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The comparative morphology of the mouthparts in the order Coleoptera treated from the standpoint of phylogeny

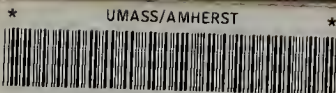
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THE COMPARATIVE MORPHOLOGY OF THE
MOUTHPARTS IN THE ORDER COLEOPTERA
TREATED FROM THE STANDPOINT OF PHYLOGENY

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The Comparative Morphology of the Mouthparts
in the Order Coleoptera Treated from the
Standpoint of Phylogeny

by

Inez W. Williams

Submitted as a thesis to the faculty of the
graduate school in partial fulfillment of
the requirements for the degree of Doctor of
Philosophy at the Massachusetts State College,
June 1936.

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The Comparative Morphology of the Mouthparts
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Introduction

With the exception of Stickney's monograph on the head capsule, Tanner's paper on the female genitalia, and Forbes' work on the wings, very little has been done on the comparative morphology of adult Coleoptera. Only a few scattered papers deal with the mouthparts of different species or with a single family at the most. The present studies of the labia and maxillae of the representatives of most of the Coleopterous families have been made with the purpose of supplementing Stickney's extensive and thorough work on the head capsules. It is hoped that these studies may add to the knowledge of the phylogenetic groupings of the families within the order.

The arrangement of the families in Leng's "Catalogue of Coleoptera of America north of Mexico" has been followed. A representative of each family has been chosen, more or less at random, for study. The consideration of members of the various subfamilies would undoubtedly have made comparisons much more complete, but due to the fact that suitable material was not available, the subfamilies have not been

included. The Eucinetidae, Nosodendridae, Trogidae, and Byturidae, which are treated by Leng (1920) as subfamilies, have not been considered in this paper. The Telegeusidae, Micromalthidae, Eurytethidae, Plastoceridae, Monoedidae, and Brathinidae have been omitted because they were either unobtainable or too minute to study with the equipment available.

As Stickney (1923) indicates in the case of the head capsule, attempts to arrange the figures of the labium and maxilla in a series from the generalized to the more specialized types proved unsuccessful. Primitive features of some structures are in many cases combined with specialized features of other structures. For this reason, the figures of the one hundred families involved in this paper have been arranged as nearly as possible in the family groupings presented by Leng in the "Catalogue of the Coleoptera."

Acknowledgments

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COLEOPTERA

SUBORDER ADEPHAGA

CARABOIDEA

1. Cicindelidae - Cicindela sexguttata Fab. (Fig. 1)
2. Carabidae - Harpalus caliginosus (Fab.) (Fig. 2)
3. Amphizoidae - Amphizoa isolens Lec. (Fig. 6)
4. Omophronidae - Omophron americanum Dej. (Fig. 3)
5. Haliplidae - Laccophilus maculosus (Germ.) (Fig. 4)
6. Dytiscidae - Colymbetes sculptilis Harr. (Fig. 5)

GYRINOIDEA

7. Cyrinidae - Dineutes vittatus (Germ.) (Fig. 7)
8. Paussidae - Paussus hova (Fig. 8)

SUBORDER POLYPHAGA

HYDROPHILOIDEA

9. Hydrophilidae - Tropisternus glaber (Hbst.) Fig. 9)

SILPHOIDEA

10. Platypsyllidae - Platypsyllus castoris Rits. (Fig. 10)
11. Leptinidae - Leptinus testaceus Mull. (Fig. 11)
12. Silphidae - Silpha americana L. (Fig. 13)
13. Clambidae - Clambus punctulum Beck. (Fig. 12)
14. Scydmaenidae - Euconnus similis Blatch. (Fig. 14)
15. Orthoperidae - Orthoperus brunnipes Gyll. (Fig. 15)

STAPHYLINOIDEA

16. Staphylinidae - Staphylinus vulpinus Nordm. (Fig. 16)
17. Pselaphidae - Pselaphus dresdensis Hbst. (Fig. 17)

- 18. Clavigeridae - Claviger testaceus (Fig. 19)
- 19. Ptilidae - Trichopteryx lata Motsch. (Fig. 18)
- 20. Sphaeriidae - Sphaerius acaroides Waltl. (Fig. 20)
- 21. Scaphidiidae - Scaphidium quadrimaculatum Oliv. (Fig. 21)
- 22. Sphaeritidae - Sphaerites glabratus (Fab.) (Fig. 22)
- 23. Histeridae - Hister obtusatus Harr. (Fig. 23)

CANTHAROIDEA

- 24. Lycidae - Eros aurora Hbst. (Fig. 24)
- 25. Lampyridae - Lucidota atra (Fab.) (Fig. 25)
- 26. Phengodidae - Phengodes sp. (Fig. 26)
- 27. Cantharidae - Cantharis andersoni Frost (Fig. 27)
- 28. Melyridae - Malachius aeneus (L.) (Fig. 28)
- 29. Cleridae - Trichodes ornatus Say (Fig. 29)
- 30. Corynetidae - Chariessa pilosa Forst. (Fig. 30)

LYMEXYLOIDEA

- 31. Lymexylidae - Hylocoetus dermestoides L. (Fig. 32)

CUPEDOIDEA

- 32. Cupedidae - Cupes latreillei Sol. (Fig. 33)

MORDELLOIDEA

- 33. Cephaloidae - Cephaloon lepturides Newm. (Fig. 34)
- 34. Oedemeridae - Ditylus laevis Fabr. (Fig. 35)
- 35. Mordellidae - Tomoxia bidentata (Say) (Fig. 36)
- 36. Rhipiphoridae - Rhipiphorus dimidiatus Fab. (Fig. 37)
- 37. Meloidae - Nemognatha piezata Fab. (Fig. 38)

- 38. Othniidae - Othnius kraatzii (Fig. 31)
- 39. Pythidae - Pytho americanus Kby. (Fig. 39)
- 40. Pyrochroidae - Pyrochroa coccinea L. (Fig. 40)
- 41. Pedilidae - Pedilus collaris (Say) (Fig. 41)
- 42. Anthicidae - Notoxus calcaratus Horn (Fig. 42)
- 43. Euglenidae - Euglenes pruinus (Fig. 43)

ELATEROIDEA

- 44. Cerophytidae - Cerophytum elateroides Latr. (Fig. 44)
- 45. Cebriionidae - Cebrio gigas Fab. (Fig. 45)
- 46. Rhipiceridae - Sandalus seguis (Fig. 46)
- 47. Elateridae - Alaus oculatus (L.) (Fig. 47)
- 48. Melasidae - Eucnemis capucina Ahrens. (Fig. 48)
- 49. Throscidae - Throscus dermestoides L. (Fig. 49)
- 50. Buprestidae - Buprestis fasciata Fab. (Fig. 50)

DRYOPOIDEA

- 51. Psephenidae - Psephenus lecontei (Lec.) (Fig. 51)
- 52. Dryopidae - Potamophilus acuminatus Fab. (Fig. 52)
- 53. Helmidae - Helmis mangel (Fig. 53)
- 54. Heteroceridae - Heterocerus parallelus Kyrnick (Fig. 55)
- 55. Georyssidae - Georyssus laevicollis Germ. (Fig. 54)

DASCILLOIDEA

- 56. Dascillidae - Dascillus cervinus L. (Fig. 56)
- 57. Helodidae - Scirtes tibialis Guér. (Fig. 57)

BYRRHOIDEA

- 58. Chelonariidae - Chelonarium ornatum Klug (Fig. 58)
- 59. Dermestidae - Dermestes lardarius L. (Fig. 59)
- 60. Byrrhidae - Byrrhus americanus Lec. (Fig. 60)

RHYSODOIDAE

- 61. Rhysodidae - Rhysodes sulcatus Fab. (Fig. 61)

CUCUJOIDEA

- 62. Ostomidae - Ostoma grossa (L.) (Fig. 62)
- 63. Nitidulidae - Prometobia sexmaculata (Say) (Fig. 63)
- 64. Rhizophagidae - Rhizophagus picipes (Fig. 64)
- 65. Monotomidae - Monotoma conicicollis (Fig. 65)
- 66. Cucujidae - Cucujus clavipes Fab. (Fig. 66)
- 67. Erotylidae - Megalodacne grandipennis (Fig. 67)
- 68. Derodontidae - Derodontus maculatus (Melsh.) (Fig. 68)
- 69. Cryptophagidae - Antherophagus ochraceus Melsh. (Fig. 69)
- 70. Mycetophagidae - Mycetophagus punctatus Say (Fig. 70)
- 71. Colydiidae - Trachypholis ornatus (Fig. 71)
- 72. Murmidiidae - Murmidius ovalis Beck. (Fig. 72)
- 73. Lathridiidae - Lathridius lardarius DeG. (Fig. 73)
- 74. Mycetaeidae - Mycetaea hirta (Marsh.) (Fig. 74)
- 75. Endomychidae - Lycoperdina ferruginea Lec. (Fig. 75)
- 76. Phalacridae - Phalacrus grossus Erichs. (Fig. 76)
- 77. Coccinellidae - Anatis quindecimpunctata (Oliv.) (Fig. 77)

TENEBRIONOIDEA

- 78. Alleculidae - Hymenorus melsheimeri Csy. (Fig. 78)
- 79. Tenebrionidae - Alobates pennsylvanica (DeG.) (Fig. 80)
- 80. Lagriidae - Arthromacra aenea (Say) (Fig. 79)
- 81. Monommidae - Monomma maximum (Fig. 81)
- 82. Melandryidae - Penthe obliquata (Fab.) (Fig. 82)

BOSTRICHOIDEA

- 83. Ptinidae - Oligomerus brunneus Oliv. (Fig. 83)
- 84. Anobiidae - Sitodrepa panicea (L.) (Fig. 84)
- 85. Bostrichidae - Apate terebrans Pall. (Fig. 85)
- 86. Lyctidae - Lyctus linearis (Goeze) (Fig. 86)
- 87. Sphindidae - Sphindus dubius Gyllh. (Fig. 87)
- 88. Cisidae - Cis boleti Scopoli (Fig. 88)

SCARABAEOIDEA

- 89. Scarabaeidae - Geotrupes splendidus (Fab.) (Fig. 89)
- 90. Lucanidae - Pseudolucanus capreolus (L.) (Fig. 90)
- 91. Passalidae - Passalus cornutus Fab. (Fig. 91)

CERAMBYCOIDEA

- 92. Cerambycidae - Tetraopes tetraophthalmus (Forst.) (Fig. 92)
- 93. Chrysomelidae - Leptinotarsa decemlineata (Say) (Fig. 93)
- 94. Mylabridae - Mylabris discoideus Say (Fig. 94)

BRENTOIDEA

- 95. Brentidae - Eupsalis minuta Drury (Fig. 95)

CURCULIONOIDEA

- 96. Platystomidae - Platystomus albinus L. (Fig. 97)
- 97. Belidae - Ithycerus noveboracensis (Forst.) (Fig. 96)
- 98. Curculionidae - Lixus concavus Say (Fig. 98)
Asynonychus godmani Crotch (Fig. 99)

SCOLYTOIDEA

- 99. Platypodidae - Platypus cylindricus Fab. (Fig. 100)
- 100. Scolytidae - Dendroctonus valens Lec. (Fig. 101)

GENERAL MORPHOLOGY

For a general discussion of the morphology of the Coleopterous labium and maxilla, it is desirable to choose as a basis a generalized form exhibiting primitive characters. The extreme range in variations of the structures concerned makes the selection of a species for general description rather difficult. Many of the forms studied combine generalized and specialized features in a bewildering fashion. Since Crampton (1925) has homologized the labium of Silpha with the type exhibited by the primitive and "ancestral" roach, Periplaneta, and Forbes (1922) has indicated the primitive nature of the wing of Silpha, it is probably justifiable to use this genus as a basis for comparison with the rest of the Coleoptera.

LABIUM: In the labium of Silpha americana (Fig. 13) the gular region (gu) is somewhat narrowed and is not demarked from the submentum (sm). The gular pits (gp), the openings of the invaginations of the posterior tentorial arms, are considered as the anterior limits of the gula. In many Coleoptera these pits are lost with the inrolling of the head capsule and consequent obliteration of the gula, or with the extension of the posterior tentorial arms along the partial or entire length of the gular sutures. The gular sutures (gs) which are distinct and separated in Silpha, demark the gula from the rest of the head capsule.

In Silpha, as in most of the other Coleoptera considered, the submentum (sm) is not demarked from the gula but is distinct from the mentum (mn). The mentum, on the other hand, is usually a distinctly defined region but is very variable in contour when compared throughout the order. A membranous region, the mental membrane (mem), which lies between the palpigers and the mentum, is present in many forms, including Silpha. In some cases the mental membrane is confluent with the mentum, but in Silpha the demarkation is definite.

The palpigers (pgr) bear the labial palpi (lp) distally and, throughout the Coleopterous families, exhibit a rather wide variation of arrangement. They may be widely separated by the intervening ligula; they may be moderately separated, as in Silpha; and they may be contiguous or even fused indistinguishably in many instances. In the last case, it is probable that the fusion may involve the labial stipites as well as the palpigers and since neither can be distinguished, the region of fusion is considered as the prementum.

The labial palpi (lp) are usually present and are three-segmented. There is a great diversity of size and shape of these three segments of the palpus. In some forms, they are so small that the palpus is hardly discernible. Claviger (Fig. 19) and Eupsalis (Fig. 95) are the only species studied

in which the labial palpi are entirely lacking. The terminal segment in most forms has a membranous area at the tip which is undoubtedly sensory.

The ligula (lg) lies between, and distal to, the palpifers. It is formed by the union of the glossae and paraglossae which fuse in varying degrees. In Silpha the paraglossae (pgl) are distinguishable as comparatively wide membranous lobes, but the glossae have been lost in the fusion. The ligula also shows a great range of structure. It is large, broad, and sclerotized in Laccophilus (Fig. 5), very small in Eros and Lucidota (Figs. 24, 25), and lacking in such highly specialized forms as Asynonychus and Platypus (Figs. 99, 100).

MAXILLA: The maxilla is composed of the cardo, stipes, lacinia, galea, palpifer, and maxillary palpus. All of these structures vary greatly when compared throughout the families. The cardo (ca) is the most proximal segment of the maxilla. In Silpha (Fig. 13), the cardo is not divided into a basicardo (bc) and disticardo (dc), nor is it so divided in most of the other beetles figured. Cantharis (Fig. 27), however, does exhibit this division. One of the commonest modifications of the cardo in Coleoptera is its elongation as illustrated by Mylabris (Fig. 94) or Platystomus (Fig. 99). The cardo always bears a basal process serving

for the attachment of the tendons of the adductor and abductor muscles of the maxilla. The basal process of Silpha is not so typical as that of other beetles such, for example, as that of Clambus (Fig. 12), in which the tendon of the adductor muscle is attached to the inner lobe of the basal process and the abductor muscle is attached to the outer lobe of the basal process. The point between these two lobes of the basal process serves as a pivot for articulation against the side of the submentum.

The stipes, in most of the Coleoptera figured, is composed typically of the basistipes (bs) and the mediostipes (ms). A dististipes, which is a small membranous area between the basigalea and basistipes, is present in many forms, but is probably best defined in Cicindela (Fig. 1) and Silpha (Fig. 13). The basistipes in Silpha is triangular in shape. Its base is contiguous with the margin of the cardo, its outer margin with the palpifer, and its inner margin with the mediostipes. In the majority of figures, the basistipes is roughly triangular in outline, but it may be broad and irregular, as in Eros and Phengodes (Figs. 24, 26), or elongate, as in Passalus (Fig. 91). In Trichopteryx (Fig. 18), the basistipes is fused with the palpifer. The mediostipes (ms) is, as a rule, irregular in outline and is variable in size. It is often fused with, or poorly demarked from, the lacinia (la). In the cases where the

mediostipes is distinct from the lacinia (see Figs. 10, 12, 18, etc.), the extent of its basal margin corresponds to the area to which the basimaxillary membrane is attached. Thus, in beetles which have the mediostipes and lacinia fused, the attachment of the basimaxillary membrane determines the limit of the basal region of the mediostipes. Tropisternus (Fig. 9) is the only form studied in which the parastipes (ps) occurs. It lies between the mediostipes and the lacinia, being strongly separated from the former by a distinct suture and weakly demarked from the latter.

