29, 30
 Peloropeodes, 14, 16, 22, 23, 25, 26, 28, 30
 Peodes, 15, 16
 Phylarchus, 14, 15, 16
 Plagioneurus, 11, 14, 15, 22, 24, 25, 26, 28, 30
 Polymedon, 15
 Porphyrops, 14, 16, 18
 Psilichium, 15
 Psilipodinus, 14
 Psilopus, 17

 Rhaphium, 12, 14, 16, 20, 21, 23, 24, 26, 27, 29

 Sarcionus, 15
 Scellus, 11, 13, 14, 15, 16, 21, 23, 25, 27, 29, 30
 Schoenophilus, 15
 Sciapus, 11, 16, 17, 22, 23, 25, 26, 27, 30
 Stenopygium, 15
 Stolidosoma, 16
 Subsympycnus, 16, 17
 Sybistroma, 15
 Symbolia, 16, 17
 Sympycnus, 11, 14, 16, 17, 22, 24, 26, 29, 30
 Syntomoneurum, 15, 16
 Syntormon, 11, 14, 16, 18, 22, 24, 26, 28, 30
 Systemus, 16

 Tachytrechus, 11, 15, 17, 20, 22, 24, 27, 29, 30
 Teuchophorus, 14, 16, 17, 18, 22, 23, 24, 27, 29, 30
 Thinophilus, 11, 14, 15, 16, 17, 20, 22, 23, 25, 26, 28, 30, 31
 Thrypticus, 14, 15, 16, 21, 23, 24, 26, 27, 29, 31

 Xanthina, 14, 16
 Xanthochlorus, 11, 14, 16, 17, 20, 21, 23, 24, 26, 27, 29
 Xiphandrium, 16

3 0112 063805979