

- FIG. 11.—*Gymnobathra omphalota* Meyr. *a*, male genitalia, lateral view; *b*, harpe, inner view; *c*, juxta; *d*, aedeagus; *e*, uncus, dorsal view; *f*, vinculum.
- FIG. 12.—*Gymnobathra caliginosa* Philp. *a*, male genitalia, lateral view; *b*, harpes, inner view; *c*, uncus, dorsal view.
- FIG. 13.—*Gymnobathra tholodella* Meyr. *a*, male genitalia, lateral view; *b*, harpes, inner view; *c*, juxta; *d*, aedeagus; *e*, uncus; *f*, vinculum.
- FIG. 14.—*Gymnobathra coarctatella* (Walk.). Female genitalia, dorsal view; *i.m.*, intersegmental membrane; *s.r.*, segmental rods.
- FIG. 15.—*Gymnobathra flavidella* (Walk.). Female genitalia, lateral view; *s.r.*, segmental rods; *c.o.*, copulatory opening.

The Maxillae in the Lepidoptera.

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The object of the present paper is to describe and figure the maxillae in all groups of which material has been available for study. Owing, however, to the limited nature of the lepidopterous fauna of New Zealand, the investigation must necessarily have proved very incomplete were it not that, through the kindness of correspondents, I have been able to study a fair number of forms from other regions. Though all the parts of the maxilla will be dealt with, the chief interest will centre in the maxillary palpi. In systematic works on the Lepidoptera, we frequently find it stated that in this or that group the maxillary palpi are absent. In many of these instances, however, careful examination will show that though the organs are extremely minute and vestigial, they are still to be found.

The general structure of the maxillae will now be briefly described, in order that the nomenclature applied to the various parts may be clearly understood. The first maxilla in the most generalized Lepidoptera consists of the following parts. (1) The Cardo, a more or less horizontally placed small basal piece, often somewhat triangular in shape. (2) The Stipes, a usually well developed sclerite following the cardo, generally longer than broad. (3) The Maxillary Palp, a four- or five-segmented appendage rising from the apical outward area of the stipes. (4) The Galea, a weakly chitinized irregularly cone-shaped structure springing from the central portion of the apex of the stipes; in all except the most primitive families the galeae are modified to form an elongated suctorial organ, the haustellum or tongue. (5) The Lacinia, a small pointed organ fused basally with the galea; in all but the Micropterygidae this organ is absent. Without dissection the cardo can seldom be seen; the stipes is usually at least partially visible; the galeae, when developed into the haustellum, become prominent, and can be seen in part even in the more primitive state; the palp, when reduced, is frequently completely hidden,

but when consisting of several segments it may come into view by hanging downwards clear of the other mouth-parts or by being curved upwards till it rests above the labial palp; the lacinia is always hidden. Certain parts which are present in some of the other orders of insects are not definitely recognizable in the Lepidoptera. These are the subgalea, a sclerite lying on the inner side of the stipes, and the digitus, or finger, a small structure forming a second segment to the lacinia. There is also the palpifer, a pedestal on which the maxillary palp articulates, but in the Lepidoptera this structure, when present, appears as an outgrowth of the stipes; it is, however, at times so prominent that it might easily be mistaken for the basal segment of the palp. Figures giving front and back views (or from above and beneath) of the head of *Sabatinca incongruella* (Walk.) are shown, in order to display the mouth parts as they appear *in situ*. These figures, in common with all the others, have been drawn with the aid of a camera lucida from material macerated in a ten per cent. solution of KOH.

A detailed description of the maxilla, from its primitive condition in the most generalised types to its specialised forms in the higher families, will now follow.

LEPIDOPTERA HOMONEURA.

MICROPTERYGIDAE (Figs. 1 to 4).

The Micropterygidae is the only family of Lepidoptera in which the five main parts of the maxillae are present. In all the others at least one part, the lacinia, is missing. I have been able to examine all the genera belonging to this family. There is little difference between the groups, but it will be seen from figures 2, 3 and 4 that the cardo in *Epimartyria* is broader and more triangular than in *Sabatinca*, while in *Micropteryx* it is irregularly oblong. The lacinia in *Sabatinca* is of a more primitive type than in the other two genera, being acutely pointed and closely appressed to the galea. The galea consists of one segment only, but indentations and one or two half bands of stronger

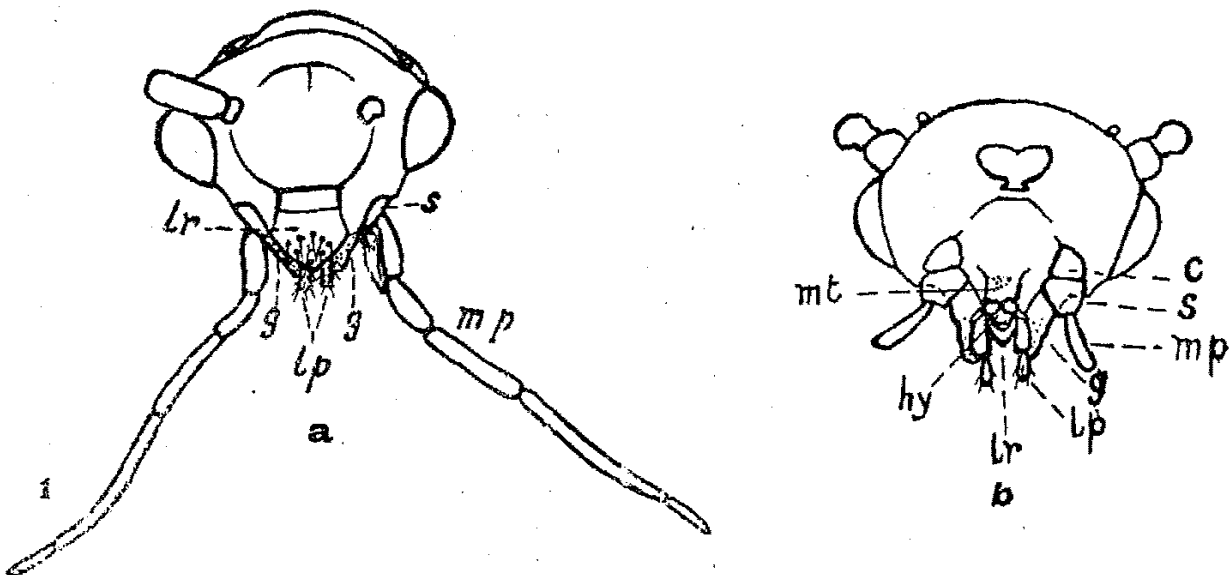


FIG. 1.—*Sabatinca incongruella* Walk. Head; a, dorsal view; b, ventral view.

chitinisation near the middle of the organ possibly point to a former articulation. On both lacinia and galea are some short fine sensory hairs. The palp consists of five segments; the first two are of about the same length, the third a little longer than the second, the fourth about as long as the second and third together, and the fifth very short, about half the length of the first. In *Micropteryx* and *Sabatinca* the fourth segment is covered, except near the base, with fine annulations, but these do not appear to be present in *Epimartyria*. The proportionate length of the whole organ as compared with the labial palps and head can be seen by reference to fig. 1.

Species examined: *Sabatinca incongruella* Walk., *S. chrysargyra* Meyr., *S. aurella* Huds., *S. ianthina* Philp., *Micropteryx aruncella* Scop., *M. calthella* L., *Epimartyria auricrinella* Wlsh., *E. pardellu* Wlsh.

ERIOCRANIIDAE (Figs. 5 to 6).

In this family the maxillae have undergone great specialization, the laciniae having completely disappeared and the galeae having been transformed into an haustellum, a change correlated with the loss of the mandibles. The haustellum, though not elongate, is fully functional, and differs in no essential way from that of the Lepidoptera Heteroneura. The remainder of the maxilla shows but slight change from the same part in the Micropterygidae; the second segment of the palp, however, is here rather shorter than the first. The genera *Neopseustis*, represented by one species from India, and *Acanthopteroctetes*, known only from a single North American specimen, have not been available for study.

Species examined: *Mnemonic auricyanea* Wlsh., *Eriocrania semipurpurella* Steph.

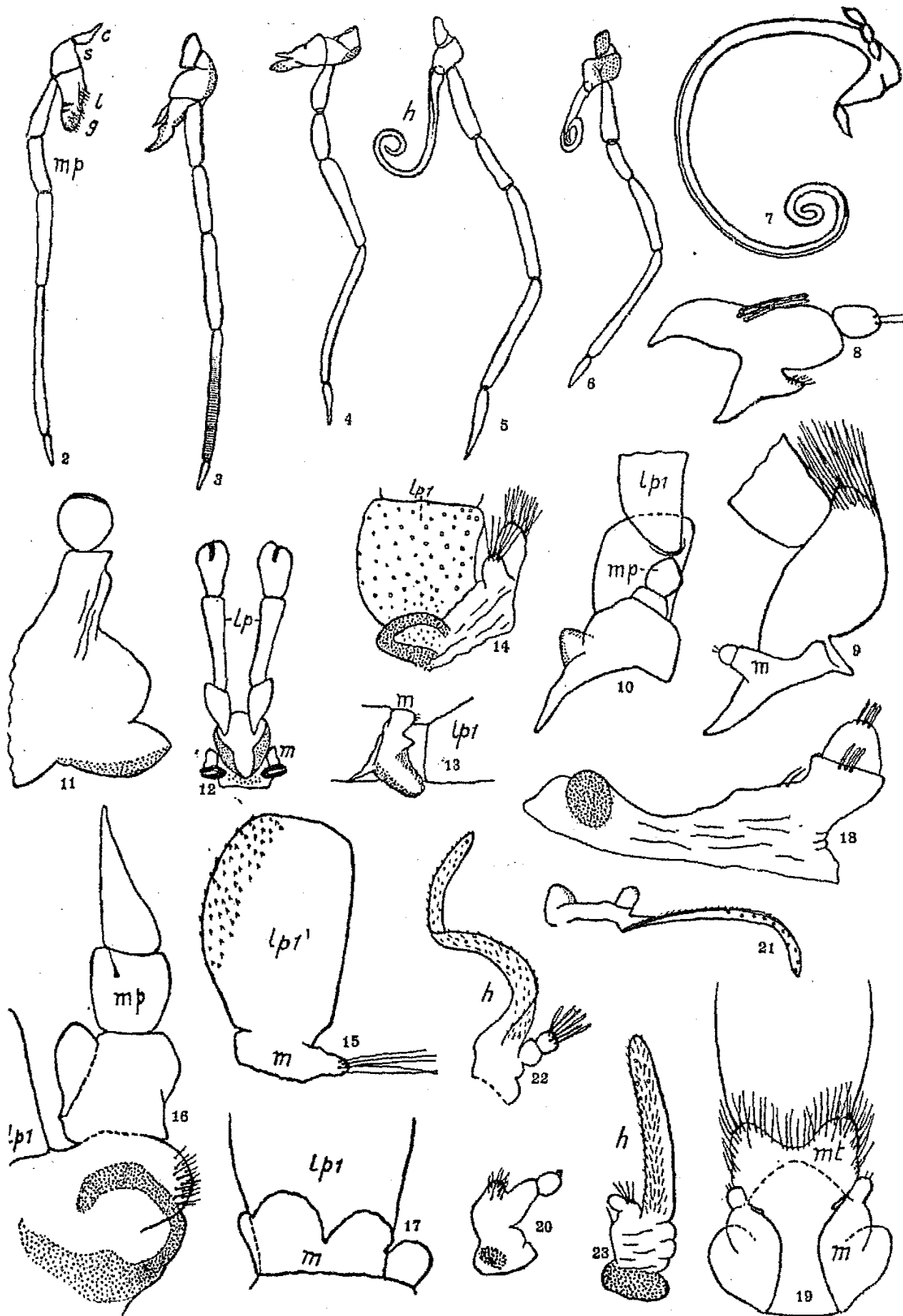
MNESARCHAEIDAE (Fig. 7).