The maxilla typically bears two lobes, an inner lobe, the lacinia (la), and an outer lobe, the galea (ga). Some of the species figured have only one lobe which is not differentiated into a lacinia and galea. Following Böving and Craighead (1930), this single maxillary lobe is designated as the "mala" (ma) (see Figs. 8, 63, 73, etc.). Both the galea and lacinia show a remarkable range of modifications when compared throughout the Coleoptera. In many forms, the galea is divided into a basal region, the basigalea (bg) and a distal region, the distigalea (dg). The distigalea, as shown in Silpha, may be tipped with a dense tuft of setae, while in other beetles it is naked (Figs. 1 - 8), or has setae sparsely arranged (Fig. 17). The setae may also be arranged in rows (Fig. 9) or in a brush (Fig. 100). The lacinia differs greatly in form, and bears setae and spines

in a number of diversified arrangements. The lateral margin of the lacinia is usually covered with setae or spines and at its apex, as in Silpha, the Caraboidea and a few other forms, may bear a digitus which in Cicindela (Fig. 1) is a movable process (dig).

In most of the Coleoptera studied, the maxillary palpus is four-segmented, but in some more specialized forms only three segments are apparent (see Figs. 95, 96, 98, 99, etc.). The basal segment of the palpus articulates with the palpifer (pfr), which is usually distinct, but may be fused with the basistipes.

MORPHOLOGY OF THE SPECIES STUDIED

CICINDELIDAE

Species studied: Cicindela sexguttata Fab. (Fig. 1)

Characters:

Labium - The ligula is entirely lacking; the palpigers are apparently separated by a median projection of the mentum; the submentum is very short and is fused with the gula; the gula, externally, is comparatively long and narrow, but the lateral areas are invaginated to form elongated, blade-like, internal ridges; the gular pits are small and the posterior tentorial arms probably are fused, in part, with the invaginated areas of the gula; a median gular suture is represented by two short sutures externally and by two short, blade-like ridges internally.

Maxilla - The basistipes is distinctly demarked; the mediostipes is fused with the lacinia; a dististipes is present as a small membranous area; the digitus forms a movable process of the lacinia; the galea is divided into a basigalea and distigalea.

CARABIDAE

Species studied: Harpalus caliginosus (Fab.) (Fig. 2)

Characters:

Labium - The ligula is composed of the fused,

sclerotized glossae and the membranous paraglossae; the labial stipites, which are fused and are continuous with the glossae, separate the palpigera; a mental membrane is present; the submentum is broad, but is partly confluent with the gula; the gula externally is long and narrow, but, as in Cicindela, the lateral areas are invaginated to form internal, blade-like ridges; the gular pits are small; the posterior tentorial arms are probably partly fused with the invaginations of the gula; the median gular suture is comparatively short externally, and internally is demarked by a blade-like ridge.

Maxilla - The maxilla is very similar to that of Cicindela but lacks the dististipes; the digitus of the lacinia is not movable.

OMOPHRONIDAE

Species studied: Omophron americanum Dej. (Fig. 3)

Characters:

Labium - The ligula is comparatively short and broad and is sclerotized with no differentiation of the glossae or paraglossae apparent; the palpigera are contiguous; the mentum is broad and is distinctly demarked from the submentum; the submentum is weakly demarked from the gula; the gula, externally, is comparatively wide, and has the lateral areas invaginated; the gular pits are not apparent, the posterior tentorial arms probably having fused with the

gular invaginations; no trace of the median gular suture is discernible.

Maxilla - The maxilla is essentially like that of Harpalus, but has a small membranous area which represents the dististipes.

HALIPLIDAE

Species studied: Laccophilus maculosus (Germ.) (Fig. 4)

Characters:

Labium - The ligula is broad and sclerotized; the palpifers are widely separated; the mentum is wide and is distinctly demarked from the submentum; the submentum is confluent with the wide gula and is weakly demarked from the head capsule; the gula is invaginated laterally; the gular pits are not apparent.

Maxilla - The maxilla is strikingly like that of Omophron.

DYTISCIDAE

Species studied: Colymbetes sculptilis Harr. (Fig. 5)

Characters:

Labium - The labium is essentially like that of Laccophilus, but the submentum is distinctly demarked.

Maxilla - The maxilla is like those of Omophron and Laccophilus.

AMPHYZOIDAE

Species studied: Amphizoa isolens Lec. (Fig. 6)

Characters:

Labium - The ligula is broad and sclerotized; the palpigers are comparatively widely separated; the mentum, submentum, and gula are all confluent; the gula is invaginated laterally; the gular pits are not apparent; the median gular suture is comparatively long.

Maxilla - The maxillae differ from those of the preceding forms in having the galea composed of a single segment and not divided into a basigalea and distigalea.

GYRINIDAE

Species studied: Dineutes vittatus (Germ.) (Fig. 7)

Characters:

Labium - The ligula is broad and sclerotized; the palpigers are not distinguishable in the fused premental region; the mentum is distinct from the submentum; the submentum is weakly demarked from the gula; the gula is invaginated laterally; the gular pits are not apparent.

Maxilla - The maxilla has a single maxillary lobe, the mala, which, after comparison with the preceding species, would seem to represent the lacinia, and the galea is apparently either fused with it or is entirely lacking.

PAUSSIDAE

Species studied: Paussus hova (Fig. 8)

Characters:

Labium - The palpigers are contiguous; the mentum is partially demarked from the submentum; the submentum is fused with the narrow gula; the gular pits are small; the

median gular suture, which is weakly defined, extends the length of the gula.

Maxilla - The maxilla is very highly specialized, the maxillary palpus forms the most dominant structure, with its second segment greatly enlarged; the stipes is reduced to a very small sclerite bearing the claw-like mala distally.

HYDROPHILIDAE

Species studied: Tropisternus glaber (Hbst.) (Fig. 9)

Characters:

Labium - The ligula is composed of the paraglossae and a small triangular plate formed by the fused glossae; the palpifers are widely separated; the mentum is strongly demarked from the submentum; the submentum is demarked weakly from the gula; the gular pits are elongate.

Maxilla - The palpifer, basistipes, and mediostipes are comparatively long and narrow; a parastipes is present, which is weakly demarked from the lacinia.

PLATYPSYLLIDAE

Species studied: Platypsyllus castoris Rits. (Fig. 10)

Characters:

Labium - The labium is very specialized; the sclerite situated distad of the mentum and between the short labial palpi is designated as the labium (li), because neither the

palpigers nor the ligula are discernible; the mentum is three-lobed and distinct from the submentum; the submentum is confluent with the gula; the gular pits are not apparent.

Maxilla - The stipes is not differentiated into a basistipes and mediostipes; the lacinia is short and broad; the galea is not divided into a basigalea and distigalea.

LEPTINIDAE

Species studied: Leptinus testaceus Müll. (Fig. 11)

Characters:

Labium - The labium is not so specialized as that of Platypsyllus; there is a broad ligula present; the mentum has two lateral lobes; the submentum is fused with the gula; the gular pits are small; the gular sutures are distinct.

Maxilla - The basistipes is demarked from the mediostipes; the mediostipes is fused with the lacinia; the galea is divided into the basigalea and distigalea.

CLAMBIDAE

Species studied: Clambus punctulatum Beck. (Fig. 12)

Characters:

Labium - The ligula is elongate; the mentum is short and distinct from the submentum; the submentum is indistinctly demarked from the gula; the gular pits are distinct.

Maxilla - The basistipes is demarked from the mediostipes; the mediostipes is distinct from the lacinia; the

galea is composed of a small basigalea and a curved, pointed distigalea.

SILPHIDAE

Species studied: Silpha americana L. (Fig. 13)

Characters:

Labium - The ligula is composed of the broad, membranous paraglossae, and a median sclerotized region, which probably represents the fused glossae; the palpigers are rather narrowly separated; there is a mental membrane present; the mentum is distinct from the submentum; the submentum is confluent with the narrowed gula; the gular pits are distinct.

Maxilla - The cardo is much wider than the basistipes; the mediostipes is fused with the lacinia; the lacinia bears an immovable digitus; the galea is divided into a basigalea and distigalea.

SCYDMAENIDAE

Species studied: Euconnus similis Blatch. (Fig. 14)

Characters:

Labium - The ligula is membranous and four-lobed, the outer lobes probably represent the paraglossae; the palpigers are rather narrowly separated; the mentum is large and demarked from the submentum; the submentum is confluent with the narrow gula; the gular pits are small.

Maxilla - The mediostipes is fused with the lacinia; the palpifer is comparatively wide; the galea is divided into a basigalea and distigalea.

ORTHOPERIDAE

Species studied: Orthoperus brunnipes Gyll. (Fig. 15)

Characters:

Labium - The ligula is broad and membranous; the palpifers are widely separated; the mentum is distinct from the submentum; the submentum is confluent with the gula; the gular pits extend the length of the gular sutures.

Maxilla - The maxilla is essentially the same as the maxilla of Euconnus.

STAPHYLINIDAE

Species studied: Staphylinus vulpinus Nordm. (Fig. 16)

Characters:

Labium - The ligula has four lobes, the outer ones of which probably represent the paraglossae; the palpifers are weakly fused; the mentum is distinct from the submentum; the submentum is fused with the narrow gula; the gular pits are distinct.

Maxilla - The basistipes and palpifer are elongate; the mediostipes is not demarked from the lacinia; the dististipes is reduced to a narrow strip of membrane between the mediostipes and the palpifer; the galea is divided into a basigalea and distigalea.

PGELAPHIDAE

Species studied: Pselaphus dresdensis Herbst (Fig. 17)

Characters:

Labium - The ligula is composed of the membranous paraglossae and two small, sclerotized areas which may represent the glossae; the palpifers are partially fused; the basal segments of the labial palpi are contiguous; the mentum is distinct from the submentum; the submentum is fused with the head capsule and is weakly demarked from the gula; the gular pits are distinct; the gular sutures are not apparent.

Maxilla - The mediostipes is fused with the lacinia; the palpifer is rather wide; the galea is divided into a basigalea and distigalea; the third segment of the maxillary palpus is very short and the terminal segment is elongate.

PTILIDAE

Species studied: Trichopteryx lata Motsch. (Fig. 18)

Characters:

Labium - The ligula is elongate and partly membranous; the labial palpi are small; a mental membrane is present; the mentum is distinct from the submentum; the submentum is weakly demarked from the gula, which is confluent with the head capsule; the gular pits are distinct.

Maxilla - The basistipes is fused with the palpifer; the mediostipes is distinct from the lacinia; the galea is divided into a basigalea and distigalea.

CLAVIGERIDAE

Species studied: Claviger testaceus (Fig. 19)

Characters:

Labium - The labium is highly specialized; the ligula, labial palpi, and premental region are lacking; the mentum, which has become the terminal region, is demarked from the submentum; the submentum is confluent with the gula; the gular sutures are lacking; the gular pits are distinct.

Maxilla - The maxilla also is greatly modified and is weakly sclerotized; the stipes is not differentiated into a basistipes and mediostipes; the lacinia bears a fringe of long setae; the galea is poorly demarked and bears a brush of long setae; the palpifer is indistinct.

SPHAERIIDAE

Species studied: Sphaerius acaroides Waltl. (Fig. 20)

Characters:

Labium - The ligula is broad and is sclerotized and rounded distally; the palpifers are not apparent in the fused premental region; the mentum is short and distinct from the submentum; the submentum is demarked from the gula; the gular pits are distinct.

Maxilla - The basistipes is distinct from the mediostipes; the mediostipes is fused with the slender, pointed lacinia; the galea is not divided into a basigalea and distigalea.

SCAPHIDIIDAE

Species studied: Scaphidium quadrimaculatum Oliv. (Fig. 21)

Characters:

Labium - The ligula is wide, and is composed of the paraglossae and a faintly demarked median area which may represent the fused glossae; the palpigers are widely separated; a mental membrane is present; the mentum is distinct; the anterior portion of the submentum is broad and is weakly demarked from the encroaching head capsule, while the posterior region has been reduced by the inrolling of the head capsule until a median suture is all that indicates it; the gular region has been obliterated except for a small basal portion; the gular pits are not apparent.

Maxilla - The basistipes is distinct from the mediostipes; the mediostipes is fused with the lacinia; the galea is divided into a basigalea and distigalea.

SPHAERITIDAE

Species studied: Sphaerites glabratus (Fab.) (Fig. 22)

Characters:

Labium - The ligula is broad; the palpigers are narrowly separated; the mentum is distinct; the submentum and gula are confluent; the gular pits are distinct.

Maxilla - The basistipes is demarked from the mediostipes; the mediostipes is fused with the lacinia; the lacinia bears a dense fringe of setae along its lateral margin, and an immovable digitus distally; the galea is divided into a basigalea and distigalea.

HISTERIDAE

Species studied: Hister obtusatus Harr. (Fig. 23)

Characters:

Labium - The ligula is largely composed of the elongated, membranous lobes of the paraglossae; the palpigers are long and narrowly separated; the mentum is distinct and has a deep, median notch in its anterior margin; the submentum is small and tapering; the gula has been obliterated by the inrolling of the head capsule; a single median suture demarks the gula, gular pits, and gular sutures externally.

Maxilla - The dististipes and mediostipes are distinct; the lacinia bears a lateral fringe of setae, and two spines distally; the galea is divided into a basigalea and distigalea.

LYCIDAE

Species studied: Eros aurora Hbst. (Fig. 24)

Characters:

Labium - The ligula is very small and membranous; the palpigers are fused, but demarked by a weak median suture;

the mentum is faintly demarked from the submentum; the submentum is weakly demarked from the head capsule and is confluent with the gula; the gular pits are distinct.

Maxilla - The basistipes is broad and is only faintly demarked from the small mediostipes; the lacinia is small and membranous; the galea is divided into a basigalea and distigalea.

LAMPYRIDAE

Species studied: Lucidota atra (Fab.) (Fig. 25)

Characters:

Labium - The ligula is small, bilobed, and membranous; the palpigerae are fused, but demarked by a median suture; the mentum is weakly sclerotized and is poorly demarked from the submentum which is confluent with the short, wide gula; the gular pits are distinct.

Maxilla - The stipes is not differentiated into a basistipes and mediostipes; the lacinia and galea are not distinguishable, but are represented by a single maxillary lobe, the mala.

PHENGODIDAE

Species studied: Phengodes sp. (Fig. 26)

Characters:

Labium - The ligula is broad and partly membranous;

but has a median area which is weakly sclerotized and is confluent with the palpigers; the palpigers are fused indistinguishably; the mentum is confluent with the submentum; the submentum is weakly demarked from the encroaching head capsule; the gula has been obliterated by the inrolling of the head capsule; the gular pits form a single median depression; a single median suture indicates the gula, which has been obliterated by the inrolling of the head capsule.

Maxilla - The basistipes is weakly demarked from the mediostipes; the mediostipes is fused with the lacinia; the galea is not divided into a basigalea and distigalea.

CANTHARIDAE

Species studied: Cantharis andersoni Frost (Fig. 27)

Characters:

Labium - The ligula is broad, bilobed, and membranous; the palpigers are narrowly separated; the mentum, submentum, and gula are confluent; the gular pits are distinct.

Maxilla - The cardo is divided into a basicardo and disticardo; the stipes is not differentiated into a basistipes and mediostipes and is not demarked from the poorly developed lacinia; the galea is not divided into a basigalea and distigalea.

MELYRIDAE

Species studied: Malachius aeneus (L.) (Fig. 28)

Characters:

Labium - The ligula is broad and membranous; the palpifers are fused but demarked by a median suture; a mental membrane is present; the mentum is very short and is weakly demarked from the mental membrane and submentum; the submentum is weakly demarked from the broad gula; the gular pits extend along the gular sutures.

Maxilla - The basistipes is distinct from the mediostipes; the mediostipes is demarked from the lacinia; the galea is divided into a basigalea and distigalea; the palpifer is small.