The Mnesarchaeidae, which includes the type genus only, is an extremely specialized family of the Micropterygoidea. Meyrick (*Genera Insectorum*, fasc. 132, p. 3) places the group as intermediate between the typical Micropterygidae and the Tineidae, though not on the actual line of transition. The maxillae share in the general specialization, the haustellum being lengthened and the palp reduced to three more or less globular segments the whole of which do not exceed in length the basal segment of the palp in the Micropterygidae. Meyrick (*ibid.*) instances the absence of vein 11 (R1) as being proof of the family not being ancestral to the Tineidae and to this character may be added the vestigial condition of the maxillary palp, many of the Tineidae having well-developed palpi of four or five segments.

Species examined: *Mnesarchaea hamadelpha* Meyr., *M. loxoscia* Meyr., *M. fusca* Philp.

HEPIALIDAE (Figs. 8 to 23).

The Hepialidae are a very isolated family, and the study of the maxillae gives little help towards discovering its relationships. Though excessively reduced in most cases, I have not examined any genus in



FIGS. 2-23.

which some trace of the maxillae could not be found. Generally what remains of the organ takes the shape of a cluster of bulbous protuberances at the base of the labium and curving transversely round it. The basal or lower piece is usually more strongly chitinized laterally, which gives it the appearance of a link-shaped structure when viewed from above. As there is no articulation or defined divisions between the parts it is not possible to homologize them with certainty with the parts composing the normal maxillae, more especially as the position of the structure has been so altered. In systematic works on the Lepidoptera it is usually stated that the maxillary palpi are absent in the Hepialidae. This, however, is by no means always, or even generally, the case. Reference to the figures will show that in *Trictena*, *Perrissectis*, and *Sthenopsis* (*argenteomaculatus*) there is a distinct one-segmented palp present, though the rest of the organ is extremely reduced. In *Porina dinodes* a similar palp occurs, apparently resting on a distinct palpifer; in other species of this genus, as *P. jocosa*, the palp appears to be absent. *Hepialus humuli* also shows a palpal segment, though less defined than that of *P. dinodes*. In passing, it may be noted that the labial palps in this species have practically disappeared, being represented only by a pair of rounded palpifers. *Oncopera mitocera* has the most vestigial maxillae of any of the Hepialidae. They amount merely to minute protuberances bearing a few rather long hairs. As the eyes in this genus nearly meet in the middle line of the face there is little room left for upturned mouth-parts and the labium is consequently greatly compressed, while the labial palpi tend to become thread-like. The gigantic Australian *Leto staceyi* possesses the least reduced maxillary palpi of any species of the family examined. There are here two well-developed segments, the basal one articulating with what is probably a palpifer as the much reduced galea fuses with it basally. The terminal segment of the palp is longer than the preceding one and tapers to a fine point. The whole structure lies less transversely to the labium than usual,

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- FIG. 2.—*Sabatinea aurella* Huds. Maxilla.
 FIG. 3.—*Micropteryx calthella* L. Maxilla.
 FIG. 4.—*Epimartyria auricrinella* Wlsh. Maxilla.
 FIG. 5.—*Mnemonica auricyanea* Wlsh. Maxilla.
 FIG. 6.—*Eriocrania semipurpurella* Steph. Maxilla.
 FIG. 7.—*Mnesarchaea toxoscia* Meyr. Maxilla.
 FIG. 8.—*Trictena labyrinthica* Don. Maxilla.
 FIG. 9.—*Perrissectis australasiae* Don. Maxilla and labium.
 FIG. 10.—*Sthenopsis argenteomaculatus* Harr. Maxilla and labium.
 FIG. 11.—*Porina dinodes* Meyr. Maxilla.
 FIG. 12.—*P. jocosa* Meyr. Maxilla, labium and labial palpi.
 FIG. 13.—*P. jocosa* Meyr. Maxilla and labium.
 FIG. 14.—*P. signata* Walk. Maxilla and labial palp.
 FIG. 15.—*Oncopera mitocera* Turn. Maxilla and labial palp.
 FIG. 16.—*Leto staceyi* Scott. Maxilla.
 FIG. 17.—*Charagia virescens* Dbld. Maxilla.
 FIG. 18.—*Pielus hyalinatus* H.S. Maxilla.
 FIG. 19.—*Hepialus humuli* L. Maxilla and labium.
 FIG. 20.—*Hectomanes* sp. Maxilla.
 FIG. 21.—*H. simulans* Walk. Maxilla.
 FIG. 22.—*H. bilineata* Meyr. Haustellum and maxillary palp.
 FIG. 23.—*H.* sp. Maxilla.

the palp projecting obliquely above that organ. The Maxillae in *Hectomanes* show some extremely interesting features. Seven species have been available for examination. Four of these, *H. fusca*, *H. polyaspila*, *H. crocea*, and an undetermined species, have a rounded one-segmented palp with a very minute tubercle arising from its apex; this may be the vestige of a second segment. The galea is represented by a rounded projection bearing some rather strong spines. In *H. simulans*, *H. bilineata*, and a second undetermined species, however, the galea is present as a true haustellum, though one which has been subject to great reduction. The labial palp in these species, as in the other three, consists of only two short segments, the haustellum, when present, being of about the same length as the palpi. In the second undetermined species the haustellum is rather broad, finger-like, and clothed with short hairs; in *H. simulans* and *H. bilineata* it is narrower, rather longer than the labial palpi and has more the appearance of a normal functional haustellum.

Species examined: *Oncopera mitocera* Turn., *Perrissectis australasiae* Don., *Sthenopsis argenteomaculatus* Harr., *Pielus hyalinatus* H.S., *Trictena labyrinthica* Don., *Porina jocosa* Meyr., *P. dinodes* Meyr., *P. signata* Walk., *P. fuscomaculata* Walk., *Charagia virescens* Dbld., *Hepiulus humuli* L., *H. gracilis* Grt., *Leto staceyi* Scott, *Hectomanes crocea* Luc., *H. fusca* Luc., *H. polyaspila* Meyr., *H. simulans* Walk., *H. bilineata* Meyr., *H. spp.* (2).

PROTOTHORIDAE (Figs. 24 and 25).

In this family there is a short, two-segmented maxillary palp and an haustellum which reaches nearly to the middle of the labial palpi. The haustellum is of normal thickness and is covered with short hair, the apex being blunt. The cardo and stipes are of the Hepialoid type.

Species examined: *Prototheora petrosema* Meyr., *Metatheora corvifera* Meyr.

LEPIDOPTERA HETERONEURA.

NEPTICULIDAE (Figs. 26 and 27).

In *Nepticula* the maxillary palp is 5-segmented and the galea, which is flattened on the inner side and armed on its lower margin with a row of curved spines, is very short. Having regard to the primitive nature of certain characters of this genus,—for instance, the retention of a small fibula and series of costal spines in some of the more generalised species,—it seems possible that the haustellum is here rather rudimentary than vestigial.

Species examined: *Nepticula rhamnicola* Braun, *N. lucida* Philp.

INCURVARIIDAE (Fig. 28).

Only one species of this family (Meyrick places the type genus in the Tineidae and gives the maxillary palpi as "long, filiform, folded") has been examined. This was *Chalceopla cyanella* Busck. The maxillary palp consists of two short, more or less globular segments. The haustellum is long and the cardo and stipes are normal.

PRODOXIDAE (Figs. 29 to 31).