CLERIDAE

Species studied: Trichodes ornatus Say (Fig. 29)

Characters:

Labium - The ligula is rather broad and is membranous; the palpifers are contiguous; a mental membrane is present; the mentum is short and is poorly differentiated from the mental membrane, but is definitely demarked from the submentum; the submentum is confluent with the gula; the gular pits extend the length of the gular sutures.

Maxilla - The basistipes is distinct from the mediostipes; the mediostipes is fused with the lacinia; the dististipes is represented by a small, membranous area; the

lacinia is elongate and has a loosely attached membranous lobe; the galea is divided into a basigalea and a long distigalea.

CORYNETIDAE

Species studied: Chariessa pilosa Forst. (Fig. 30)

Characters:

Labium - The ligula is broad and bilobed; the palpigers are fused indistinguishably; a mental membrane is present; the mentum is weakly demarked from the mental membrane but definitely demarked from the submentum; the submentum is confluent with the narrow gula; the gular pits are distinct.

Maxilla - The maxilla is essentially like that of Trichodes but has the membranous lobe partly overlapping the lacinia.

OTHNIIDAE

Species studied: Othnius kraatzii (Fig. 31)

Characters:

Labium - The ligula is broad and is membranous in its distal portion; the palpigers are not discernible but probably have become fused in the premental region; a short mental membrane is present; the mentum is clearly demarked; the submentum is fused laterally with the head capsule and is not definitely demarked from the wide gula; the gular pits are distinct.

Maxilla - The basistipes is demarked from the mediostipes; the mediostipes is fused with the lacinia; the galea is divided into a basigalea and distigalea.

LYMEXYLIDAE

Species studied: Hylocoetus dermestoides L. (Fig. 32)

Characters:

Labium - The ligula is rather broad and rounded; the palpigers are fused, but demarked by a median suture; a mental membrane is present; a membranous area lies between the sclerotized region of the mentum and submentum; the submentum is weakly demarked from the head capsule and is confluent with the broad gula; the gular pits are distinct.

Maxilla - The stipes is not differentiated into a basistipes and mediostipes and is fused with the lacinia; the lacinia is small and pointed; the galea is not divided into a basigalea and distigalea.

CUPEDIDAE

Species studied: Cupes latreillei Sol. (Fig. 33)

Characters:

Labium - The ligula is composed of two irregular, membranous lobes; the palpigers are small and widely separated; the mentum is long and broad and is distinct from the submentum; the submentum is confluent with the gula; the anterior region of the gula, which lies between the two small gular pits, is distinct, but the posterior region has been obliterated by the encroaching head capsule;

the gular sutures are distinct for a very short distance behind the gular pits, but fuse posteriorly to form a single median suture.

Maxilla - The basistipes is distinct from the mediostipes; the mediostipes is weakly demarked from the elongate lacinia; the galea is "petiolate" but not differentiated into a basigalea and distigalea.

CEPHALOIDAE

Species studied: Cephaloon lepturides Newm. (Fig. 34)

Characters:

Labium - The ligula is composed of the membranous paraglossae and a median, sclerotized region which may represent the fused glossae; the palpigers are widely separated; the mentum is distinct from the submentum; the submentum is very long and is confluent with the gula; the gular pits and gular sutures are distinct but are not shown in figure.

Maxilla - The basistipes and mediostipes are distinctly demarked; the lacinia is long and narrow; the galea is divided into a basigalea and a long distigalea.

OEDEMERIDAE

Species studied: Ditylus laevis Fab. (Fig. 35)

Characters:

Labium - The ligula is broad and partly membranous; the palpigers are widely separated; the mentum is distinct

from the submentum; the submentum is confluent with the gula and is weakly demarked from the head capsule; the gular pits are distinct.

Maxilla - The basistipes and mediostipes are distinctly demarked; the dististipes is represented by a small membranous area; the galea is divided into a basigalea and distigalea.

MORDELLIDAE

Species studied: Tomoxia bidentata (Say) (Fig. 36)

Characters:

Labium - The ligula is composed of two broad, membranous lobes; the palpigers are narrowly separated; a mental membrane is present; the mentum is not definitely demarked from the mental membrane but is distinctly demarked from the submentum by an intervening strip of membrane; the submentum is confluent with the gula; the gular pits are distinct.

Maxilla - The basistipes and mediostipes are distinctly demarked; the dististipes is represented by a small membranous area; the lacinia is long and is more heavily sclerotized at its base; the galea is divided into a basigalea and a distigalea.

RHIPHORIDAE

Species studied: Rhipiphorus dimidiatus Fab. (Fig. 37)

Characters:

Labium - The ligula is small and bilobed; the palpi-
gers are contiguous; the mentum is distinct from the
submentum; the submentum is confluent with the gula; the
gular pits are distinct.

Maxilla - The stipes is not differentiated into a
basistipes and mediotipes and is fused with the lacinia;
the lacinia is narrow and is closely associated with the
basigalea; the distigalea is very long and slender and is
covered with setae.

MELOIDAE

Species studied: Nemognatha piezata Fab. (Fig. 38)

Characters:

Labium - The ligula is broad and has two lateral lobes
separated by a small median area; the palpigers are fused
indistinguishably in the premental region; the mentum is
long and broad; the submentum is confluent with the narrow
gula and is weakly demarked from the mentum, anteriorly,
and from the head capsule laterally; the gular pits are
distinct.

Maxilla - The maxilla is strikingly like that of
Rhipiphorus; the stipes is weakly differentiated into a
basistipes and mediotipes; the distigalea is extremely long
and slender.

PYTHIDAE

Species studied: Pytho americanus Kby. (Fig. 39)

Characters:

Labium - The ligula is broad and bilobed; the palpifers are widely separated; the mentum is broad and distinct; the submentum is weakly demarked from the gula; the gular pits are distinct anteriorly but extend posteriorly along the gular sutures.

Maxilla - The basistipes and mediostipes are distinct; a small membranous area represents the dististipes; the galea is divided into a basigalea and distigalea.

PYROCHROIDAE

Species studied: Pyrochroa coccinea L. (Fig. 40)

Characters:

Labium - The ligula is broad and bilobed; the palpifers are widely separated; the mentum is distinctly demarked from the submentum, but is weakly demarked from the premental region; the submentum is confluent with the gula; the gular pits are distinct.

Maxilla - The maxilla is very similar to that of Pytho; the lacinia and distigalea are comparatively shorter; the palpifer is longer.

PEDILIDAE

Species studied: Pedilus collaris (Say) (Fig. 41)

Characters:

Labium - The ligula is broad and bilobed; the palpi-
gers are narrowly separated; a short region of mental
membrane is present; the mentum is separated from the
submentum by an intervening strip of membrane; the sub-
mentum is confluent with the wide gula; the gular pits are
distinct.

Maxilla - The basistipes is distinct from the medio-
stipes; the mediostipes is fused with the lacinia; the
galea is divided into a basigalea and distigalea.

ANTHICIDAE

Species studied: Notoxus calcaratus Horn (Fig. 42)

Characters:

Labium - The ligula is broad and membranous; the
palpigers are small and rather widely separated; the mentum
is small and, together with part of the anterior region of
the submentum, is partially covered by two flap-like pro-
jections of the submental region, or of part of the head
capsule; the submentum is confluent with the gula; the gular
pits extend nearly the length of the gular sutures.

Maxilla - The basistipes and mediostipes are distinct;
the galea is divided into a basigalea and distigalea.

EUGLENIDAE

Species studied: Euglenes pruinosa (Fig. 43)

Characters:

Labium - The ligula is broad; the palpigers are fused indistinguishably in the premental region; the basal segments of the labial palpi are contiguous; a narrow strip of mental membrane is present; the mentum is distinctly demarked; the submentum is confluent with the head capsule and with the gula; the gular pits extend along the gular sutures.

Maxilla - The basistipes and mediostipes are distinct; a small membranous area represents the dististipes; the lacinia is comparatively small; the galea is divided into a basigalea and distigalea.

CEROPHYTIDAE

Species studied: Cerophytum elateroides Latr. (Fig. 44)

Characters:

Labium - The ligula is broad; the palpigers are small and contiguous; the mentum is short and is distinctly demarked from the submentum; the submentum is narrower than the mentum and is distinct from the broad gula; the gular pits are distinct.

Maxilla - The basistipes is distinct from the mediostipes; the mediostipes is weakly demarked from the short lacinia; the galea is divided into a basigalea and distigalea.

CEBRIONIDAE

Species studied: Cebrio gigas Fab. (Fig. 45)

Characters:

Labium - The ligula is broad and bilobed; the palpigers are moderately separated; a narrow strip of mental membrane is present; the mentum is distinctly demarked from the submentum; the submentum is confluent with the gula; the gular pits are distinct.

Maxilla - The basistipes and mediostipes are distinct; the lacinia is short; the galea apparently is not divided into a basigalea and distigalea.

RHIPICERIDAE

Species studied: Sandalus segnis (Fig. 46)

Characters:

Labium - The ligula is slender and membranous; the palpigers are long and contiguous; the mentum is weakly demarked from the submentum; the submentum is confluent with the gula; the gular pits are not distinct.

Maxilla - The stipes is not differentiated into a basistipes and mediostipes and is continuous with the short lacinia; the galea is not divided into a basigalea and distigalea.

ELATERIDAE

Species studied: Alaus oculatus (L.) (Fig. 47)

Characters:

Labium - The ligula is broad and bilobed; the palpigers are narrowly separated; the mentum is definitely demarked

from the submentum; the submentum is weakly demarked from the wide gula; and the gular pits are distinct.

Maxilla - The basistipes and mediotipes are distinct; the lacinia is membranous and is covered with fine setae; the galea is broad and covered with setae but is not divided into a basigalea and distigalea; the palpifer is very small.

MELASIDAE

Species studied: Eucnemis capucina Ahrens (Fig. 48)

Characters:

Labium - The ligula is short, pointed, and membranous; the palpifers are fused but demarked by a median suture; the mentum is distinct from the submentum; the submentum is demarked from the short gula; the gular pits are not distinct.

Maxilla - The basistipes and mediotipes are distinctly demarked; the lacinia is comparatively short and broad; the galea is not divided into a basigalea and distigalea.

THROSCIDAE

Species studied: Throscus dermestoides L. (Fig. 49)

Characters:

Labium - The ligula is wide and bilobed; the palpifers are narrowly separated; the mentum is demarked from the submentum; the submentum is weakly demarked from the short gula; the gular pits are not distinct.

Maxilla - The basistipes is demarked from the mediotipes; the mediotipes is continuous with the lacinia; the galea is divided into a basigalea and distigalea.

BUPRESTIDAE

Species studied: Buprestis fasciata Fab. (Fig. 50)

Characters:

Labium - The ligula is comparatively broad and rounded; the palpigers are widely separated; a narrow strip of mental membrane is present; the mentum is demarked from the submentum; the submentum is confluent with the wide gula; the gular pits are distinct.

Maxilla - The basistipes and mediostipes are distinct; the lacinia is weakly sclerotized basally; the galea is divided into a basigalea and distigalea.

PSEPHINIDAE

Species studied: Psephenus lecontei (Lec.) (Fig. 51)

Characters:

Labium - The ligula is short and broad; the palpigers are narrowly separated; the mental membrane is small; the mentum is demarked from the submentum; the submentum is confluent with the gula; the gular pits extend the length of the gular sutures.

Maxilla - The stipes is not differentiated into a basistipes and mediostipes and is continuous with the lacinia; the small galea is divided into a basigalea and distigalea; the palpifer is comparatively large.

DRYOPIDAE

Species studied: Potamophilus acuminatus Fab. (Fig. 52)

Characters:

Labium - The ligula is very broad distally; the palpigers are contiguous; the mentum is demarked from the submentum; the submentum is weakly demarked from the gula; the gular pits are small and oblique.

Maxilla - The basistipes is demarked from the mediostipes; the mediostipes is poorly demarked from the lacinia; a small, membranous area represents the dististipes; the lacinia is comparatively long and bears four rows of curved setae distally; the galea is divided into a basigalea and distigalea.

HELMIDAE

Species studied: Helmis mangel (Fig. 53)

Characters:

Labium - The ligula is broad and partly membranous; the palpigers are contiguous; the mental membrane is small; the mentum is distinct; the submentum is weakly demarked from the narrowed gula; the gular pits are distinct.

Maxilla - The basistipes is demarked from the mediostipes; the mediostipes is confluent with the lacinia; a small, membranous area represents the dististipes; the galea is divided into a basigalea and distigalea; the maxillary palpus is three-segmented.

GEORYSSIDAE

Species studied: Georyssus laevicollis Germ. (Fig. 54)

Characters:

Labium - The ligula is bilobed; the palpigers are very small and are narrowly separated; a mental membrane is present; the mentum and submentum are distinct; the gula is restricted to a small, anterior region which has not been obliterated by the inrolling of the head capsule; the gular pits have merged to form a single median pit, posterior to which the gular sutures form a single median suture.

Maxilla - The basistipes and mediostipes are distinct; the lacinia is narrow; the galea is divided into a basigalea and distigalea.

HETEROCERIDAE

Species studied: Heterocerus parallelus Kyrnick (Fig. 55)

Characters:

Labium - The ligula is bilobed; the palpigers are not distinguishable in premental region; a mental membrane is present; the mentum is distinctly demarked; the submentum is small and distinct; the gula appears to be very short, because its anterior portion is overlapped by the submentum; the gular pits have been obliterated, but the posterior arms of the tentorium form a pair of swellings between the submentum and the gula.

Maxilla - The basistipes is distinct from the mediostipes; the mediostipes is confluent with the long lacinia; the palpifer is very long; the galea is divided into a basigalea and distigalea.

DASCILLIDAE

Species studied: Dascillus cervinus L. (Fig. 56)

Characters:

Labium - The ligula is composed of two, bilobed, membranous processes which are separated by a small, median, membranous area; the palpifers are widely separated; the mentum is distinct; the submentum is confluent with the gula; the gular pits are elongate and distinct.

Maxilla - The basistipes is demarked from the mediostipes; the mediostipes is fused with the lacinia; the galea is divided into a small basigalea and a bilobed distigalea.

HELODIDAE

Species studied: Scirtes tibialis Guer. (Fig. 57)

Characters:

Labium - The ligula is membranous and has a single, pointed lobe; the palpifers are comparatively widely separated; the mentum is distinct; the submentum is confluent with the wide gula; the gular pits are distinct.

Maxilla - The basistipes and mediostipes are distinctly demarked; the lacinia is elongate; the galea is divided into a small basigalea and a long distigalea.

CHELONARIIDAE

Species studied: Chelonarium ornatum Klug (Fig. 58)

Characters:

Labium - The ligula is composed of two long, slender lobes; the palpigers are small and contiguous; a small mental membrane is present; the small mentum is not distinctly demarked from the mental membrane, but is distinctly demarked from the submentum; the submentum is narrow and is confluent with the gula; the gular pits extend nearly the length of the gular sutures.

Maxilla - The basistipes is distinct; the mediotipes is fused with the short lacinia; a small, membranous area represents the dististipes; the galea has two long, slender, membranous lobes and is not divided into a distinct basigalea and distigalea.

DERMESTIDAE

Species studied: Dermestes lardarius L. (Fig. 39)

Characters:

Labium - The ligula is short and broad; the palpigers are narrowly separated; the mentum is distinct; the submentum is confluent with the wide gula; the gular pits are small and distinct.

Maxilla - The basistipes and mediotipes are distinctly demarked; the lacinia bears a long digitus; the galea is divided into a basigalea and distigalea.

BYRRHIDAE

Species studied: Byrrhus americanus Lec. (Fig. 60)

Characters:

Labium - The ligula is broad and bilobed; the palpifers are narrowly separated; a mental membrane is present; the mentum is distinct; the submentum is short and broad, and is demarked from the wide gula; the gular pits extend the length of the gular sutures.

Maxilla - The basistipes is distinct; the mediotipes is confluent with the lacinia; the galea is divided into a basigalea and distigalea.

RHYSODIDAE

Species studied: Rhysodes sulcatus Fab. (Fig. 61)

Characters:

Labium - The ligula is membranous and bilobed; the palpifers are small and are widely separated; the mentum is large and distinct; the submentum is very small, and is very weakly demarked from the head capsule and the narrow gula; the gular sutures are indistinct; the gular pits are not apparent.

Maxilla - The basistipes and mediotipes are both small and are distinctly demarked; the lacinia is long and slender; the galea is divided into a basigalea and a long, slender distigalea; the palpifer is large.

OSTOMIDAE

Species studied: Ostoma grossa (L.) (Fig. 62)

Characters:

Labium - The ligula is bilobed and bears long setae densely arranged; the palpigers are not apparent but probably have fused to form the premental region; the mentum is weakly demarked from the mental membrane, but is distinctly demarked from the submentum by an intervening strip of membrane; the submentum is demarked from the narrow gula; the gular pits extend along the posterior portion of the gular sutures.

Maxilla - The basistipes is distinct; the mediostipes is confluent with the lacinia; the lacinia terminates in a claw-like digitus; the galea is divided into a basigalea and distigalea.

NITIDULIDAE

Species studied: Prometobia sexmaculata (Say) (Fig. 63)

Characters:

Labium - The ligula is small and bilobed, and bears two small processes; the palpigers are small and are narrowly separated; the mentum is broad and distinct, and has two lateral lobes which extend forward as far as the distal portion of the ligula; the submentum is broad and is confluent with the gula; the gular pits are distinct; the gular sutures are not definite.

Maxilla - The basistipes is distinct; the mediostipes is fused with the single maxillary lobe, the mala.

RHIZOPHAGIDAE

Species studied: Rhizophagus picipes (Fig. 64)

Characters:

Labium - The ligula is partly membranous and is bilobed; the palpigers are fused with the premental region; the mental membrane is small; the mentum is distinct; the submentum is confluent with the gula and is not demarked laterally from the head capsule; the gular pits are distinct.

Maxilla - The basistipes is distinct; the mediostipes is confluent with the long lacinia; the long, slender galea is not divided into a basigalea and distigalea.

MONOTOMIDAE

Species studied: Monotoma conicicollis (Fig. 65)

Characters:

Labium - The ligula is broad, rounded, and partly membranous, and has a median suture; the palpigers are fused in the premental region; the mentum and the submentum are distinctly demarked; the gula has been obliterated by the inrolling of the head capsule except for its proximal region; the gular pits extend the length of the gular sutures.

Maxilla - The basistipes is distinctly demarked; the mediostipes is confluent with the long and slender lacinia; the galea is not divided into a basigalea and distigalea; the first segment of the palpus is very small.

CUCUJIDAE

Species studied: Cucujus clavipes Fab. (Fig. 66)

Characters:

Labium - The ligula is bilobed and partly membranous; the palpigers are short and are widely separated; a mental membrane is present; the mentum is wide and is distinctly demarked; the mentum is weakly demarked from the head capsule and the narrow gula; the gular pits extend the length of the gular sutures.

Maxilla - The basistipes and mediotipes are distinctly demarked; the lacinia is comparatively long; the galea is divided into a basigalea and distigalea.

EROTYLIDAE

Species studied: Megalodacne grandipennis (Fig. 67)

Characters:

Labium - The ligula consists of two membranous lobes, the paraglossae, and a large, hood-like, sclerotized region which has a median suture; the palpigers are very broad and are narrowly separated; the wide mentum is distinct, and is irregular in contour, due to the presence of grooves and ridges; the submentum is weakly demarked from the head capsule and the gula; the gula is very broad; the gular pits are distinct.

Maxilla - The basistipes is distinctly demarked and is long and slender in its distal region; the mediotipes is

confluent with the lacinia; the galea is divided into a very short basigalea and a long, slender distigalea.

DERODONTIDAE

Species studied: Derodontus maculatus (Melsh.) (Fig. 68)

Characters:

Labium - The ligula is composed of two membranous lobes, the paraglossae, and a median sclerotized area; the palpigers are small and are widely separated; a mental membrane is present; the mentum is distinct; the submentum is confluent with the gula and is weakly demarked from the head capsule; the gular pits are distinct.

Maxilla - The basistipes is distinctly demarked; the mediostipes is confluent with the lacinia; the lacinia is slender and terminates in a claw-like digitus; the galea is divided into a basigalea and distigalea.

CRYPTOPHAGIDAE

Species studied: Antherophagus ochraceus Melsh. (Fig. 69)

Characters:

Labium - The ligula has two lateral, membranous lobes and a sclerotized median region; the palpigers are fused in the premental region; the mentum is distinct and has a transverse ridge; the submentum is confluent with the gula; the gular pits are distinct.

Maxilla - The basistipes is distinctly demarked; the mediostipes is weakly demarked from the lacinia; the lacinia is long and slender and terminates in a claw-like digitus; the galea is divided into a basigalea and distigalea.

MYCETOPHAGIDAE

Species studied: Mycetophagus punctatus Say (Fig. 70)

Characters:

Labium - The ligula is broad and sclerotized; the palpigers are comparatively small and are widely separated; a mental membrane is present; the mentum is clearly demarked; the submentum is demarked from the narrow gula; the gular pits are distinct.

Maxilla - The basistipes and mediostipes are distinct; the lacinia is long and slender; the galea is divided into a basigalea and distigalea.

COLYDIIDAE

Species studied: Trachypholis ornatus (Fig. 71)

Characters:

Labium - The ligula is composed of a small, membranous, terminal lobe and a broad, sclerotized region; the palpigers are fused in the premental region; the mentum is distinct; the submentum is confluent with the gula and is weakly demarked laterally from the head capsule; the gular pits are large and distinct.

Maxilla - The basistipes is distinct; the mediostipes is weakly demarked from the lacinia; the lacinia is long and is terminated in a claw-like digitus; the galea is divided into a basigalea and distigalea.

MURMIDIIDAE

Species studied: Murmidius ovalis Beck. (Fig. 72)

Characters:

Labium - The ligula is composed of two lateral, membranous lobes and a median, sclerotized region; the palpigers are fused in the premental region; a mental membrane is present; the mentum and the submentum are distinctly demarked; the gula is short; the gular pits are distinct.

Maxilla - The basistipes and mediostipes are distinctly demarked; the lacinia is long; the galea is divided into a basigalea and distigalea.

LATHRIDIIDAE

Species studied: Lathridius lardarius De G. (Fig. 73)

Characters:

Labium - The ligula is composed of a sclerotized basal area and two very small, membranous lobes; the palpigers are not apparent; the mentum is weakly demarked from the premental region; the submentum is poorly demarked from the gula and has a peculiar raised margin along its lateral and anterior borders; the gular pits are distinct.

Maxilla - The stipes is not differentiated into a basistipes and mediotipes, and is confluent with the single maxillary lobe, the mala; the palpifer is apparently fused with the stipes.

MYCETAEIDAE

Species studied: Mycetaea hirta (Marsh.) (Fig. 74)

Characters:

Labium - The ligula is broad and sclerotized; the palpigers are fused in the premental region; the mentum is distinct; the submentum is weakly demarked from the head capsule; the gula is very short; the gular pits are distinct.

Maxilla - The basistipes and mediotipes are distinct; the lacinia is long and slender; the galea is not divided into a basigalea and distigalea.

ENDOMYCHIDAE

Species studied: Lycoperdina ferruginea Lec. (Fig. 75)

Characters:

Labium - The ligula is broad and is membranous distally, and sclerotized basally; the palpigers are rather narrowly separated; a mental membrane is present; the mentum is distinct; the submentum is narrowly continuous with the head capsule laterally; the gula is very short; the gular pits are distinct.

Maxilla - The basistipes and mediotipes are distinctly demarked; the lacinia is comparatively long and slender; the galea is divided into a basigalea and distigalea.

PHALACRIDAE

Species studied: Phalacrus grossus Erichs. (Fig. 76)

Characters:

Labium - The ligula is broad and is sclerotized except for its membranous distal margin; the palpigers are widely separated; a mental membrane is present; the mentum is distinct; the submentum is short and broad, and is weakly demarked from the head capsule; the gula is very short; the gular pits are distinct.

Maxilla - The basistipes and mediostipes are distinctly demarked; the lacinia is long and bears two long, pointed processes at its tip; the galea is divided into a basigalea and distigalea.

COCCINELLIDAE

Species studied: Anatis quindecimpunctata (Oliv.) (Fig. 77)

Characters:

Labium - The ligula is broad and weakly sclerotized; the palpigers are fused in the premental region; the mental membrane is small; the mentum is distinct; the submentum is confluent with the broad gula and is weakly demarked from the head capsule; the gular pits are distinct.

Maxilla - The basistipes and mediostipes are distinct; the lacinia is comparatively short and broad; the galea is divided into a basigalea and distigalea.

ALLECULIDAE

Species studied: Hymenorus melsheimeri Say (Fig. 78)

Characters:

Labium - The ligula is broad, sclerotized, and bilobed; the palpigers are fused; a mental membrane is present; the mentum is distinct; the submentum is weakly demarked from the head capsule; the gula is comparatively long; the gular pits are distinct.

Maxilla - The maxilla is essentially like that of Anatis.

LAGRIIDAE

Species studied: Arthromacra aenea (Say) (Fig. 79)

Characters:

Labium - The ligula is broad and sclerotized; the palpigers are fused; the mentum is distinct; the anterior portion of the submentum is weakly demarked from the head capsule, which encroaches upon the remainder of the submental region and reduces it so much that an inverted, Y-shaped suture is its only indication; the gula is invaginated laterally.

Maxilla - The basistipes is distinctly demarked; the mediostipes is distinctly demarked from the lacinia but weakly from the basigalea; the lacinia is comparatively long and broad; the galea is divided into a basigalea and distigalea.

TENEBRIONIDAE

Species studied: Alobates pennsylvanica (De G.) (Fig. 80)

Characters:

Labium - The ligula is broad and is well sclerotized; the palpigers are rather widely separated; the anterior portion of the submentum is distinctly demarked, but its median and posterior regions are obliterated by the encroaching head capsule, thus forming a single, median suture between the recognizable submentum and gula; the gula is demarked externally by the gular sutures, and internally by ridges with which the posterior arms of the tentorium have fused.

Maxilla - The basistipes and mediostipes are distinctly demarked; the lacinia bears two pointed processes distally; the galea is divided into a large basigalea and distigalea.

MONOMMIDAE

Species studied: Monomma maximum (Fig. 81)

Characters:

Labium - The ligula is broad and sclerotized; the palpigers are fused in the premental region; the mentum is distinct and ridged; the submentum is confluent with the gula, is weakly demarked from the head capsule, and has a median tuft of bristles; the gular pits are distinct and oblique.

Maxilla - The basistipes is very large and distinct; the mediostipes is demarked from the lacinia; the galea is divided into a basigalea and distigalea; the palpifer is large.

MELANDRYIDAE

Species studied: Penthe obliquata (Fab.) (Fig. 82)

Characters:

Labium - The ligula is broad and sclerotized; the palpifers are fused in the premental region; the terminal segment of the labial palpus is constricted, thereby giving the appearance of a four-segmented palpus; a short mental membrane is present; the mentum is distinct; anteriorly the submentum is distinct, but posteriorly the encroachment of the head capsule reduces it to an inverted, Y-shaped suture; the gular pits are distinct.

Maxilla - The cardo is very broad; the basistipes and mediostipes are fused distally and are faintly demarked from the basigalea; the lacinia is slender; the galea is weakly divided into a basigalea and distigalea.

PTINIDAE

Species studied: Oligomerus brunneus Oliv. (Fig. 83)

Characters:

Labium - The ligula is broad and sclerotized; the palpifers are fused in the premental region; the mentum is distinct; the submentum is weakly demarked from the head capsule; the gula is apparently invaginated laterally, and these invaginations fuse with the posterior tentorial arms;

the gular pits are not distinct.

Maxilla - The basistipes is broad and distinctly demarked; the mediostipes is fused with the lacinia; the galea is not divided into a basigalea and distigalea.

ANOBIIDAE

Species studied: Sitodrepa panicea (L.) (Fig. 84)

Characters:

Labium - The ligula is membranous, and is composed of a median lobe and two lateral lobes, which probably represent the paraglossae; the palpigers are contiguous; the mentum is distinct; the submentum is weakly demarked from the head capsule; the lateral areas of the gula are invaginated and fuse internally with the posterior tentorial arms; the gular pits are distinct.

Maxilla - The basistipes is distinct; the mediostipes is weakly demarked from the broad lacinia; the galea is divided into a very small basigalea and a large distigalea.

BOSTRICHIDAE

Species studied: Apate terebrans Pall. (Fig. 85)

Characters:

Labium - The ligula is comparatively broad and is sclerotized; the palpigers are fused; there is a mental membrane present; the mentum is weakly demarked from the mental membrane and from the submentum; the submentum is

weakly demarked from the gula; the gula is long and narrow, and apparently its lateral areas are invaginated; the gular pits are distinct, but the posterior tentorial arms are fused with the gular invaginations.

Maxilla - The cardo is elongate; the basistipes and mediostipes are weakly demarked; the lacinia is short and broad; the galea is divided into a basigalea and distigalea.

LYCTIDAE

Species studied: Lyctus linearis (Goeze) (Fig. 86)

Characters:

Labium -- The ligula is composed of a median, sclerotized lobe and two lateral, membranous lobes, which probably represent the paraglossae; the palpifers are rather narrowly separated; the mentum is distinct; the submentum is confluent with the narrow gula; the gular pits are distinct.

Maxilla - The basistipes is distinctly demarked; the mediostipes is fused with the lacinia; the galea is divided into a basigalea and a long distigalea.

SPHINDIDAE

Species studied: Sphindus dubius Gyllh. (Fig. 87)

Characters:

Labium - The ligula is broad and sclerotized; the palpifers are widely separated; the mentum is distinct; the submentum is confluent with the gula and is weakly demarked

from the head capsule laterally; the gula is short; the gular pits extend the length of the gular sutures.

Maxilla - The basistipes is fused with the mediostipes distally; the mediostipes is weakly demarked from the long lacinia; the galea is not divided into a basigalea and distigalea.

CISIDAE

Species studied: Cis boleti Scopoli (Fig. 88)

Characters:

Labium - The ligula is lacking; the palpigers are contiguous; the mental membrane is small; the mentum is small and is distinctly demarked; the submentum is confluent with the gula; the gular pits are small and distinct.

Maxilla - The basistipes is distinct; the mediostipes is confluent with the short lacinia; the galea is not divided into a basigalea and distigalea.

SCARABAEIDAE

Species studied: Geotrupes splendidus (Fab.) (Fig. 89)

Characters:

Labium - The ligula is bilobed and sclerotized; the palpigers are widely separated; the mentum is distinct; the submentum is weakly demarked from the gula; the gular pits are distinct. Geotrupes does not exhibit an invagination of the submental region which Snodgrass (1935) describes and figures as occurring in Phyllophaga. Popillia japonica

shows the submental invagination mentioned by Snodgrass, but to a lesser degree than Phyllophaga.

Maxilla - The basistipes is distinctly demarked; the mediostipes is confluent with the lacinia; the galea is not divided into a basigalea and distigalea.

LUCANIDAE

Species studied: Pseudolucanus capreolus (L.) (Fig. 90)

Characters:

Labium - The ligula is slender, bilobed, and sclerotized; the palpifers are narrowly separated; the mentum is short and broad and is distinctly demarked; the submentum is very broad and is weakly demarked from the wide gula; the gular pits extend the length of the gular sutures.

Maxilla - The basistipes is distinctly demarked and has a flap-like, sclerotized, lateral projection; the mediostipes is weakly demarked from the lacinia and has a lateral projection; the lacinia is pocket-like and is curled about the basal region of the galea; the galea is divided into a small basigalea and a long, hairy distigalea; the large palpifer has a flap-like, lateral margin.

PASSALIDAE

Species studied: Passalus cornutus Fab. (Fig. 91)

Characters:

Labium - The ligula is broad and sclerotized; the palpifers are fused in the premental region; the mentum is distinct; the submentum is weakly demarked from the gula; a large swelling occupies most of the gular region; an internal ridge extends nearly the entire length of the median gular region, but is not demarked by a suture externally; the gular pits are not apparent.