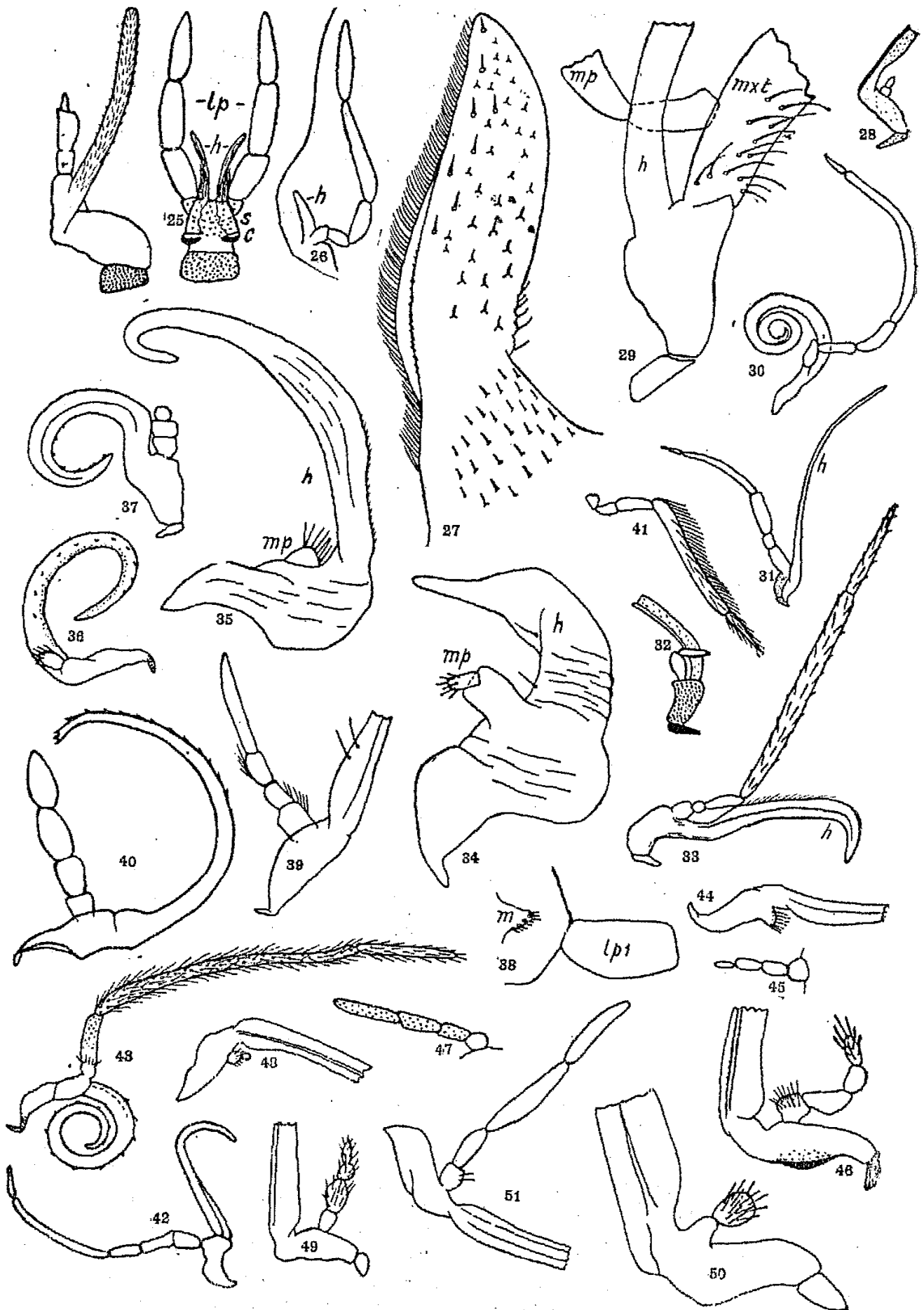
In this family, which consists of the genera *Tegiticula* and *Prodoxus* only, the maxillary palpi are 5-segmented and ordinarily folded as in many of the Tineidae. In the very long fourth segment followed by the short apical one there is some resemblance to the Micropterygid type but the same structure also obtains in the generalised Tineoids. A well-developed haustellum is present in both genera and in the female of *Tegiticula* a unique organ, known as the maxillary tentacle, is present. This structure rises from the apex of the stipes, and is quite twice as thick and a little longer than the galea (haustellum). It is covered, except dorsally, with stout spines, set in a ring-like base. It takes a downward course, curving round in a half-circle, the maxillary palpi springing from near its base. Riley (*Third Annual Report, St. Louis, Mo., 1892, p. 99*) has fully described the function of this curious organ, its use being to hold the ball of pollen which the moth gathers from the yucca plant as provender for its future larvae. Riley regarded the tentacle as the greatly-modified basal segment of the maxillary palp, but other investigators have considered it to be an extension of the palpifer. The writer inclines to Riley's view. If the maxilla of the male is examined it will be seen that the basal segment of the maxillary palp has an apical process pointing in the direction which, in the female, is followed by the maxillary tentacle. It will also be noticed that in the female, though the base of the tentacle is not freely articulated with the stipes, there is an indication, in the form of a dorsal fold, of a former jointing. As the function of the tentacle is to hold the ball of pollen, it would be an advantage for the basal joint to become more or less fused so that it would grip the mass by an automatic spring action, there being, as far as is known, no provision for muscular control. Another point which may have some bearing on the matter may be mentioned. Reference has been made to the strong spines which are present on the maxillary tentacle, but not on the maxillary palp, and if the labial palpi be examined it will be found that the basal segment is armed with exactly similar spines, which are absent from the following segments. In *Prodoxus* the maxillae are alike in both sexes, the female showing no trace of a maxillary tentacle.

Species examined: *Tegiticula alba* Z., *Prodoxus quinquepunctella* Chamb.

ADELIDAE (Fig. 32).

Meyrick (*Genera Insectorum, fasc. 133, p. 1*) describes the maxillary palpi of this family as "5-jointed, or 3-jointed, or rudimentary, porrected or folded." In *Adela bella* Chamb., the only species available for examination, the maxillary palpi is 2-segmented and the haustellum long and coiled. The first segment of the palp is in line with the haustellum, but the second takes an upward course at a right angle. The cardo and stipes are strongly chitinised.

Species examined: *Adela bella* Chamb.



FIGS. 24-51.

OPOSTEGIDAE (Fig. 33).

The maxillae of this group are of a fairly primitive type, the maxillary palpi being 5-segmented with a very long fourth segment, and the haustellum short and stout.

Species examined: *Opostega 4-strigella* Chamb., *Opostega non-strigella* Chamb.

COSSIDAE (Figs. 34 and 35).

Though many lepidopterists now regard the Cossids as the most primitive of the Heteroneura, the maxillae have undergone extreme reduction. In *Zeuzera pyrina* L. the haustellum is represented by a very short flaccid vestige and the maxillary palp consists of a small basal segment and a minute apical one, the latter bearing a few hairs. The cardo and stipes are not differentiated and the whole organ is weakly chitinized. The labial palpi are also reduced to two segments. In *Xyleutes eucalypti* H. S., the haustellum is short and thread-like while the palp consists of but one minute papilla. In *Xyleutes* no maxillae were found.

Species examined: *Xyleutes eucalypti* H.S., *Zeuzera pyrina* L.

MEGALOPYGIDAE.

LACOSOMIDAE.

In these two small families only one species of each was examined. The maxillae were absent and the labial palpi reduced to two small segments.

Species examined: *Lagoa crispata* Pack. (Megalopygidae), *Cicinus melsheimeri* Harr. (Lacosomidae.)

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- FIG. 24.—*Metatheora corvifera* Meyr. Maxilla.
 FIG. 25.—*M. corvifera* Meyr. Maxilla, labium and labial palpi.
 FIG. 26.—*Nepticula lucida* Philp. Maxilla.
 FIG. 27.—*N. lucida* Philp, Haustellum (or galea).
 FIG. 28.—*Chalceopta cyanella* Busck. Maxilla.
 FIG. 29.—*Tegiticula alba* Z. Female, maxilla.
 FIG. 30.—*T. alba* Z. Male, maxilla.
 FIG. 31.—*Prodoxus quinquepunctella* Chamb. Maxilla.
 FIG. 32.—*Adela bella* Chamb. Maxilla.
 FIG. 33.—*Opostega 4-strigella* Chamb. Maxilla.
 FIG. 34.—*Zeuzera pyrina* L. Maxilla.
 FIG. 35.—*Z. sp.*
 FIG. 36.—*Lithacodes fasciola* H.S. Maxilla.
 FIG. 37.—*Oochlidion biguttata* Pack. Maxilla.
 FIG. 38.—*Mallobathra strigulata* Philp. Maxilla and portion of labium.
 FIG. 39.—*Archyala terranea* Butl. Maxilla.
 FIG. 40.—*Scardia australasiella* Don. Maxilla.
 FIG. 41.—*Sagephora phortegella* Meyr. Maxillary palp.
 FIG. 42.—*Lindera tessellatella* Blanch. Maxilla.
 FIG. 43.—*Hieroxestis omoscopa* Meyr. Maxilla.
 FIG. 44.—*Bedellia somnulentella* Z. Maxilla.
 FIG. 45.—*Protosynaema eratopis* Meyr. Maxillary palp.
 FIG. 46.—*Phutella maculipennis* Curt. Maxilla.
 FIG. 47.—*Orthenches similis* Philp. Maxillary palp.
 FIG. 48.—*Zelleria copidota* Meyr. Maxilla.
 FIG. 49.—*Tonza purella* Walk. Maxilla.
 FIG. 50.—*Lactura egrigiella* Walk. Maxilla.
 FIG. 51.—*Gracilaria linearis* Butl. Maxilla.

EUCLEIDAE (LIMACODIDAE) (Figs. 36 and 37).

Nine genera of the Eucleidae have been examined, six of which, i.e. *Doratifera*, *Susica*, *Euclea*, *Adoneta*, *Monoleuca*, and *Limacodes*, have entirely lost the maxillae. In the remaining three, *Prolimacodes*, *Lithacodes*, and *Cochlidion*, minute maxillae are present, consisting of cardo, stipes, haustellum, and maxillary palpi. The haustellum may possibly still be of use as it bears a series of papillae on its lower surface. *Cochlidion* has maxillary palpi of three small, somewhat globular segments; in *Lithacodes* and *Prolimacodes* the organ is reduced to a single tiny segment. It may be noted that in this family the labial palpi, though short, are usually three-segmented; in *Cochlidion*, however, only two segments are present.

Species examined: *Doratifera vulnerans* Lew., *D. oxlei* Newm., *Susica humeralis* Walk., *Euclea paenulata* Clem., *Adoneta spinuloides* H.S., *Monoleuca semifascia* Walk., *Prolimacodes scapha* Harr., *Lithacodes fasciola* H.S., *Cochlidion biguttata* Pack.

TINEIDAE (Figs. 38 to 41).