Maxilla - The cardo is elongate; the basistipes is long and slender, and is distinctly demarked; the mediostipes is continuous with the lacinia; the lacinia is long and bears a crescentric projection distally; the galea is not divided into a basigalea and distigalea, but bears a claw-like projection distally; the palpifer is very long.

CERAMBYCIDAE

Species studied: Tetraopes tetraophthalmus (Forst.) (Fig. 92)

Characters:

Labium - The ligula is broad and sclerotized; the palpifers are fused in the premental region; a mental membrane is present; the mentum is weakly demarked from the mental membrane; the submentum is confluent with the wide gula and is weakly demarked from the head capsule laterally; the gular pits extend the length of the gular sutures.

Maxilla - The basistipes is distinct; the mediostipes is weakly demarked from the wide lacinia; the galea is not divided into a basigalea and distigalea; the palpifer is comparatively small.

CHRYGOMFLIDAE

Species studied: Leptinotarsa decemlineata (Say) (Fig. 93)

Characters:

Labium - The ligula is broad and sclerotized; the palpigers are widely separated and weakly demarked; a short strip of mental membrane is present; the mentum and submentum are distinctly demarked; the gula is wide; the gular pits are distinct.

Maxilla - The basistipes is distinct; the mediostipes is fused with the wide lacinia; the galea is divided into a basigalea and distigalea.

MYLABRIDAE

Species studied: Mylabris discoides Say (Fig. 94)

Characters:

Labium - The ligula is comparatively wide and is partly membranous; the palpigers are fused in the premental region; the mentum and submentum are distinctly demarked; the gular pits are distinct.

Maxilla - The basistipes is small and weakly demarked; the mediostipes is fused with the lacinia; the galea is not divided into a basigalea and distigalea; the palpifer is weakly demarked.

BRENTIDAE

Species studied: Eupsalis minuta Drury (Fig. 95)

Characters:

Labium - The ligula is comparatively small and is heavily sclerotized, and has no labial palpi or palpifers evident; the mentum and submentum are confluent, and are continuous with the head capsule anteriorly; the gular region is obliterated by the encroaching head capsule and is represented by a median, gular suture.

Maxilla - The cardo is small and slender; the stipes is composed of a slender, sclerotized portion and a membranous area, and is not differentiated into a basistipes and mediostipes; there is a single, elongate, maxillary lobe, the mala; the palpifer is distinct; the maxillary palpus is three-segmented.

BELIDAE

Species studied: Ithycerus noveboracensis (Forst.) (Fig. 96)

Characters:

Labium - The ligula is small and membranous; the palpifers are not apparent; the mentum is distinct; the submentum is distinctly demarked and tapers proximally; the gula is obliterated by the encroaching head capsule, and is represented by a median gular suture.

Maxilla - The basistipes and mediostipes are comparatively small and are distinctly demarked; the lacinia is slender and its lateral margin is covered with peg-like setae; the galea is not divided into a basigalea and distigalea; the palpifer is very large; the palpus is three-segmented.

PLATYSTOMIDAE

Species studied: Platystomus albinus L. (Fig. 97)

Characters:

Labium - The ligula is composed of two slender, sclerotized lobes; the palpigers are fused to form a Y-shaped structure; the mentum is small and is weakly demarked from the broad submentum; the submentum is confluent with the gula and with the head capsule; the gula is not demarked from the head capsule; the elongate gular pits are situated just posterior to the submentum.

Maxilla - The cardo is elongate; the stipes is not differentiated into a basistipes and mediostipes, and is fused with the lacinia; the long, slender lacinia bears a pointed digitus distally; the galea is divided into a small basigalea and a long distigalea.

CURCULIONIDAE

Species studied: Lixus concavus Say (Fig. 98)

Asynonychus godmani Croten (Fig. 99)

Characters:

Labium - The ligula in Lixus is short, broad, and heavily sclerotized; the palpigers are not apparent; the mentum is distinctly demarked; the submentum is very long and tapered, and is weakly demarked from the head capsule proximally; the gula is obliterated by the inrolling of the head capsule and is represented by a median gular suture; the gular pits have fused to form a single median pit.

Maxilla - The stipes in Lixus is not differentiated into a basistipes and mediostipes and is fused with the single maxillary lobe, the mala; the palpifer is large; the palpus is three-segmented.

Labium - The ligula is lacking in Asynonychus; the palpifers are weakly demarked; the mentum is distinct and is broad distally but tapered proximally; the submentum is small; the gula is obliterated by the encroaching head capsule and is represented by a median gular suture.

Maxilla - The basistipes and mediostipes in Asynonychus are weakly demarked; the lacinia is short; the small galea is not divided into a basigalea and distigalea; the palpifer is comparatively large; the palpus is three-segmented.

PLATYPODIDAE

Species studied: Platypus cylindricus Fab. (Fig. 100)

Characters:

Labium - The ligula is lacking; the palpifers are not apparent; the mentum is distinctly demarked; the submentum is distinct and is broad distally, but tapered proximally; the gula is obliterated by the head capsule and is represented by a very short, median, gular suture; the gular pits are not apparent.

Maxilla - The stipes is composed of a slender, sclerotized area and a membranous region; the lacinia is a

slender process; the galea is not divided into a basigalea and distigalea, and bears a brush of long setae distally; the palpifer is apparently fused narrowly with the galea; the maxillary palpus has three weakly sclerotized segments.

SCOLYTIDAE

Species studied: Dendroctonus valens Lec. (Fig. 101)

Characters:

Labium - The ligula is small and sclerotized; the palpifers are not apparent; the mental membrane is small; the mentum is narrow and distinctly demarked; the submentum is confluent with the head capsule laterally; the gula is obliterated by the encroaching head capsule and is represented by a median gular suture.

Maxilla - The stipes is very broad, and is not differentiated into a basistipes and mediostipes; a single maxillary lobe, the mala, is present; the palpifer is not apparent, but probably is fused with the stipes; the maxillary palpus is three-segmented.

PHYLOGENETIC ASPECTS

ADEPHAGA

Caraboidea

A comparative study of the labium and maxilla of Coleoptera indicates that the families of the Adephaga, namely, the Cicindelidae, Carabidae, Amphizoidae, Omophronidae, Haliplidae, Dytiscidae, and Gyrinidae, undoubtedly form the closest and best defined group of any in the entire order. Leng (1920), Stickney (1923), and Tanner (1927) place this group as the most primitive in the phylogenetic scheme. From the standpoint of the labium and maxilla alone, however, these families exhibit specialization when compared with a form like Silpha (Fig. 13) which was selected as a representative of the family Silphidae. Crampton (1925) has homologized the labium of Silpha with that of the primitive and "ancestral" roach, Periplaneta, on the one hand, and, on the other, with the labium of the Carabid, Harpalus.

A comparison of Harpalus (Fig. 2) with Silpha (Fig. 13) indicates that Harpalus is specialized in the following features: the ligula is narrowed and crowded forward; the palpigerae are elongated; the mentum is enlarged; the submentum is reduced; the gula is very narrow due to the inrolling of the head capsule and consequent invagination of the lateral

areas of the gula. The maxilla of Harpalus also exhibits the following modifications when compared with that of Silpha: the cardo, stipes, and lacinia are narrowed; the membranous dististipes is lost; the galea is a slender process. In view of these facts, the family Silphidae, which is undoubtedly related to the families of the Adephaga, should be considered as more primitive than the Adephagous families.

The family Cicindelidae, represented by Cicindela (Fig. 1), is considered by Leng (1920) to be the most primitive of the Coleoptera. When the figures of the labium and maxilla are compared (Figs. 1, 2 - 7) it is evident that the family Cicindelidae is more specialized than the rest of the Adephagous families. The ligula is lacking, the submentum is very small, and the maxilla is elongated and has an articulated digitus. Comparison of Figures 1 - 7 clearly shows the similarity of structure of both the labium and maxilla throughout the Adephagous series, and it is evident that the family Paussidae (see Fig. 8), although more highly specialized, should be included in this series.

Gyrinoidea

The superfamily Gyrinoidea includes one family, the Gyrinidae, represented by Dinutes (Fig. 7). This family is so closely related to the families of the Caraboidea it should be included in this superfamily.

POLYPHAGA

Hydrophiloidea

The superfamily Hydrophiloidea contains only one family, the Hydrophilidae, represented by Tropisternus (Fig. 9). According to Stickney's studies of the head capsule, and Tanner's studies of the female genitalia, the Hydrophilidae should be grouped with the Adephaga, since its characters are similar to those of the Dytiscidae and Gyrinidae. The comparative study of the labium and maxilla, however, does not warrant the grouping of the Hydrophilidae with the Adephagous families. The nature of the labium and maxilla of Tropisternus (Fig. 9) indicates that the family Hydrophilidae more closely resembles some of the families of the Polyphaga, the less specialized Silphidae, for example (see Fig. 13). This grouping of the superfamily Hydrophiloidea with the Polyphaga supports Forbes' studies of the wings and Leng's classification.

Silphoidea

The superfamily Silphoidea, as listed by Leng, includes the families Platypsyllidae, Leptinidae, Silphidae, Clambidae, Scydmaenidae, and Orthoperidae (Figs. 10 - 15). Silpha is probably the most generalized of any form figured in this series. Its resemblance to the Caraboidea has already been indicated, and it is also very similar to staphylinus (Fig. 16), among the Staphylinidae. Tanner places the

Staphylinidae in the Silphoid series, while Forbes places the two families as very near together forming "an isolated group apparently not nearer the Polyphaga than Adephaga."

Platypsylla, although rather highly specialized, clearly resembles Leptinus in the characters of the labium, particularly in the lobed nature of the mentum. Leptinus resembles Silpha in the structure of both the labium and maxilla. The Scydmaenid, Euconus, and the Orthoperid, Orthoperus, also resemble Silpha. In the superfamily Silphoidea, the labium is characterized by a broad ligula, a comparatively long submental region demarked from the head capsule laterally, and distinct gular sutures and gular pits. The maxilla in all forms has the mediostipes confluent with the lacinia and the galea divided into a basigalea and distigalea.

Staphylinoidea

The superfamily Staphylinoidea is comprised of eight families, namely, the Staphylinidae, Pselaphidae, Clavigeridae, Ptilidae, Sphaeriidae, Scaphidiidae, Gphaeritidae, and Histeridae (Figs. 16 - 23). In this superfamily, the labium and maxilla show a rather diversified structure, as indicated in the figures. As mentioned above, Staphylinus strongly resembles Silpha in having the submentum comparatively long and confluent with the narrow gula, in having the gular

sutures and pits distinct, and in having the structure of the maxilla essentially similar. The Silphoid family Clambidae, represented by Clambus (Fig. 12), resembles the Stanphylinoid families Ptilidae, represented by Trichopteryx (Fig. 18), and Sphaeriidae, represented by Sphaerius (Fig. 20). In these three families, the general character of the maxilla is the same. The gular region is short, and the submentum is only weakly demarked from the head capsule. Scaphidium and Hister are alike in having confluent gular sutures and a reduced submental region. Pselaphus, although specialized, bears a striking resemblance to Tuconnus. Claviger, which is also specialized, can be placed near Pselaphus.

Cantharoidea

The superfamily Cantharoidea is a comparatively close-knit group which includes the families Lycidae, Lampyridae, Phengodidae, Cantharidae, Melyridae, Cleridae, and Corynetidae (Figs. 24 - 30). Within this group, the Lycidae and Lampyridae as represented by Eros and Lucidota are very similar. In both forms the gula is short and broad, the mentum and submentum are small and weakly demarked, the palpigerae are fused, and the ligula and labial palpi are essentially alike. The maxilla are also very similar. The Phengodidae and Cantharidae represented by Phengodes and Cantharis can be grouped together. The gula in these two forms is longer than in Eros and Lucidota.

The Clerid, Trichodes, and the Corynetid, Chariessa, are strikingly similar in the structure of the maxilla. Both of the last two genera in the general characters seem to resemble the members of the Mordelloidea more closely than they resemble the members of the Cantharoidea, as is indicated by the breadth of the ligula, the demarkation of the mentum, the development of the gula, the division of the maxillary galea into a basigalea and distigalea, and the development of a long, distinct lacinia. The family Melyridae as represented by Malachius resembles the Cleridae in having a similar structure of the labium. In both cases, the ligula is membranous, the palpigers are contiguous, and the mentum is weakly developed and poorly demarked from the mental membrane. In Malachius, the submentum is weakly demarked from the gula and the gular pits extend the length of the gular sutures, while in Trichodes, the submentum is confluent with the gula and the gular pits extend the length of the gular sutures. The above mentioned affinities of the Cantharoidea are in general agreement with Stickney's views of the group.

Lymexyloidea

Unfortunately, a single family of the Lymexyloidea must be relied upon in attempting to determine the affinities of this group, because representatives of the other two families, the Teleguesidae and Mecromalthidae, were unobtainable.

The Lymexylidae are represented in this discussion by Hylocoetus. Although rather specialized, this genus seems to resemble the Dryopoid genus Psephenus (Fig. 51), particularly in the structure of the maxilla. In both genera, the stipes is not differentiated into a basistipes and mediostipes and is confluent with the lacinia, and the palpifer is a ring-like segment. In the labium in both forms, the palpigers are contiguous, or nearly so, and the submentum is weakly demarked from the head capsule and is confluent with the wide gula. Stickney and Tanner both place this superfamily with the Cucujoidea.

Cupedoidea

The Cupedoidea contains one family, the Cupedidae, represented by Cupes (Fig. 33). Although the form studied is somewhat specialized, the labium resembles this structure in some of the families of the Mordelloidea. The palpigers are widely separated, the mentum is large, the submentum is weakly demarked from the head capsule and is confluent with the gula, as is the case in representatives of the Cephaloidea and Mordellidae (Figs. 34, 35). Apparently the superfamily Cupedoidea should be grouped with the superfamily Mordelloidea as Stickney and Tanner have indicated.

Mordelloidea

Representatives of eleven of the twelve families listed under the superfamily Mordelloidea have been figured (see Figs.

31, 34 - 43), and the group, as a whole, shows considerable homogeneity of structure in the labium and maxilla. In the labium, in most of these forms, the ligula is broad and bilobed, the mentum is well developed, the submentum is confluent with the long gula and is demarked from the head capsule, and the gular pits are usually distinct. In the maxilla, the mediostipes is, in most cases, demarked from the lacinia, and the galea is divided into a basigalea and distigalea. The Rhipiphoridae and the Meloidae, represented by Rhipiphorus and Nemognatha, show a striking similarity in the great elongation of the distigalea of the maxilla and in the close association of the lacinia with the basigalea.

As Stickney has pointed out, the Oedemeridae, Cephaloidae, Pyrochroidae, Pedilidae, and Anthicidae are closely related. All of these forms (see Figs. 34, 35, 40, 41, 42) have the ligula broad and bilobed, the mentum distinct, and the submentum confluent with the long gular region. In all but Notoxus, which represents the Anthicidae, the mediostipes of the maxilla is demarked from the lacinia. The general nature of the labium and maxilla of Othnius, Tomoxia, and Pytho would seem to group the families Othniidae, Mordellidae, and Pythidae within this series.

Elateroidea

The superfamily Elateroidea, as listed by Leng, includes the families Cerophytidae, Cebriionidae, Plastoceridae, Rhipiceridae, Elateridae, Melasidae, Throscidae, and Buprestidae (Figs. 44 - 50). A representative of all of these families has been figured, except for the Plastoceridae. The Cerophytidae, represented by Cerophytum, the Melasidae, represented by Eucnemis, and the Throscidae, represented by Throscus, seem to be related. In these three forms, the submentum and gula are broad and greatly shortened, the mentum is well developed, the palpifers are contiguous, or nearly so, and the maxillary galea and lacinia are short and comparatively broad.

The representatives of the Elateridae and Buprestidae, Alaus and Buprestis, are similar, particularly in the structure of the maxilla. The mediostipes is demarked from the lacinia, and the lacinia is comparatively short and is membranous in its basal region. In the labium, the mentum is broad and bears a weak, transverse, median division, the gula is broad, and the gular pits are distinct. The Cebriionidae, represented by Cebrio, resembles the Elaterid Alaus. The ligula is bilobed, the mentum is weakly divided transversely, and the maxillary mediostipes is demarked from the short lacinia. The family Rhipiceridae, represented by

Sandalus, is probably related to the Cantharoids. The general nature of the labium and maxilla seem to ally it with the characters found in this group.