The Tineidae exhibit a very great diversity in the condition of the maxillae. In many genera all the parts except the lacinia, i.e. the cardo, stipes, haustellum, and maxillary palpi, are present. The palps do not differ much from those of the Micropterygidae, being 5-segmented, folded, and with the fourth segment as long or longer than the three preceding ones. The haustellum is short, but often stout and well formed, giving the impression of a developing structure rather than one undergoing reduction. To this group with the 5-segmented palpi belong the genera *Lysiphragma*, *Opogona*, *Tinea*, *Monopis*, *Prothinodes*, *Lindera*, and *Sagephora*. Of *Scardia* three species have been dissected, with unexpected results. *S. clonodes* Meyr. has maxillary palpi of the type just referred to, but in *S. australasiella* Don. and *S. primaeva* Meyr. the palps are 4-segmented and more or less moniliform. This genus, however, seems to be an ill-defined one; none of the three species referred to agrees in venation with either of the others. *Archyala* also had a 4-segmented unfolded palp, but in this instance the terminal segment is about as long as the first three. In *Mallobathra* there is only a minute vestige of the maxilla left. This takes the form of a papilla bearing a number of short but stout spines set on a circular base; it is probably the remains of the basal segment of the palp. *Narycia* represents the final stage in the reduction of the maxillae, the organ having here completely disappeared.

Species examined: *Lysiphragma epixyla* Meyr., *Lindera tessellatella* Blanch., *Monopis ethelella* Newm., *Tinea accusatrix*, Meyr., *T. fagicola* Meyr., *Prothinodes grammocosma* Meyr., *Sagephora phortegella* Meyr., *Opogona micranthes* Meyr., *Scardia primaeva* Meyr., *S. clonodes* Meyr., *S. australasiella* Don. *Archyala terranea* Butl., *Taleporia cawthronella* Philp., *Mallobathra strigulata* Philp., *Narycia saxosa* Meyr.

LYONETIIDAE (Figs. 43 and 44).

Most of the genera in this family differ little, as regards the maxillae, from the generalized Tineidae. The haustellum is short, but not

extremely so, and in most cases probably functional. The palpi are five-segmented and the fourth segment is very long; the third segment, however, tends to be of greater length than in the Tineids. *Hieroxestis*, *Hectacma*, *Erechthias*, and *Eschatotypa* exhibit this type, but *Bedellia* possesses quite a different structure. Here the haustellum is long and the palp reduced to a minute tubercle bearing an armature of a few short hairs.

Species examined: *Hieroxestis omoscopia* Meyr., *Hectacma stilbella* Dbld., *Erechthias externella* Walk., *Eschatotypa derogatella* Walk., *Bedellia somnulentella* Z.

PLUTELLIDAE (Figs. 45 to 47).

Here the haustellum is well developed and the maxillary palpi consist of four more or less filiform segments. There is usually a folding at the base, recalling the structure of the generalized Tineids. The cardo is large and well chitinized.

Species examined: *Plutella maculipennis* Curt., *Orthenches similis* Philp., *Dolichernis chloroleuca* Meyr., *Protosynaemis eratopis* Meyr.

HYPONOMEUTIDAE (Figs. 48 to 50).

In all the genera of this family examined, with the exception of *Tonza*, a minute two-segmented maxillary palp was found; in *Tonza* the palp has four segments. The haustellum is long and well developed and the other parts are normal.

Species examined: *Tonza purella* Walk., *Lactura egregiella* Walk., *Hyponomeuta interellus* Walk., *Zelleria copidota* Meyr.

GRACILARIIDAE (Figs. 51 to 53).

The Gracilariidae are characterized by a very long haustellum and a four-segmented maxillary palp. The palp is not porrect and the basal segment is more or less globular. In some genera, as *Epicephala* and *Paractopa*, the terminal segment is the longest of the four but in others, as *Acrocercops* and *Gracilaria*, the third has the greatest length. A full-length figure of the haustellum of *Epicephala* is given. It is here about five times the length of the maxillary palp but in *Gracilaria* it is about eight times as long.

Species examined: *Gracilaria linearis* Butl., *G. selenitis* Meyr., *G. xylophanes* Turn., *Acrocercops ordinatella* Meyr., *A. calicella* Stt., *Paractopa formosa* Stt., *Epicephala frugicola* Turn.

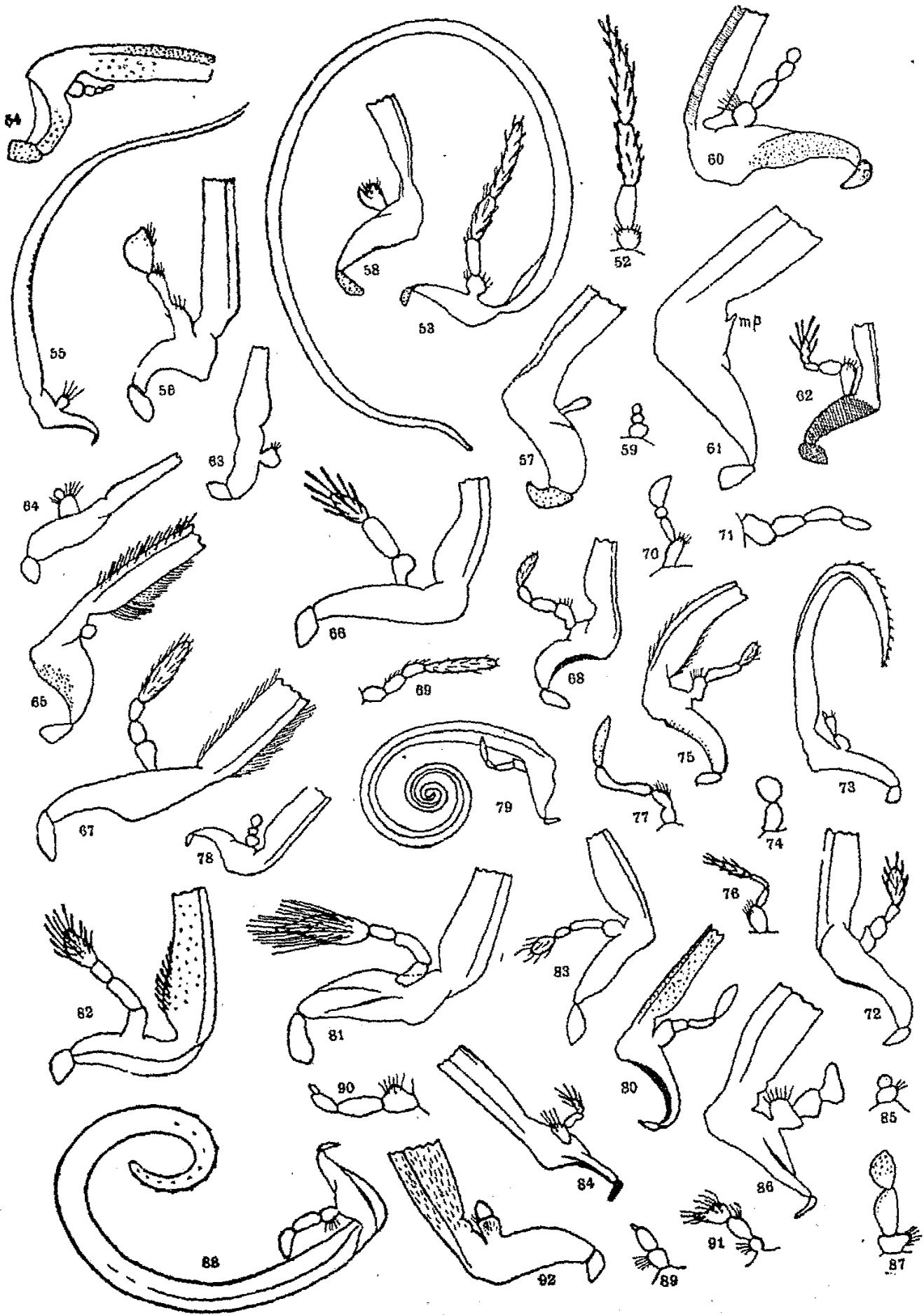
SCYTHRIDAE (Fig. 54).

A single species of this family has been examined. The haustellum was found to be well developed, the stipes normal, and the cardo large and subquadrate. The maxillary palp consisted of four globular segments, the series diminishing in size to the apex.

Species examined: *Scythris epistrota* Meyr.

ELACHEISTIDAE (Fig. 55).

In the type genus, the only one examined, the haustellum is much reduced, and an extremely minute maxillary palp is present. The



FIGS. 52-92.

segments are globular, and in *Elachista thallophe* Meyr. there are two of these, but in *E. archaeonoma* Meyr. and *E. exaula* Meyr. only one remains.

Species examined: *Elachista thallophe* Meyr., *E. archaeonoma* Meyr., *E. exaula* Meyr.

COLEOPHORIDAE (Fig. 56).

Batrachedra is the only genus of this family which has been available for examination. In this instance I have found some difficulty in making out the number of segments in the maxillary palpi. It seems probable, however, that there are three, the first two being more or less fused. The terminal one is swollen and lemon-shaped. As in the preceding family, the haustellum is long and well developed.

Species examined: *Batrachedra agaura* Meyr.

GLYPHIPTERYGIDAE (Figs. 57 to 62).

In the Glyphipterygidae the genera *Hierodoris* and *Heliosibes* have a four-segmented maxillary palp. The segments are short, and

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- FIG. 52.—*Parectopa formosa* Stt. Maxillary palp.
 FIG. 53.—*Epicephala frugicola* Turn. Maxilla.
 FIG. 54.—*Scythris epistrotta* Meyr. Maxilla.
 FIG. 55.—*Elachista archaeonoma* Meyr. Maxilla.
 FIG. 56.—*Batrachedra agaura* Meyr. Maxilla.
 FIG. 57.—*Choreutis bjerkanndrella* Thunb. Maxilla.
 FIG. 58.—*Simaethis albifasciata* Philp. Maxilla.
 FIG. 59.—*Glyphipteryx transversella* Walk. Maxillary palp.
 FIG. 60.—*G. cometophora* Meyr. Maxilla.
 FIG. 61.—*Imma acosma* Turn. Maxilla.
 FIG. 62.—*Heliosibes electrica* Meyr. Maxilla.
 FIG. 63.—*Amphithera heteroleuca* Turn. Maxilla.
 FIG. 64.—*Encoptila idiopsis* Turn. Maxilla.
 FIG. 65.—*Eretmocera flavicincta* Turn. Maxilla.
 FIG. 66.—*Vanicela xenadclpha* Meyr. Maxilla.
 FIG. 67.—*Stathmopoda melanochoa* Meyr. Maxilla.
 FIG. 68.—*Machimia zatrephes* Turn. Maxilla.
 FIG. 69.—*Eulechria baryptera* Turn. Maxillary palp.
 FIG. 70.—*Macrobathra diplochrysa* Low. Maxillary palp.
 FIG. 71.—*Nymphostola galactina* Feld. Maxillary palp.
 FIG. 72.—*Eschatura lemurtas* Meyr. Maxilla.
 FIG. 73.—*Cryptophaga rubescens* Lew. Maxilla.
 FIG. 74.—*C. nubila* Luc. Maxillary palp.
 FIG. 75.—*Xylorycta melaleuca* Turn. Maxilla.
 FIG. 76.—*Telecrates laetiorella* Walk. Maxillary palp.
 FIG. 77.—*Neodrepta luteotactella* Walk.
 FIG. 78.—*Apatetris melanombra* Meyr. Maxilla.
 FIG. 79.—*Phthorimaea operculella* Z. Maxilla.
 FIG. 80.—*Trachydora droserodes* Meyr. Maxilla.
 FIG. 81.—*Glaphyrstis marmarea* Meyr. Maxilla.
 FIG. 82.—*Pyroderces deliciosella* Walk. Maxilla.
 FIG. 83.—*Cosmopteryx mimetis* Meyr. Maxilla.
 FIG. 84.—*Irenicodes eurychora* Meyr. Maxilla.
 FIG. 85.—*Bactra noteraula* Walshm. Maxillary palp.
 FIG. 86.—*Eucosma trangulana* Meyr. Maxilla.
 FIG. 87.—*Spilonoia macropetana* Meyr. Maxillary palp.
 FIG. 88.—*Acropolitis rudis* Walk. Maxilla.
 FIG. 89.—*Tortrix postvittana* Walk. Maxillary palp.
 FIG. 90.—*T. amoenana* Meyr. Maxillary palp.
 FIG. 91.—*Oacoecia polygraphana* Walk. Maxillary palp.
 FIG. 92.—*Proselena antiquana* Walk. Maxilla.

the organ is folded like that of the Plutellids. In *Glyphipteryx* the palp may be either three- or four-segmented, the structure being much smaller than in the preceding genera. In *Simaethis* the palp consists of one segment only, but its peculiar shape may indicate that the second segment has been much reduced and has become fused with the basal one. *Choreutis* exhibits a single segment, and in *Imma* the palp is represented by a mere papilla. The cardo and stipes are usually large and well chitinised but the haustellum is rather weak. It was noticeable that in this family many specimens had either lost the maxillae entirely or had the haustellum broken off short near the base.

Species examined: *Hebiostibes electrica* Meyr., *Hierodoris frigida* Philp., *Glyphipteryx cometophora* Meyr., *G. chrysoplanetis* Meyr., *G. zelota* Meyr., *G. octonaria* Philp., *G. ataracta* Meyr., *G. transversella* Walk., *G. achlyoessa* Meyr., *G. acronoma* Meyr., *Simaethis albifasciata* Philp., *S. combinatana* Walk., *S. analoga* Meyr., *Choreutis bjerkanrella* Thunb., *Imma acosma* Turn.

HELIODINIDAE (Figs. 65 to 67).

Of the genera examined in this family *Stathmopoda* has the least reduced maxillary palpi, the organ consisting of four segments, the apical one of which is comparatively long. *Vanicela* has lost another segment, but the second is rather elongate and possibly represents the fused second and third. *Thylacosceles* possesses only two greatly reduced segments, and in *Eretmocera* there is but a single small globular segment. The cardo and stipes are well developed and the haustellum, though of less than normal length, is apparently functional.

Species examined: *Stathmopoda melanothroa* Meyr., *S. crocophanes* Meyr., *S. coracodes* Meyr., *Vanicela disjunctella* Meyr., *V. xenadelpha* Meyr., *Thylacosceles acridomima* Meyr., *Eretmocera flavicincta* Turn.

AMPHITHERIDAE (Figs. 63 and 64).

Only two species of the Amphitheridae have been examined. The haustellum was found to be of normal structure, and the maxillary palp consisted, in one instance, of two segments—a rather stout basal one and a minute globular apical one—and in the other of a single segment.

Species examined: *Enchoptila idiopis* Turn., *Amphithera heteroleuca* Turn.

OECOPHORIDAE (Figs. 68 to 71).

In this extensive family there seems to be a remarkable uniformity in the structure of the maxillae. The cardo, stipes, and haustellum are usually normal, though the latter is in some instances rather short and evidently somewhat reduced. The maxillary palpi are always four-segmented and are only generically differentiated, and that in only a few instances, by the shape and size of the segments. The basal segment is generally irregular, the posterior side having frequently a deep constriction and the anterior side being swollen and bearing a group of stiff hairs. The second and third segments are rather shorter and the apical one may be from very slightly longer,

as in *Borkhausenia*, to as long as the first three segments, as in *Eulechria*. In a few genera, as *Macrobathra* and others, the apical segment is swollen, making a clavate palp. In the normal position the palp is bent round and closely embraces the base of the haustellum, the apical segment lying against its upper surface. The genus *Nymphostola* is the only one which tends to stand by itself in the matter of palpal structure. Here there are the usual four segments, but they are very closely set, and the divisions not at all clearly indicated, so that the organ has the appearance of a finger-like process rather than a segmented structure.

The foregoing observations must not, however, be taken as conclusive, only forty-two out of the total of more than three hundred genera which constitute the family having been available for examination.

Species examined: *Macrobathra diplochrysa* Low., *Ochlogenes advectella* Walk., *Borkhausenia hemisphaerica* Meyr., *B. pseudospretella* Stt., *B. basella* Walk., *Machimia carnea* Z., *M. zatrephes* Turn., *Eulechria baryptera* Turn., *Barea leucocephala* Turn., *Piloprepes lophoptera* Low., *Machaeritis aegrella* Meyr., *Coesyra paulinella* Newm., *C. apora* Meyr., *C. dichroella* Z., *Oxythecta acceptella* Walk., *Coeranica isabella* Meyr., *Pleurota psammozantha* Meyr., *Saropla philocala* Meyr., *Protomacha chalcaspis* Meyr., *Chezala conjunctella* Walk., *Philobota xiphostola* Meyr., *P. disjunctella* Walk., *Lophopepla igniferella* Walk., *Zonopetala clerota* Meyr., *Callithauma pyrites* Meyr., *Eupselia satrapella* Meyr., *Eutorna pabulicola* Meyr., *Thudaca obliquella* Walk., *Endorsis lactella* Schiff., *Schiffermuelleria orthopanes* Meyr., *Leptocroca meselectra* Meyr., *Euchersadaula lathriopa* Meyr., *Euthictis chloratma* Meyr., *Trachypepla contritella* Walk., *Izatha epiphanes* Meyr., *Proteodes carnifex* Butl., *Lathicrossa leucocentra* Meyr., *Atomotricha chloronota* Meyr., *A. exsomnia* Meyr., *Thamnosara sublitella* Walk., *Cryptolechia liochroa* Meyr., *C. radiosella* Walk., *Nymphostola galactina* Feld., *Wingia lambertella* Wing.

XYLORYCTIDÆ (Figs. 72 to 77).

Good examples of progressive reduction in the maxillary palpi are exhibited in this large family. *Lichenaula* has a five-segmented palp; the genera *Telecrates*, *Odites*, *Procometis*, *Agriophora*, *Chalarotona*, *Scieropepla*, *Eschatura*, *Uzucha*, and *Catoryctis* have each lost a segment; *Xylorycta* and *Maroga* have only three remaining; *Cryptophaga rubescens* has two, with a third represented by a minute papilla, while in *C. nubila* this papilla has been lost. In *Neodrepta* the third segment is elongate, curved and medially constricted, having all the appearance of being the result of the fusion of the third and fourth. Bearing in mind the shape and size of the apical segment in the majority of the genera, it would appear that reduction has usually taken place by the loss of median or basal segments; and in some genera, i.e., *Telecrates*, *Agriophora*, etc., the evidence points pretty conclusively to the basal one as having disappeared. In *Neodrepta*, however, the original basal segment is almost certainly present, and the evidence seems to warrant the conclusion that here the loss of a segment has been brought about by the fusion of two, such fusion

being a preliminary to the shortening of the structure. The cardo and stipes are of normal form and chitinization. The haustellum is short but its two halves are always closely fitted to each other, and the organ is doubtless functional. On the apical half it bears a number of prominent sensory papillae. In *Cryptophaga* the haustellum shows its greatest reduction, and here also the maxillary palpi are most vestigial.

Species examined: *Lichenaula lichenea* Meyr., *Telecrates lactiorella* Walk., *Odites pudica* Low., *Eschatura lemurias* Meyr., *Chalarotona intatescens* Meyr., *Scieropepla reversella* Walk., *Catoryctis eugramma* Meyr., *Procometes hylonoma*, *Agriophora confertella* Walk., *Uzucha humeralis* Walk., *Maroga unipunctana* Don., *Xylorycta melaleuca* Turn., *Cryptophaga rubescens* Lew., *C. nubila* Luc., *Neodrepta luteo-tactella* Walk.

GELECHIDAE (Figs. 78 and 79).

The structure of the maxillae in the Gelechiidae is very uniform. The cardo is small, the stipes normal, the haustellum very well developed, though not elongate, and the palpi usually four-segmented. These latter take up the same position as in the Oecophoridae but are not so closely appressed to the base of the haustellum. The segments are all short; the third is usually curved and is the shortest of the four, while the apical one is generally the largest and is slightly swollen. Out of fourteen genera examined this description holds good, but in *Apatetris* the palp was found to consist of three minute globular segments.

Species examined: *Aristotelia furtiva* Meyr., *Anacamptis simplicella* Walk., *Macrenches clerica* Rosen., *Stegasta variana* Meyr., *Phthorimaea operculella* Z., *Anaptilora eremias* Meyr., *Crocantbes perigrapta* Meyr., *Lecithocera micromela* Low., *Protolechia micropa* Meyr., *Cymatomorpha euplecta* Meyr., *Dichomeris capnitis*, Meyr., *Thiotricha tetraphala* Meyr., *Gelechia monophragma* Meyr., *Apatetris melanombra* Meyr.

COSMOPTERYGIDAE (Figs. 80 to 83).

This family has a well-developed haustellum and a four-segmented maxillary palp. The segments of the palp are, however, very short; the apical one is usually swollen and covered with rather long scales. The cardo is comparatively large.