Dryopoidea

The superfamily Dryopoidea is composed of the families Psephinidae, Dryopidae, Helmidae, Heteroceridae, and Georyssidae (Figs. 51 - 55). With the exception of Georyssus and Psephenus, this group seems to be related to the Elateroidea. Georyssus seems to resemble Hister. Comparison of Figures 54 and 23 shows a similarity in the structure of the labium and maxilla. The ligula is bilobed; the mentum is distinct; the submentum is tapered posteriorly; the gular region, which has been obliterated by the inrolling of the head capsule, is represented by a median suture; the mediostipes of the maxilla is demarked from the lacinia; the lacinia is slender; and the palpifer is large.

The shortened submental and gular regions in the Heteroceridae, represented by Heterocerus, would suggest its relation to the Cerophytidae, Melasidae, and Throscidae. Potamophilus representing the Dryopidae, and Helmis representing the Helmidae, are similar. The palpigers are contiguous; the mentum is distinct; the submentum is weakly demarked from the narrowed gula; the lacinia of the maxilla is comparatively long; the galea is divided into a basigalea and distigalea; and the mediostipes is weakly demarked from

the lacinia in Potamophilus, and is confluent with the lacinia in Helmis.

Dascilloidea

The superfamily Dascilloidea includes two families, the Dascillidae and the Helodidae (Figs. 56, 57). The similarities in the characters of the labium show that these two families are probably closely related. The mentum is wide and distinctly demarked, the submentum is demarked from the head capsule and is confluent with the wide gula. In the maxilla of the Helodid, Scirtes, the mediostipes is demarked from the lacinia, while in Dascillus it is confluent with the lacinia.

Byrrhoidea

In the superfamily Byrrhoidea, representatives of the Chelonariidae, Dermestidae, and Byrrhidae have been figured (Figs. 58 - 60). Stickney includes the Chelonariidae in the Dascilloidea. Comparison of Figure 53 with Figure 56 shows that, although Chelonarium is somewhat more specialized than Dascillus, the two genera are undoubtedly closely related and therefore the Chelonariidae are perhaps appropriately grouped with the Dascilloidea rather than with the Byrrhoidea.

Dermestes and Byrrhus (Figs. 59, 60) are apparently closely related to the Cucujoidea and are therefore discussed with this group.

Rhysodoidea

The superfamily Rhysodoidea contains one family, the Rhysodidae, represented by Rhysodes (Fig. 61). This form is so specialized that it is difficult to place it with any degree of certainty. The development of the mentum and the narrowing of the gula suggest a relationship to the Cucujoidea in general, and to Cucujus in particular.

Cucujoidea

The superfamily Cucujoidea, according to Leng, includes more families than any other superfamily. Representatives of seventeen of the eighteen families have been figured, a representative of the Monoedidae being unobtainable (Figs. 62 - 77). The Nitidulidae and Lathridiidae, represented by Prometobia and Lathridius (Figs. 63, 73), are alike in having the mentum very broad, the submentum broad and not demarked from the head capsule, and only a single maxillary lobe, the mala, present.

The Rhizophagidae, Derodontidae, Cryptophagidae, Colydiidae, and Dermestidae (see Figs. 64, 68, 69, 71, 59) are alike in having the mentum well developed, the submentum confluent with the gula and demarked from the head capsule, the gular broad, and the gular pits distinct. The maxilla has the mediostipes confluent with, or weakly demarked from, the lacinia, except in Dermestes which has the demarkation distinct. In all of these forms, the lacinia, and galea

are comparatively long and slender, and, in all except Rhizophagus, the galea is divided into a basigalea and distigalea, and the lacinia terminates in a claw-like process.

The Erotylidae, Murgidiidae, Mycetacidae, Endomychidae, and Phalacridae (Figs. 67, 72, 74, 75, 76) are similar in having the mentum well developed; the submentum short and demarked from the encroaching head capsule, which widely separates the distinct region of the submentum from the gula; and the gula extremely short and demarked by distinct gular pits. The maxilla in this group, with the exception of the Mycetacidae, has the galea divided into a basigalea and distigalea, the lacinia long and slender, and the mediostipes demarked from the lacinia, with the exception of the Erotylidae. The family Monotomidae, represented by Monotoma (Fig. 65), probably belongs in this group, although the gula is somewhat longer in this form, and the gular pits extend the length of the gular sutures.

The Ostomidae, Cucujidae, and Mycetophagidae (Figs. 62, 66, 70) have the anterior region of the submentum wide and demarked from the head capsule, and the posterior region narrowed and confluent with the gula. The gular pits are distinct in Mycetophagus but extend the length of the gular sutures in Ostoma and Cucujus.

Byrrhus (Fig. 60) does not resemble any genus figured for the Cucujoidea in all respects, but is similar to the more specialized Ostoma (Fig. 62) in the characters of the labium and maxilla. The Coccinellidae, represented by Leptinotarsa (Fig. 77), might be placed either with the Cucujoidea or with the Tenebrionoidea.

Several families of the Cucujoidea strongly resemble families of the Mordelloidea, showing that these two groups are, without doubt, closely related. Cucujus (Fig. 66) is very similar to Pytho (Fig. 39) in the characters of the labium and maxilla. The Mordelloids Tomoxia, Pedilus, Pyrochroa, Notoxus, etc. (Figs. 35, 40, 41, 42, etc.) resemble such Cucujoids as Rhizophagus and Derodontus (Figs. 64, 68) in their general characters.

Tenebrionoidea

The superfamily Tenebrionoidea includes the Alleculidae, Tenebrionidae, Lagriidae, Monomidae, and Melandryidae (Figs. 73 - 82). These families form a comparatively homogeneous group. In all of these families excepting the Monomidae, represented by Monomma (Fig. 81), the labium has the anterior region of the submentum broad and at least weakly demarked from the encroaching head capsule, and the posterior region either obliterated or represented by a median suture, as in Arthromacra (Fig. 80), or by a Y-shaped suture, as in Alobates and Penthe (Figs. 79, 82). The gular pits extend along the

gular sutures in Arthromacra, but are distinct in the other genera. The maxillae are similar in all the forms figured in this group. The mediostipes is demarked from the lacinia and the galea is divided into a basigalea and distigalea. The Tenebrionoidea as a whole seem closely related to the Mordelloidea and Cucujoidea.

Bostrichoidea

The superfamily Bostrichoidea is comprised of the Ptinidae, Anobiidae, Bostrichidae, Lyctidae, Sphindidae, and Cisidae (Figs. 83 - 88). The Ptinidae and Sphindidae (Figs. 83, 87) are similar in having the ligula bilobed and sclerotized, the submentum weakly demarked from the head capsule, the gular pits extending along the gular sutures, the mediostipes confluent with the lacinia, and the galea not divided into a basigalea and distigalea.

The Anobiidae, Bostrichidae, and Lyctidae (Figs. 84, 85, 86) have a trilobed ligula, distinct gular pits, a comparatively slender gula, the maxillary mediostipes confluent with, or weakly demarked from, the lacinia, and the galea divided into a basigalea and distigalea. The family Cisidae, represented by Cis (Fig. 88), is rather specialized in the loss of the ligula, the narrowing of the labium, and shortening of the galea and lacinia. Except for the loss of the ligula, the labium resembles that of the Mordelloid family Rhipiphoridae (Fig. 37).

Scarabaeoidea

The superfamily Scarabaeoidea includes the Scarabaeidae, Lucanidae, and Passalidae, represented by Geotrupes, Pseudolucanus, and Passalus (Figs. 89, 90, 91). This group is homogeneous, and is undoubtedly related to the families of the Adephaga and their close relatives. The mentum is very broad, the submentum is broad and weakly demarked from the wide gula, the gular pits extend along the gular sutures, and the maxillary mediostipes is confluent with, or only weakly demarked from, the lacinia. Passalus (Fig. 91) resembles Aphizoa (Fig. 6), particularly in the character of the maxilla, and apparently is more specialized than Geotrupes and Pseudolucanus. Geotrupes appears to be the least specialized of this series. In this form, the mentum and submentum are not so broad, the ligula is sclerotized and bilobed, and the palpifers are widely separated. Pseudolucanus would seem to occupy an intermediate position between Geotrupes and Passalus. The mentum and submentum are wide, the ligula is bilobed and sclerotized, and the palpifers are narrowly sclerotized. In Passalus, the mentum and submentum are wide, the ligula is broad and sclerotized, and the palpifers are fused in the premental region.

Cerambycoidea

The superfamily Cerambycoidea is composed of three families, the Cerambycidae, Chrysomelidae, and Mylabridae.

(Figs. 92, 93, 94). These families form a homogeneous group in which the ligula is broad and sclerotized, or partly so, the palpigers are fused in the premental region, a mental membrane is present, the mentum is short, and the maxillary mediostipes is confluent with the lacinia or weakly demarked from it. In Tetraopes (Fig. 92), the submentum is confluent with the wide gula, and the gular pits extend along the gular sutures. Except for the demarkation of the anterior region of the submentum, Leptinotarsa resembles Tetraopes in the nature of the submentum and gula. Mylabris has the anterior region of the submentum enlarged and cut off from the narrowed gula by the encroaching head capsule.

Brentoidea

The superfamily Brentoidea has one family, the Brentidae, represented by Eupsalis (Fig. 95). This genus is highly specialized and should be included with the Curculionoidea, to which they are closely related. The labium lacks the labial palpi and palpigers; the mentum is confluent with the elongated submentum; the gula has been obliterated, and is represented by a median gular suture; the maxillary cardo and stipes are fused to form a narrow strip; there is a single maxillary lobe; and the maxillary palpus is three-segmented.

Curculionoidea

The superfamily Curculionoidea includes the Platystomidae, Belidae, and Curculionidae. The family Platystomidae,

represented by Platystomus (Fig. 97), although highly specialized, suggests the Adephaga in the breadth of the labium and general nature of the maxilla found in the Adephagous family, Cicindelidae. The family Belidae, represented by Ithycerus (Fig. 96), resembles the more specialized Scolytidae, represented by Dendroctonus (Fig. 101). The ligula in both of these forms is short, the palpifers are lacking, the mentum is wide in Ithycerus, but narrow in Dendroctonus; the submentum is long and wide in Ithycerus, but short and confluent with the head capsule laterally in Dendroctonus; and, in both, the gula is represented by a median suture. The maxilla in Dendroctonus is more highly specialized in having the basistipes, mediostipes, and palpifer fused; and in having a single maxillary lobe, the mala, present. In Ithycerus, however, the basistipes, mediostipes, palpifer, galea, and lacinia are all distinctly demarked. In both of these genera, the maxillary palpus is three-segmented.

The family Curculionidae is represented by Lixus, a form with a long snout (Fig. 98), and by Asynonychus, a form with a short snout (Fig. 99). Both of these genera are specialized. Lixus has minute labial palpi, a comparatively broad ligula, a greatly elongated submental region, and the gula represented by a median suture. In the maxilla the stipes is not

differentiated into a basistipes and mediostipes, and is confluent with the mala. Asynonychus has the labial palpi larger, but lacks the ligula, and the submental region is short. The maxilla has the stipes weakly differentiated into a basistipes and mediostipes, and the galea and lacinia are both present. In both of these genera, the maxillary palpus is three-segmented.

Scolytoidea

The superfamily Scolytoidea includes two families, the Scolytidae (Fig. 101) discussed above, and the Platypodidae, represented by Platypus (Fig. 100). Platypus is also specialized, especially in the features of the maxilla. The labium is similar to that of Asynonychus, but the maxilla appears to resemble that of Eupsalis.

In summarizing the affinities of the superfamilies of the Coleoptera as indicated by the comparative study of the labium and maxilla, two principal groups are recognizable which agree with Stickney's grouping of the superfamilies based on the study of the head capsule. The first of these groups includes the following superfamilies: Caraboidea, Gyrinoidea, Hydrophiloidea, Silphoidea, Staphylinoidea, Cantharoidea (in part), and Scarabaeoidea.

The second and larger group includes the following superfamilies: Cantharoidea (in part), Lymexyloidea, Mordelloidea, Elateroidea, Dryopoidea, Dascilloidea, Byrrhoidea,

Rhysodoidea, Cucujoidea, Tenebrionoidea, and Bostrichoidea.

The superfamilies Cerambycoidea, Brentoidea, Curculionoidea, and Scolytoidea might be grouped separately. Due to the specializations occurring in them, it is extremely difficult to determine to which of these two main groups they are more closely related.

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EXPLANATION OF PLATES

Each figure includes a line drawing in ventral aspect of the labium and maxilla of representatives of the following Coleopterous families:

- Fig. 1. Cicindelidae - Cicindela sexguttata Fab.
Fig. 2. Carabidae - Harpalus caliginosus (Fab.)
Fig. 3. Omophronidae - Omophron americanum Dej.
Fig. 4. Haliplidae - Laccophilus maculosus (Germ.)
Fig. 5. Dytiscidae - Colymbetes sculptilis Harr.
Fig. 6. Amphizoidae - Amphizoa isolens Lec.
Fig. 7. Gyrinidae - Dineutes vittatus (Germ.)
Fig. 8. Paussidae - Paussus hova
Fig. 9. Hydrophilidae - Tropisternus glaber (Hbst.)
Fig. 10. Platypsyllidae - Platypsyllus castoris Rits.
Fig. 11. Leptinidae - Leptinus testaceus Mull.
Fig. 12. Clambidae - Clambus punctulatum Beck.
Fig. 13. Silphidae - Silpha americana L.
Fig. 14. Scydmaenidae - Euconnus similis Blatch.
Fig. 15. Orthoperidae - Orthoperus brunnipes Gyll.
Fig. 16. Staphylinidae - Staphylinus vulpinus Nordm.
Fig. 17. Pselaphidae - Pselaphus dresdensis Herbst.
Fig. 18. Ptilidae - Trichopteryx lata Motsch.
Fig. 19. Clavigeridae - Claviger testaceus
Fig. 20. Sphaeriidae - Sphaerius acaroides Waltl.

- Fig. 21. Scaphidiidae - Scaphidium quadrimaculatum Oliv.
Fig. 22. Sphaeritidae - Sphaerites glabratus (Fab.)
Fig. 23. Histeridae - Hister obtusatus Harris
Fig. 24. Lycidae - Eros aurora Hbst.
Fig. 25. Lampyridae - Lucidota atra (Fab.)
Fig. 26. Phengodidae - Phengodes sp.
Fig. 27. Cantharidae - Cantharis andersoni Brost
Fig. 28. Melyridae - Malachius aeneus (L.)
Fig. 29. Cleridae - Trichodes ornatus Say
Fig. 30. Corynetidae - Chariessa pilosa Forst.
Fig. 31. Othniidae - Othnius kraatzi
Fig. 32. Lymexylidae - Hylecoetus dermestoides L.
Fig. 33. Cupesidae - Cupes latreillei Sol.
Fig. 34. Cephaloidae - Cephaloon lepturides Newm.
Fig. 35. Oedemeridae - Ditylus laevis Fab.
Fig. 36. Mordellidae - Tomoxia bidentata (Say)
Fig. 37. Rhipiphoridae - Rhipiphorus dimidiatus Fab.
Fig. 38. Meloidae - Nemognatha piezata Fab.
Fig. 39. Pythidae - Pytho americanus Kby.
Fig. 40. Pyrochroidae - Pyrochroa coccinea L.
Fig. 41. Pedilidae - Pedilus collaris (Say)
Fig. 42. Anthicidae - Notoxus calcaratus Horn
Fig. 43. Euglenidae - Euglenes pruinosis
Fig. 44. Cerophytidae - Cerophytum elateroides Latr.
Fig. 45. Cebrionidae - Cebrion gigas Fab.
Fig. 46. Rhipiceridae - Sandalus segnis

- Fig. 47. Elateridae - Alaus oculatus (L.)
- Fig. 48. Melasidae - Eucnemis capucina Ahrens.
- Fig. 49. Throscidae - Throscus dermestoides L.
- Fig. 50. Buprestidae - Buprestis fasciata Fab.
- Fig. 51. Psephenidae - Psephenus lecontei (Lec.)
- Fig. 52. Dryopidae - Potamophilus acuminatus Fab.
- Fig. 53. Helmidae - Helmis mangel
- Fig. 54. Georyssidae - Georyssus laevicollis Germ.
- Fig. 55. Heteroceridae - Heterocerus parallelus Krynick
- Fig. 56. Dascillidae - Dascillus cervinus L.
- Fig. 57. Melodidae - Scirtes tibialis Guer.
- Fig. 58. Chelonariidae - Chelonarium ornatum Klug
- Fig. 59. Dermestidae - Dermestes lardarius L.
- Fig. 60. Byrrhidae - Byrrhus americanus Lec.
- Fig. 61. Rhysodidae - Rhysodes sulcatus Fab.
- Fig. 62. Ostomidae - Ostoma grossa (L.)
- Fig. 63. Nitidulidae - Prometobia sexmaculata (Say)
- Fig. 64. Rhizophagidae - Rhizophagus picipes Walker
- Fig. 65. Monotomidae - Monotoma conicicollis
- Fig. 66. Cucujidae - Cucujus clavipes Fab.
- Fig. 67. Erotylidae - Megalodacne grandipennis
- Fig. 68. Derodontidae - Derodontus maculatus Melsh.
- Fig. 69. Cryptophagidae - Antherophagus ochraceus Melsh.
- Fig. 70. Mycetophagidae - Mycetophagus punctatus Say
- Fig. 71. Colydiidae - Trachypholis ornatus

- Fig. 72. Mirmidiidae - Mirmidius ovalis Beck.
- Fig. 73. Lathridiidae - Lathridius lardarius DeG.
- Fig. 74. Mycetidae - Mycetaea hirta (Marsh)
- Fig. 75. Endomychidae - Lycoperdina ferruginea Lec.
- Fig. 76. Phalacridae - Phalacrus grossus Erichs.
- Fig. 77. Coccinellidae - Anatis quindecimpunctata (Oliv.)
- Fig. 78. Alleculidae - Hymenorus melsheimeri Say.
- Fig. 79. Lagriidae - Arthromacra aenea (Say)
- Fig. 80. Tenebrionidae - Alobates pennsylvanica (DeG.)
- Fig. 81. Monommidae - Monomma maximum
- Fig. 82. Melandryidae - Penthe obliquata (Fab.)
- Fig. 83. Ptinidae - Oligomerus brunneus Oliv.
- Fig. 84. Anobiidae - Sitodrepa panicea (L.)
- Fig. 85. Bostrichidae - Apate terebrans Pall.
- Fig. 86. Lyctidae - Lyctus linearis (Goeze)
- Fig. 87. Sphindidae - Sphindus dubius Gyllh.
- Fig. 88. Cisidae - Cis boleti Scopoli
- Fig. 89. Scarabaeidae - Geotrupes splendidus (Fab.)
- Fig. 90. Lucanidae - Pseudolucanus capreolus (L.)
- Fig. 91. Passalidae - Passalus cornutus Fab.
- Fig. 92. Cerambycidae - Tetraopes tetraophthalmus (Forst.)
- Fig. 93. Chrysomelidae - Leptinotarsa decemlineata (Say)
- Fig. 94. Mylabridae - Mylabris discoides Say
- Fig. 95. Brentidae - Eupsalis minuta Drury
- Fig. 96. Belidae - Ithycerus noveboracensis (Forst.)

- Fig. 97. Platystomidae - Platystomus albinus L.
Fig. 98. Curculionidae - Lixus concavus Say
Fig. 99. Curculionidae - Asynonychus godmani Crotch
Fig. 100. Platypodidae - Platypus cylindricus Fab.
Fig. 101. Scolytidae - Dendroctonus valens Lec.

ABBREVIATIONS

bc	-	basicardo
bg	-	basigalea
bs	-	basistipes
ca	-	cardo
dc	-	disticardo
dg	-	distigalea
dig	-	digitus
ga	-	galea
gl	-	glossa
gp	-	gular pit
gs	-	gular suture
gu	-	gula
la	-	lacinia
lg	-	ligula
li	-	labium
lp	-	labial palp
ls	-	labial stipes
ma	-	mala
mem	-	mental membrane
mn	-	mentum
mp	-	maxillary palpus
ms	-	mediostipes
pfr	-	palpifer
pgl	-	paraglossa
pgr	-	palpiger
ps	-	parastipes
sm	-	submentum
st	-	stipes

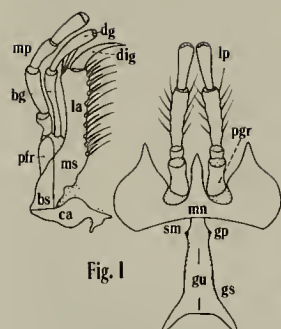


Fig. 1

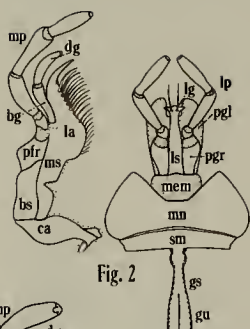


Fig. 2

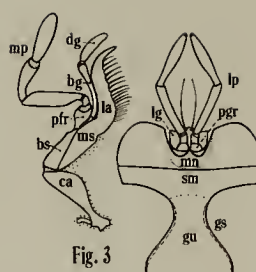


Fig. 3

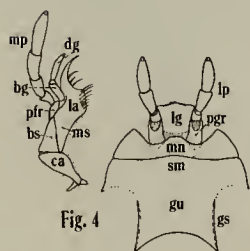


Fig. 4

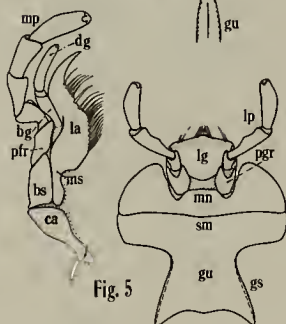


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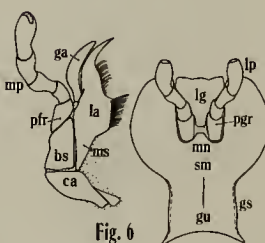


Fig. 6

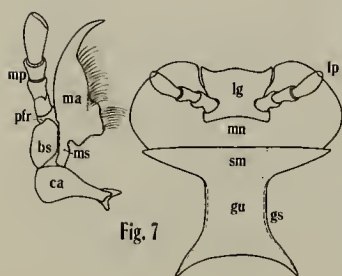


Fig. 7

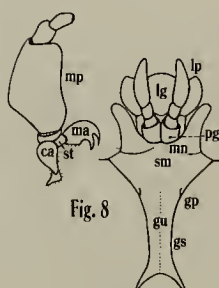


Fig. 8

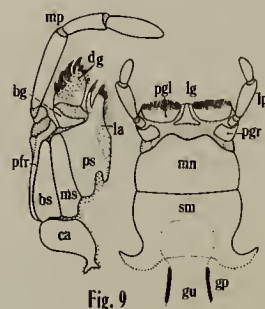


Fig. 9

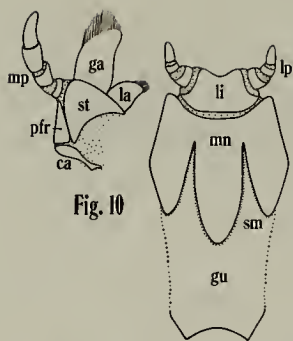


Fig. 10

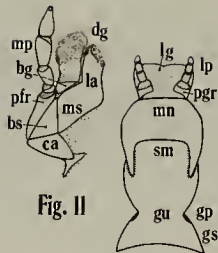


Fig. 11

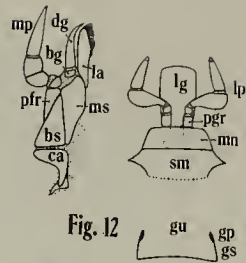


Fig. 12



Fig. 13

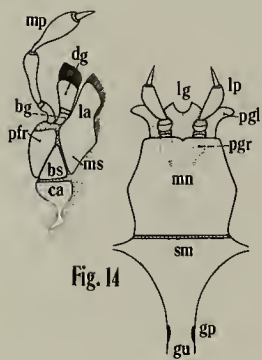


Fig. 14

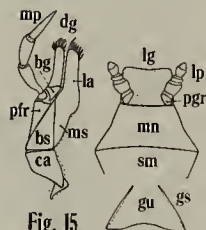


Fig. 15

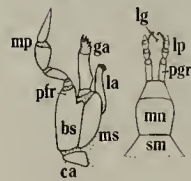


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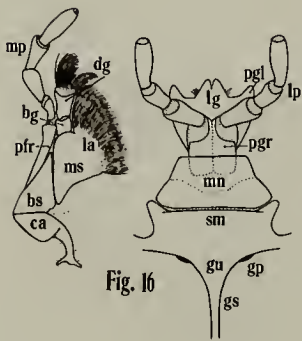


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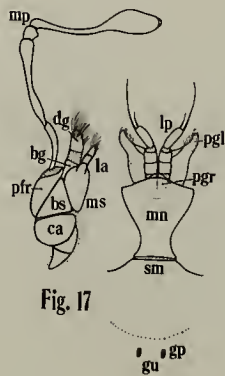


Fig. 18



Fig. 19

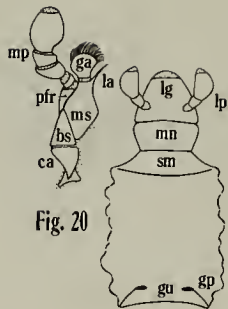


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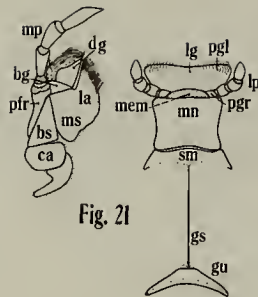


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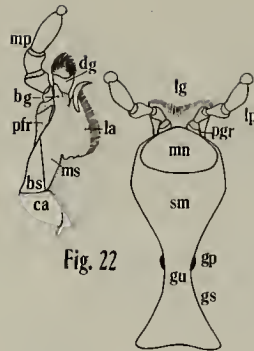


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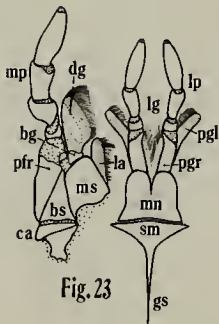


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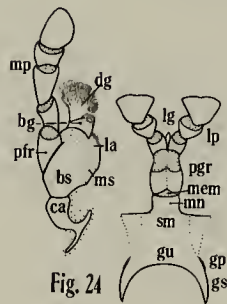


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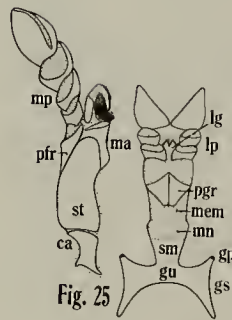


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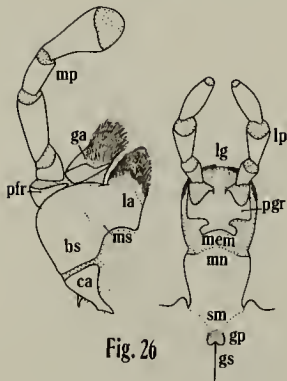


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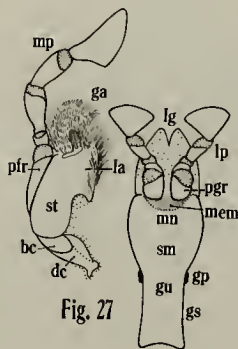


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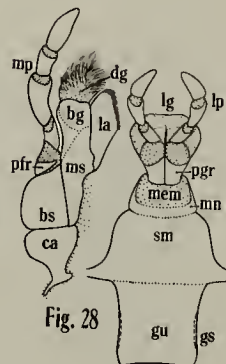


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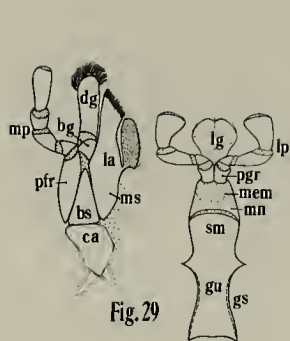


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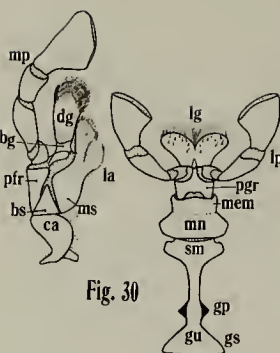


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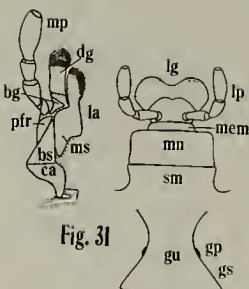


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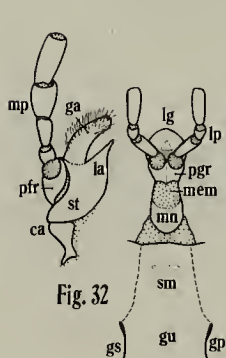


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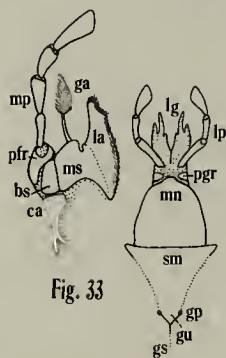


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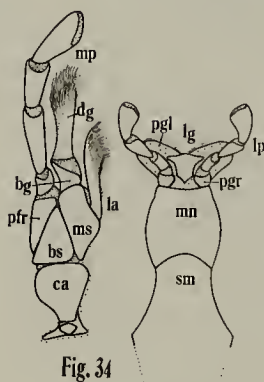


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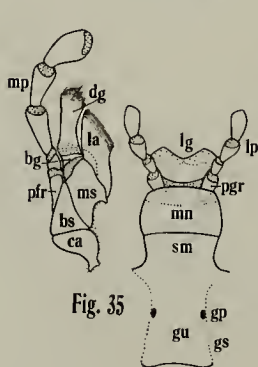


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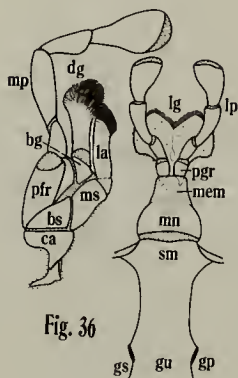


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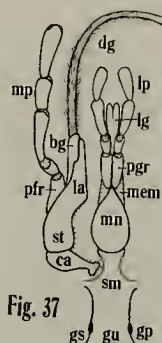


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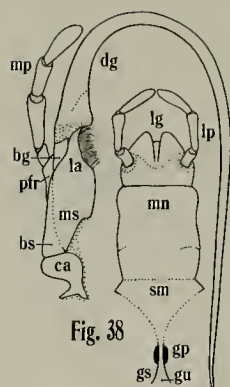


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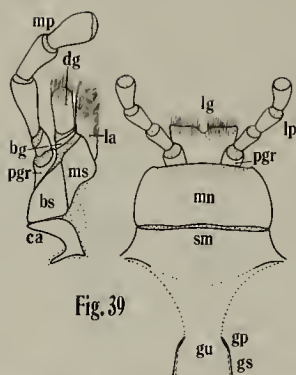


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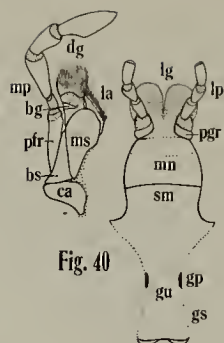


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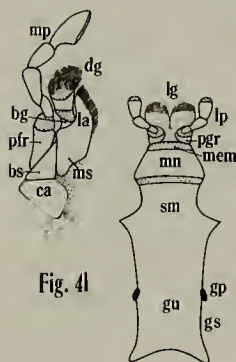