Species examined: *Cosmopteryx mimetis* Meyr., *Pyroderces deliciosella* Walk., *Glaphyristis marmarea* Meyr., *Trachydora droserodes* Meyr.

DIPLOSARIIDAE (Fig. 84).

Only one example of this family has been examined. This species, *Irenicodes eurychora* Meyr., the only known New Zealand representative of the group, is said by its describer to be a rather highly specialized member. The haustellum is well developed but the maxillary palpi are greatly reduced, consisting only of three small segments.

Species examined: *Irenicodes eurychora* Meyr.

EUCOSMIDAE (Figs. 85 to 87).

The few Eucosmids which I have been able to study all exhibit, with the exception of *Bactra*, a thick, though not very long, haustellum, and a maxillary palp consisting of three fairly stout segments. The anterior face of the basal segment is rounded and swollen, and bears a number of hairs; the other two segments may be irregular, as in *Eucosma*, or more symmetrical, as in *Argyroploce*. In *Bactra* there are but two small globular segments, the apical one being about half the size of the basal one.

Species examined: *Eucosma triangulana* Meyr., *Argyroploce illepida* Butl., *Cydia pomenella* L., *Spilonota macropetana* Meyr., *Bactra noteraula* Wlshn.

TORTRICIDAE (Figs. 88 to 92).

The maxillae of this important family do not call for much remark. The cardo, stipes, and haustellum are all well developed and of normal shape. The maxillary palpi are usually three-segmented, but the segments are short and generally more or less elongate-oval. A fairly constant feature is a rounded prominence on the inner surface of the basal segment from which springs a number of hairs. In a few instances there is a minute fourth apical segment and more frequently the number is reduced to two. The number of segments is not necessarily a generic character as *Tortrix* exhibits all three variations.

Species examined: *Tortrix amoenana* Walk., *T. liquidana* Meyr., *T. postvittana* Walk., *T. crypsibodes* Meyr., *T. pictoriana* Feld., *T. excessana* Walk., *T. flavescens* Butl., *Harmologa amplexana* Z., *Gelophaula siraea* Meyr., *Cacoecia polygraphana* Walk., *C. australana* Lew., *Acropolitis rudis* Walk., *Ctenopseustis obliquana* Walk., *Epalxiphora azenana* Meyr., *Epichorista emphanes* Meyr., *Pyrgotis pyramidias* Meyr., *Proselena antiquana* Walk., *Catamacta gavisana* Walk., *Capua intractana* Meyr., *Cnephasia rupicolana* Meyr., *Homona similans* Walk., *Scoliopecta comptana* Walk.

CARPOSINIDAE (Fig. 93).

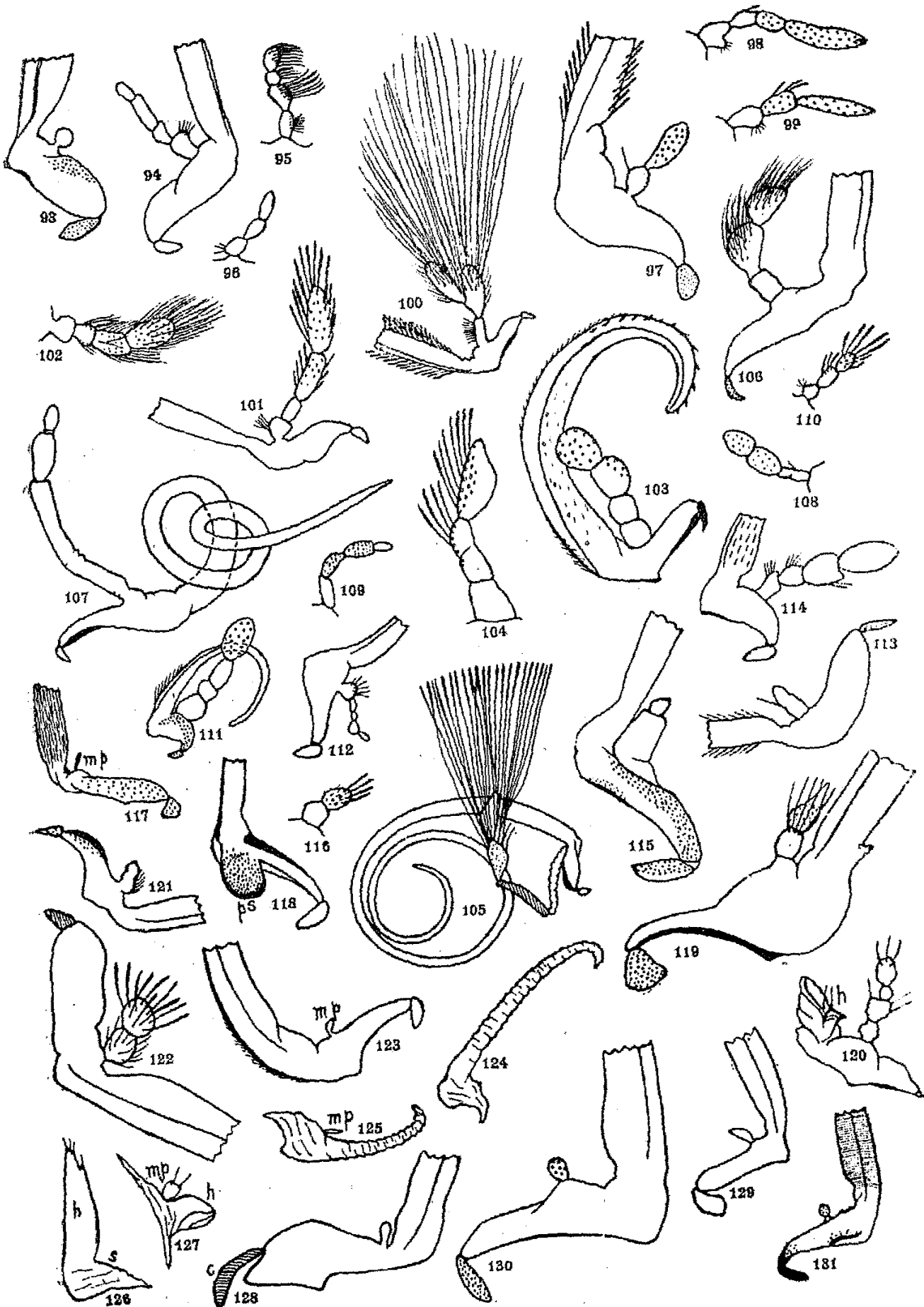
The two genera examined of this family had the maxillary palpi reduced to a single small rounded segment. The haustellum was well developed and the other parts normal.

Species examined: *Carposina gonosemana* Meyr., *Helicosma incongruana* Walk.

PRALIDIDAE.

PYRAUSTINAE (Figs. 94 to 96).

In this large subfamily the maxillary palpi seem to be normally four-segmented though in two genera, *Scelodes* and *Musotima*, only three segments are present. The basal segment usually bears an anterior rounded protuberance which is always armed with a group of short spines. The third and fourth segments are generally densely clothed with long scales and in a few forms, such as *Agrotera* and *Sameodes*, these are replaced by elongate hairs directed rectangularly to the segment. In *Nacoleia* the segments are subglobular and minute,



Figs. 93-131.

and in *Dichocrocis* they are of similar form but larger in proportion. The haustellum is long and well developed being shortest in *Nymphula* where it is about thrice as long as the palpi.

Species examined: *Nymphula dicentra* Meyr., *Cataclysta drusialis* Walk., *Musotima acrias* Meyr., *Eurrhyarodes tricoloralis* Z., *Ercta ornatalis* Dup., *Agrotera amathealis* Walk., *Dichocrocis punctiferalis* Guen., *Nacoleia rhoeonalis* Walk., *B. Bradina admixtalis* Walk., *Sylepta derogata* Fabr., *Margaronia atlitalis* Walk., *Marasmia venialialis* Walk., *Sameodes iolealis* Walk., *Loxostege massalis* Walk., *Metasia capnochora* Meyr., *Acharana licarsialis* Walk., *Pyrausta phoenicealis* Hb., *Mecyna ornithopteralis* Guen., *Heliothela floricola* Turn., *Scoparia favillifera* Meyr., *S. philerga* Meyr., *Tetraprosopis meyricki* Butl., *Euclastis maceratatalis* Led., *Nausinoe pueritia* Cram., *Diasemia grammalis* Dbl., *Nesarcha hybrealis* Walk., *Sceliodes cordalis* Dbl.

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- FIG. 93.—*Carposina gonosemana* Meyr. Maxilla.
 FIG. 94.—*Cataclysta drusialis* Walk. Maxilla.
 FIG. 95.—*Agrotera amathealis* Walk. Maxillary palp.
 FIG. 96.—*Musotima acrias* Meyr. Maxillary palp.
 FIG. 97.—*Scenedra accoratalis* Walk. Maxilla.
 FIG. 98.—*Trichophysetis cretacea* Butl. Maxillary palp.
 FIG. 99.—*Spectatrotta fimbrialis* Warr. Maxillary palp.
 FIG. 100.—*Macalla concisalis* Walk. Maxilla.
 FIG. 101.—*Crumbus malacellus* Dup. Maxilla.
 FIG. 102.—*Uvida ramostriella* Walk. Maxillary palp.
 FIG. 103.—*Eucallionyma sarcodes* Meyr. Maxilla.
 FIG. 104.—*Heteromicta tripartitella* Meyr. Maxillary palp.
 FIG. 105.—*Epicrocis sublignalis* Walk. Male, Maxilla.
 FIG. 106.—*E. sublignalis* Walk. Female, Maxillary palp.
 FIG. 107.—*Papua rhabdota* Turn. Maxilla.
 FIG. 108.—*Hypsotropha chlorogramma* Meyr. Maxillary palp.
 FIG. 109.—*Lelogenex limadoxa* Meyr. Maxillary palp.
 FIG. 110.—*Homocosoma formacella* Meyr. Maxillary palp.
 FIG. 111.—*Scirpophaga patulella* Walk. Maxilla.
 FIG. 112.—*Orneodes phricodes* Meyr. Maxilla.
 FIG. 113.—*Alucita monospilalis* Walk. Maxilla.
 FIG. 114.—*Coenoloba obliteralis* Walk. Maxilla.
 FIG. 115.—*Morova subfasciata* Walk. Maxilla.
 FIG. 116.—*Addea subtessellata* Walk. Maxillary palp.
 FIG. 117.—*Euschemon rafflesia* Macleay. Maxilla.
 FIG. 118.—*Zizina labradus* Godart. Maxilla.
 FIG. 119.—*Synemon directa* Westw. Maxilla.
 FIG. 120.—*S. hesperoides* Feld. Female, maxilla.
 FIG. 121.—*Pollanisus iridescens* B-B. Maxilla.
 FIG. 122.—*Zygaena filipendulae* L.
 FIG. 123.—*Nyctalemon orontes* L. Maxilla.
 FIG. 124.—*Porthesia fimbriata* Luc. Maxilla.
 FIG. 125.—*Acyphas chionites* Turn. Maxilla.
 FIG. 126.—*Orgyia australis* Walk. Female, Maxilla.
 FIG. 127.—*Lymantria reducta*, Walk. Maxilla.
 FIG. 128.—*Hippotion celerio* L. Maxilla.
 FIG. 129.—*Xanthorhoe rosearia* Dbl. Maxilla.
 FIG. 130.—*Digama marmorea* Butl. Maxilla.
 FIG. 131.—*Hecatesia fenestrata* Boisd. Maxilla.

LETTERING.

c, cardo; *g*, galea; *h*, haustellum; *hy*, hypopharynx; *l*, lacinia; *lp*, labial palp; *lpl*, first segment of labial palp; *lr*, labrum; *m*, maxilla; *mp*, maxillary palp; *mt*, mental plate; *mtt*, maxillary tentacle; *ps*, process of stipes; *s*, stipes.

PYRALIDINAE (Figs. 97 to 100).

In the Pyralidinae there is much variation in the maxillary palpi. In *Scenedra* and *Endotricha* there are but two segments while in *Trichophysetis*, *Herculia* and *Cardamyla* there are four. In the latter instances the second and third segments are so closely set that they appear as one structure and in *Spectatrotta* it would seem that the fusion of the two segments had taken place, there being but three pieces and the second having an indentation which probably marks the line of fusion. *Macalla* has an extraordinarily modified maxillary palp. It consists of three well-developed segments, the third of which articulates laterally close to the base of the second. These two segments are clothed with a dense tuft of long fine hair. In all the genera examined the haustellum stipes and cardo were found to be of normal proportions.

Species examined: *Trichophysetis cretacea* Butl., *Herculia albidalis* Walk., *Cardamyla didymalis* Walk., *Macalla concisalis* Walk., *Spectatrotta fimbrialis* Warr., *Scenedra decoratilis* Walk., *Endotricha mesenteralis* Walk.

CRAMBINAE (Figs. 101 and 102).

In the Crambinae there is not much variability in the parts of the maxillae. The maxillary palpi, in so far as my observations have been carried out, are always four-segmented, the shape of the segments varying from the short form of *Ubida* to the longer and more slender kind of *Crambus*, the apical segment or segments being invariably slightly swollen. The haustellum is usually well developed, but in a few instances it shows some reduction, and in *Calamotropha* it is not twice the length of the palp.

Species examined: *Crambus dicrenellus* Meyr., *C. malacellus* Dup., *Orocrambus mylites* Meyr., *Argyria amoenalis* Snel., *A. plumbolinealis* Hmps., *Talis bivittella* Don., *Chilo lativittalis* Walk., *Neargyria argyraspis* Meyr., *Tauroscopa gorgopis* Meyr., *Ubida ramosiella* Walk., *Diptychophora ochracealis* Walk., *Gadira acerella* Walk., *Calamotropha parramattellus* Meyr.

GALLERINAE (Figs. 103 and 104).

The two genera, *Eucallionyma* and *Heteromicta*, of this subfamily, which are all that have been examined, differ a great deal in the character of the maxillae. Both have a four-segmented palp, but the form of the segments differs considerably. The haustellum in *Eucallionyma* is reduced to an apparently non-functional vestige and the cardo and stipes are also greatly atrophied. In *Heteromicta*, however, the haustellum is well developed and the cardo and stipes quite normal.

Species examined: *Eucallionyma sarcodes* Meyr., *Heteromicta tripartitella* Meyr.

PHYCITINAE (Figs. 105 to 110).

In the Phycitinae the haustellum is somewhat weak, and is apparently undergoing reduction. The maxillary palp in some genera, e.g., *Homoeosoma*, *Sclerobia*, and *Crocodypora*, consist of three short segments; in *Hypsotropha* it is difficult to decide whether there are three

or four, the basal segment being very weakly chitinized and showing certain indications of being the result of fusion of the first and second segments. In *Delogenes* there are undoubtedly four rather short segments; here again the basal segments is more or less membranous, but there is no evidence of fusion. *Papua* has developed a very unusual type of palp, the first and second segments being extremely long, very weakly chitinized, and with the division merely indicated. *Epicrocis* has one of the most remarkable maxillary palps to be found in the Lepidoptera. The organ is four-segmented, the basal segment being long, membranous, and flexible. It droops downwards from the stipes, but the second segment, which is well chitinized, is directed sharply upwards. This segment is about the same length as the first, both being thin in comparison to their length. The third and fourth are short, the former being clavate and the latter cone-shaped. From the last two segments arise a great number of extremely long hairs. These hairs are slightly thickened at their apices, and being all of about the same length form a pair of truncated stiff brushes which lie immediately behind the upturned labial palpi. These very remarkable palpi are, however, confined to the male, the female having a three-segmented organ of ordinary structure.

Species examined: *Delogenes limodoxa* Meyr., *Papua rhabdota* Turn., *Hypsotropha chlorogramma* Meyr., *Epicrocis sublignalis* Walk., *Homoeosoma formacella* Meyr., *Sclerobia tritalis* Walk., *Crocodypora cinigerella* Walk.

SCHOENOBINAE (Fig. 111).

Two genera of this group have been examined. The haustellum is greatly reduced; in *Cirrochrista* it is a little more than twice as long as the maxillary palp and in *Scirpophaga* it is only about half as long again. The palp is four-segmented, the segments being rather short and thick, and the stipes and cardo are small and of an unusual curved shape. The whole organ exhibits much reduction, the palp being the most normal in size and form.

Species examined: *Scirpophaga patulella* Walk., *Cirrochrista trizonalis* Walk.

ORNEODIDAE (Fig. 112).

Only one species, *Orneodes phricodes* Meyr., has been examined. The haustellum is of moderate development, and the cardo and stipes are normal. The maxillary palp consists of five greatly-reduced segments. The basal one is the largest, and bears the usual group of spines on its anterior surface; the second and third are less than half the size of the first; the fourth is considerably larger and more or less globular, while the fifth is minute and set at an angle to the fourth.

Species examined: *Orneodes phricodes* Meyr.

TINEODINIDAE (Fig. 114).

Coenoloba, the only genus studied, has a well-developed haustellum and a four-segmented maxillary palp. The latter is somewhat clavate, the two apical segments being considerably broader than the basal ones.

Species examined: *Coenoloba obliteralis* Walk.

PTEROPHORIDAE (Fig. 113).

In the plume-moths the maxillary palp is represented by a single papilla, usually armed on the anterior aspect with a spine or spines. In some genera it is rather long, and possibly more than one segment is present, but no definite division can be seen. The haustellum is generally long and the other parts are normal.

Species examined: *Alucita monospilalis* Walk., *Platyptilia falcatalis* Walk., *Trichoptilus adelphodes* Meyr., *Stenoptilia lithoxesta* Meyr., *Sphenarches caffer* Z.

THYRIDIDAE (Figs. 115 and 116).

In the Thyrididae, of which five genera have been examined, the haustellum is fully developed, as also are the stipes and cardo, but the palp is far on the road to disappearance. In *Striglina* the structure is represented by a conical papilla only; in *Morova* and *Oxycophina* a similar papilla has a small rounded segment on its apex; in *Addaea* and the aberrant *Meskea* the palp consists of two very small but more normal segments.

Species examined: *Addaea subtessellata* Walk., *Meskea dyspteria* Grote, *Morova subfasciata* Walk., *Oxycophina theorina* Meyr., *Striglina scitaria* Walk.

PAPILIONOIDEA (Figs. 117 and 118).

Of the butterflies I have examined such a small number of species that any observations offered must be regarded as strictly provisional. The haustellum in this group is well developed and very strongly chitinized, as also are the cardo and stipes. In the Hesperidae the maxillary palp consists of a single minute segment articulating by a slender base. A similar structure is found in the Satyridae, and a still smaller one in the Nymphalidae. In the Papilionidae the palp is merely indicated by a blunt protuberance (probably the palpifer) bearing a tuft of hair, while in the Pieridae and Lycaenidae all trace of the palp has been lost. The Lycaenidae, and in a lesser degree, the Papilionidae, exhibit an unusual modification of the stipes. From the apical region of the stipes beneath, a bulb-like swelling projects in a line with the haustellum. It is smooth and very strongly chitinized, and has the appearance of a condyle, but I have not found that it fits into any corresponding socket.

Species examined: *Euschemon rafflesia* Macleay, *Pamphila hobomoc*, *Signeta tymbophora* Meyr. and Low., *Motasingha dominula* Ploetz, *Cephrenes augiades* Feld., *Dodonidia helmsi* Frdy., *Argyrophenega antipodum* Dbld., *Pyrameis gonerilla* Fabr., *P. cardui* L., *Papilio brucei* Edwards, *P. macleayanus* Leach, *Delias mysis* Fabr., *Zizina labradus* Godart.

CASTNIIDAE (Figs. 119 and 120).

Synemon hesperoides Feld. has the maxillae much reduced. The haustellum is represented only by a short, shrivelled, and irregular process; the cardo is minute, and the stipes much altered; the palp, however, still consists of four segments, though they are weak and irregular in shape. Contrary to what would be expected, the maxillae

of *S. directa* Westw. shows a fairly normal structure. The haustellum is quite well developed; the cardo is large and well chitinized; the stipes normal and the palpi symmetrical though consisting of but two segments. The second segment, however, has the apical half produced into a membranous point, and it is not improbable that this represents the third segment which has become fused with the second. A peculiar feature of the haustellum is the presence of a ridge or fold near the base beneath. The vestigial state of the haustellum in *hesperoides* is no doubt connected with the feeding-habits of the species and Australian lepidopterists might be able to throw some light on the matter by closely observing the habits of both *hesperoides* and *directa* in this respect.