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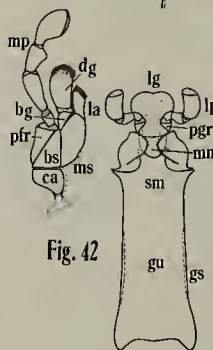


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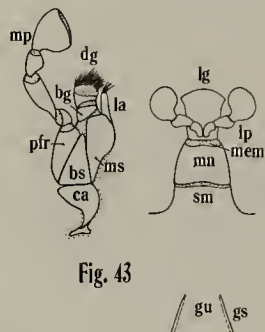


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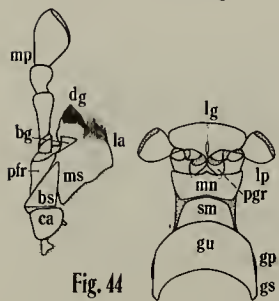


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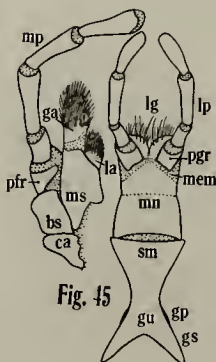


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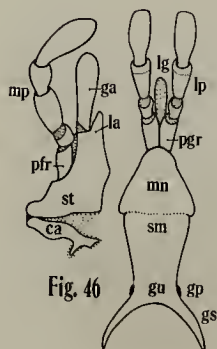


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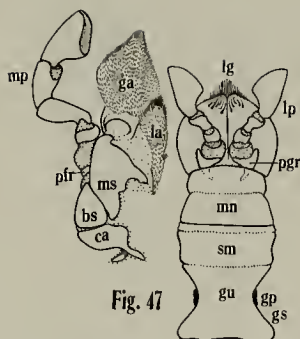


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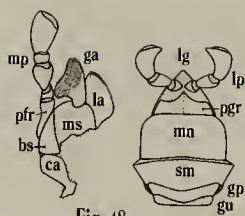


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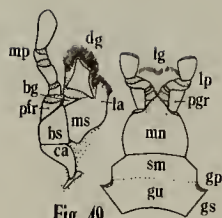


Fig. 49



Fig. 50

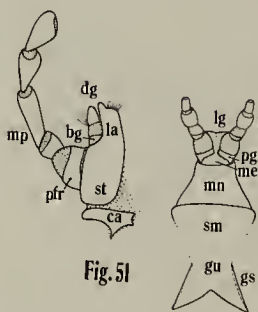


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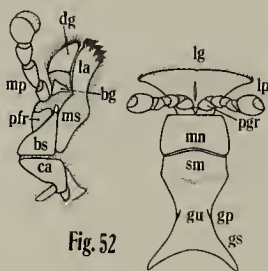


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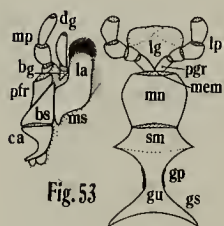


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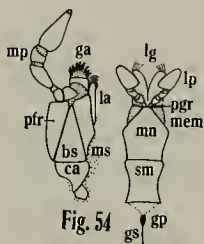


Fig. 54

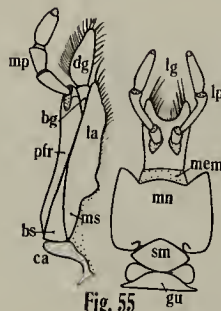


Fig. 55

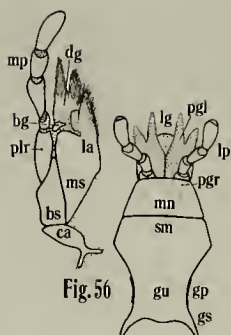


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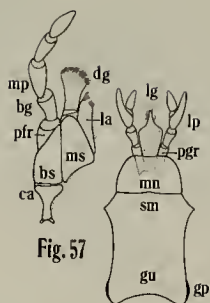


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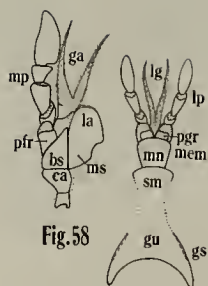


Fig. 58

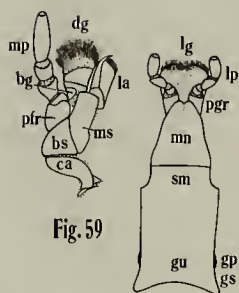


Fig. 59

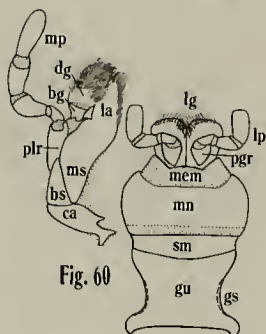


Fig. 60

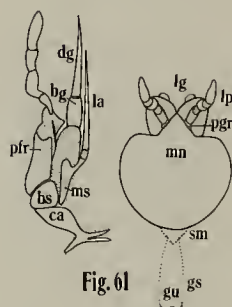


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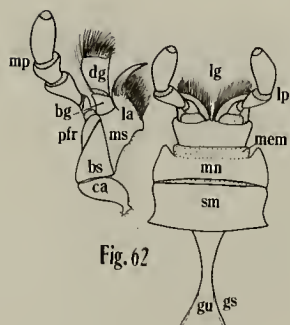


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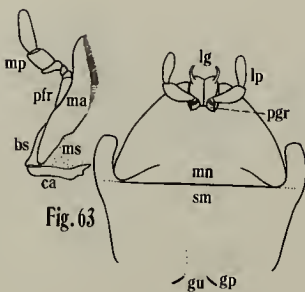


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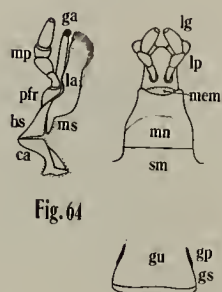


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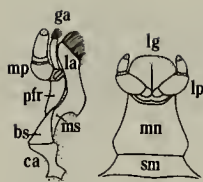


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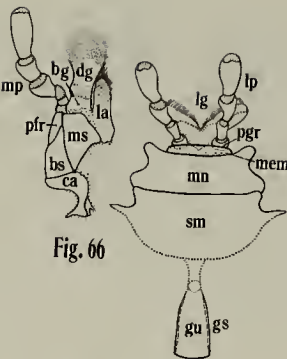


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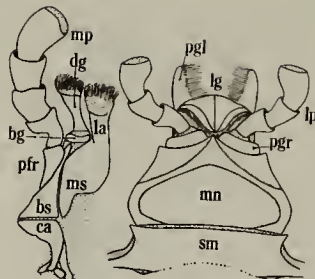


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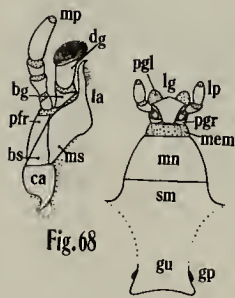
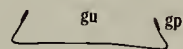


Fig. 68

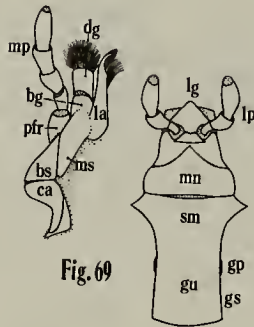


Fig. 69

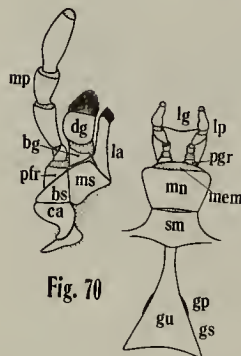


Fig. 70

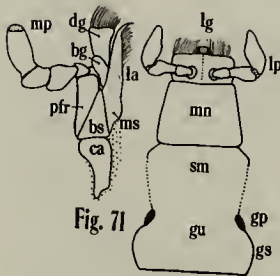


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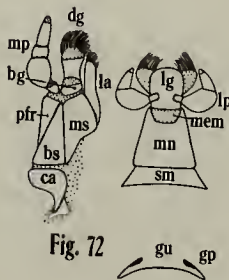


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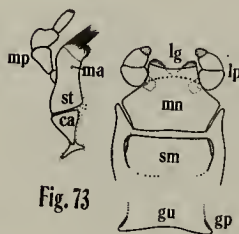
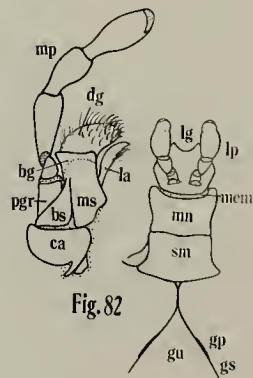
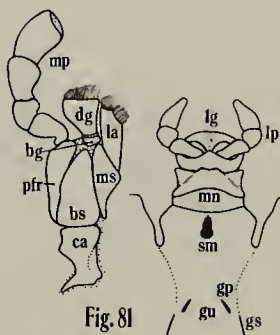
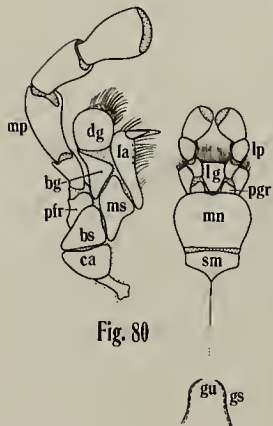
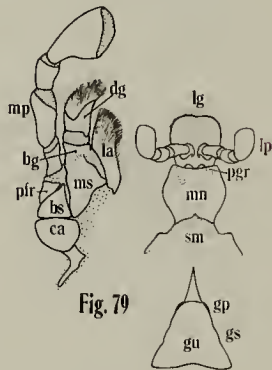
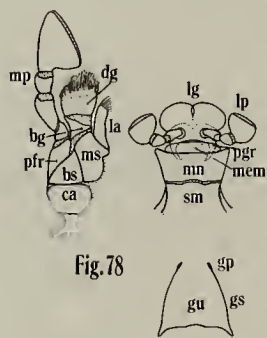
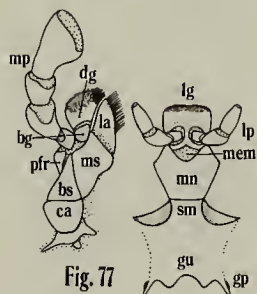
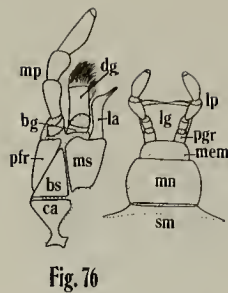
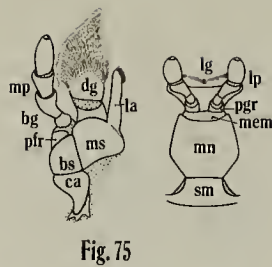
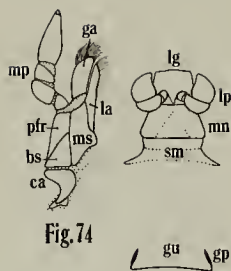


Fig. 73



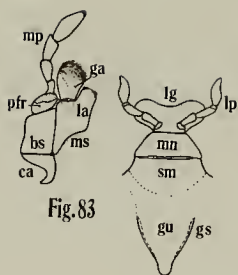


Fig. 83

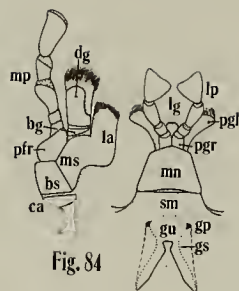


Fig. 84

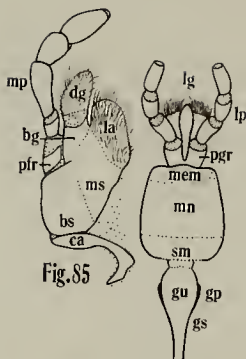


Fig. 85

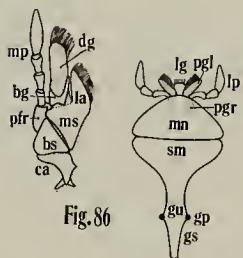


Fig. 86

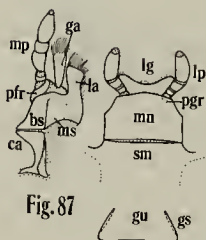


Fig. 87

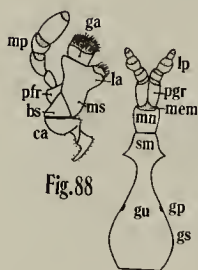


Fig. 88

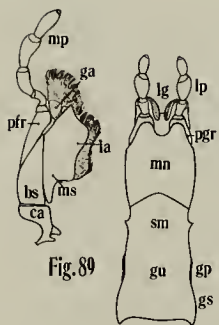


Fig. 89

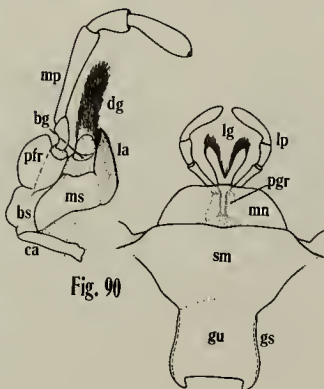


Fig. 90

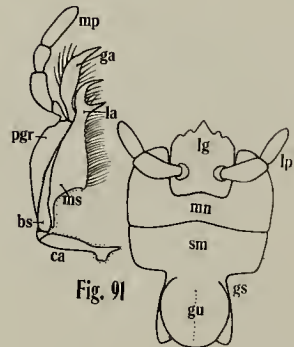


Fig. 91

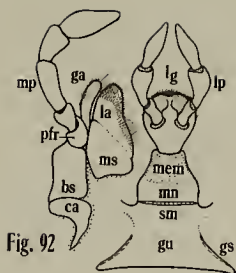


Fig. 92

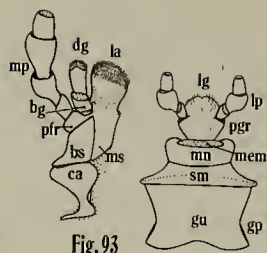


Fig. 93

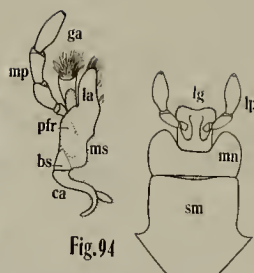


Fig. 94

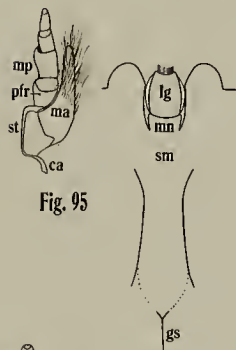


Fig. 95

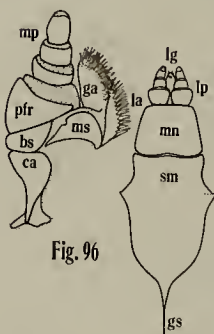


Fig. 96

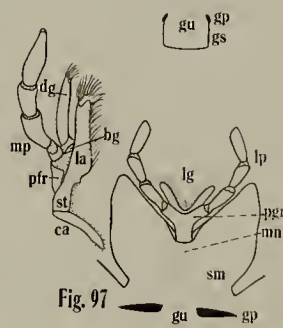


Fig. 97

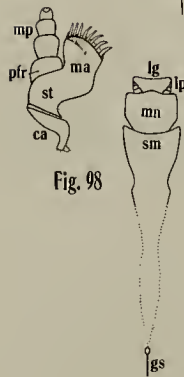


Fig. 98

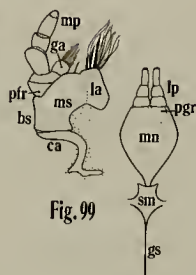


Fig. 99

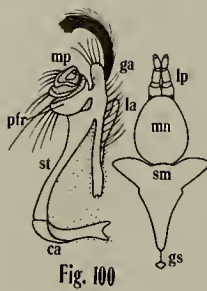


Fig. 100

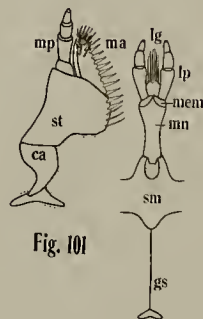


Fig. 101

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