Species examined: *Synemon directa* Westw., *S. hesperoides* Feld.

ZYGAEINIDAE (Figs. 121 and 122).

The haustellum in the Zygaenidae is unusually long, but the maxillary palp is reduced to a one- or two-segmented vestige. The cardo and stipes are normal and well chitinized.

Species examined: *Pollanisus iridescens* B-B., *Zygaena filipendulae* L.

LASIOCAMPIDAE.

Only two species belonging to this family have been examined. In both instances the maxillae were found to be absent.

Species examined: *Entometa fervens* Walk., *Porela arida* Walk.

NOTODONTIDAE.

In *Neola* the cardo, stipes and haustellum were found to be well developed and the maxillary palpi to consist of two small segments, but in *Epicoma* the maxillae seemed to be entirely absent. Packard, in his monograph of the North American species of the family (*Nat. Acad. Sci.* vol. 7, p. 87) states that the maxillary palpi form "small papillae at the base of the maxillae" (galeae).

Species examined: *Neola semiaurata* Walk., *Epicoma tristis* Lew.

URANIDAE (Fig. 123).

Three genera only of this family have been examined. They agree in having the haustellum fairly well developed, the cardo and stipes normal and the maxillary palpi reduced to one tiny segment.

Species examined: *Nyctalemon orontes* L., *Acropteris nanula* Warr., *Lobogethes interrupta* Warr.

SATURNIIDAE.

In the only species dissected the maxillae were found to be reduced to a weakly chitinized irregular vestige lying at the base of the small labial palpi.

Species examined: *Antherea eucalypti* Scott.

ANTHELIDAE.

The maxillae are reduced to a wrinkled and irregular membranous vestige. One or two papillae are present, but it is not possible to definitely relate these to any part of the normal maxillae.

Species examined: *Anthela varia* Walk., *A. acuta* Walk.

LYMANTRIIDAE (Figs. 124 to 127).

The maxillae here are much reduced in all their parts. The organs are only slightly, if at all, chitinized, and are much crinkled. The cardo is frequently absent and the stipes is short and irregular in shape. The palp is sometimes absent, and sometimes present as a minute papilla. In *Laelia*, however, the cardo and stipes are normal in shape and have a chitinized core while the haustellum is fairly long and but little crinkled. In *Orgyia* the female is apterous, and it is interesting to find that the sexes differ also in the maxillae. The male has the organs greatly reduced but of the same form as those of *Euproctes*; in the female the haustellum is straight, and the apex terminates in two or three papillae, each bearing a hair; there is also a similar papilla a little distance below the apex. *Lymantria* exhibits the greatest reduction of any genus dissected, there being distinguishable only the base of the haustellum and a rounded tubercle representing the maxillary palp.

Species examined: *Laelia obsoleta* Fabr., *Porthesia fimbriata* Luc., *P. lutea* Fabr., *Acyphas chionitis* Turn., *Orgyia australis* Walk., *Lymantria reducta* Walk.

SPHINGIDAE (Fig. 128).

In the hawk-moths the parts of the maxillae, with the exception of the maxillary palpi, are well developed and very strongly chitinized. The haustellum in most forms is of abnormal length, but in a few instances it is reduced to a vestige. In the few genera examined the stipes was found to be broadened basally, roundly projecting beneath the curved cardo in a way not observed in any other lepidopteron. The maxillary palp was in all instances reduced to a single small segment.

Species examined: *Hippotion celerio* L., *Metamina australasiae* Don., *Deilephila hypothous* Cram., *Theretra pinastrina* Martyn, *Hemaris hylas* Lew.

GEOMETROIDEA (Fig. 129).

In the families composing this group the maxillae display very little variation. The haustellum is well developed though not long, the stipes is rather narrow and the cardo fairly large, but the maxillary palp consists of a single small, more or less rounded segment. Prout (Genera Insectorum, fasc. 103, p. 7) states that in *Ligdia* (Brepinae) the palp consists of two segments.

Species examined: *Chloroclystis testulata* Guen., *Tatosoma tipulata* Walk., *Mnesiloba eupitheciata* Walk., *Euchoeca rubropunctaria* Dbld., *Eulype leucophragma* Meyr., *Protaulaca scythropa* Meyr., *Poecilasthena subpurpureata* Butl., *Hydriomena deltoidata* Walk., *H. subrectaria* Dbld., *Horisme peplodes* Turn., *Xanthorhoe rosearia* Dbld., *X. orophylla* Meyr., *Lythria chrysopeda* Meyr., *Notoreas mechanitis* Meyr., *Dasyuris hedylecta* Turn., *Leptomeres rubraria* Dbld., *L. optivata* Walk., *Eois albicostata* Walk., *Gnamptoloma aventiaria* Guen., *Anisodes pallida* Moore, *Pisoraca niveopuncta* Warr., *Euloxia meandriaria* Guen., *Chlorocoma dichoraria* Guen., *Prasinocyma albicosta* Walk., *Urolitha bipunctifera* Walk., *Eucyclodes pieroides* Walk.,

Crypsiphona occultaria Don., *Euschema fenestrata* Swain., *Eucryphia frontisignata* Walk., *Dichromodes consignata* Walk., *Epidesmia chilonaria* Guen., *Adeixis griseata* Huds., *Monoctenia pallida* Luc., *Osteodes procurata* Walk., *Cleora inflexaria* Snel., *Lophodes sinistraria* Guen., *Ectropis fractaria* Guen., *Deilinea rectaria* Walk., *Rhinodia rostraria* Guen., *Idiodes apicata* Guen., *Planolocha autoptis* Meyr., *Thalaina clara* Walk., *Declana leptomeris* Walk.

HYPSIDAE (Fig. 130).

In the Hypsidæ all the parts of the maxillae except the palp, which is one-segmented are well developed and strongly chitinized, the cardo being unusually large.

Species examined: *Nyctemera amica* White, *Digama marmorea* Butl., *Argina cribraria* Clerck, *Hypsa plagiata* Walk., *Agape chloropyga* Walk.

NOCTUIDAE (Fig. 131).

In the great family Noctuidæ examples of all the sub-families except the Hyblæinæ have been studied. Throughout the group the maxillae are almost uniform in structure. The haustellum, though not usually very long, is stout and well chitinized; the cardo and stipes are also well developed, and the maxillary palp is always one-segmented but is frequently mounted on a pronounced palpifer. Comstock (*An Introduction to Entomology*, p. 655) states that the maxillary palpi of the Hyblæinæ are "large and triangular" but he gives the group family rank, placing it next to the Thyrididæ.

Species examined: *Phalaenoides tristifica* Hb., *Hecatesia fenestrata* Boisdv., *Apina callista* Walk., *Canthylidia moribunda* Guen., *Agrotis ypsilon* Rott., *Eumichtis saliaris* Guen., *Persectania ewingii* Westw., *Melanchra ustistriga* Walk., *Spodoptera umbraculata* Walk., *Cosmodes elegans* Don., *Aræoptera canescens* Walk., *Eublemma cochylioides* Guen., *Eustrotia ritsemæ* Snel., *Bombotelia jocosatrix* Guen., *Nanaguna breviscula* Walk., *Donuca memorabilis* Walk., *Parallelia constricta* Butl., *Dasypodia selenophora* Guen., *Hypena scabra* L., *Palthis dugulalis* Hb.

ARCTIIDAE.

In the Arctiidæ the haustellum may vary from the strongly chitinized and well developed organ of *Rhodogastris* to the non-functional and weakly-vestigial structure in *Ardices*. In all grades, however, the maxillary palp remains the same; it is minute, generally rounded, and consists of a single segment. The cardo and stipes are much the same as those of the Noctuidæ.

Species examined: *Celama fraterna* Moore, *Lexis nitens* Walk., *Calamidia hirta* Walk., *Scaptesytle monogrammaria* Walk., *Asura lydia* Don., *Comarchis staurocola* Meyr., *Ardices curvata* Don., *Cretonotus gangis* L., *Rhodogastris crokeri* Macleay.

SYNTOMIDAE.

The Syntomidæ resemble the normal Arctiids in the structure of the maxillae but the organs are exceptionally strongly chitinized.

Species examined: *Syntomis annulata* Fabr., *Euchromia creusa* L.

From the preceding survey it will be seen at once that as far as the more generalized groups of Lepidoptera are concerned, the maxillae, and more particularly the maxillary palpi, form a valuable structure for purposes of classification. In the higher groups, such as the Geometroidea and Noctuoidea, the palp, having been reduced to a simple vestige, is of little systematic value, but in the lower groups, where such reduction is in process of being carried out, the state of the organ may often furnish decisive data as to relationships. It seems probable that the function of the maxillary palp in the early mandibulate Lepidoptera was of a tactile nature. As the galeae began to take on the function of a sucking organ the palpi would still be useful as tactile structures, but as the haustellum grew longer the usefulness of the palpi in this direction would decline. Also, sensory hairs and spines began to be developed on the haustellum itself, thus rendering the organ independent of the tactile functions of the palpi. In accordance with nature's invariable custom, the useless structure began to atrophy, the process being carried on over a very extended period. It is this slow process of reduction which gives systematic value to the condition of the palp. It is extremely improbable that the organ, having once lost one or more segments, should regain them, and thus, if in a given group of Lepidoptera certain genera have a three-segmented palp while others have a four-segmented one, the former can be set down with confidence as not having been ancestral to any of the latter. Thus, the Pyralididae, with a four-segmented palp, could not be derived from the Thyrididae, with at most a two-segmented organ; nor, in the Papilionoidea, could the Pieridae, with no trace of the maxillary palp, have given rise to the Nymphalidae or the Satyridae, both of which have a one-segmented palp. These instances, however, apply only so far as the evidence of the present investigation goes, and are merely to be considered as illustrations of the principle; examination of other genera might destroy their force. It is not, of course, proposed that a system of classification should be based solely on the maxillary palpi—no system can be satisfactory which does not take cognisance of the whole structure of an organism—but it is suggested that the maxilla, and its palp in particular, may frequently be the deciding factor when other data fail to lead to a definite conclusion.

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