

- C. Wings and keel, indicating their connection and relative size.
- D. Flower magnified, indicating the form and relation of the parts.
- E. Keel magnified, with the wings removed.
- F. Monadelphous stamens, and stigma.

PLATE LVI.

Lupinus rostratus.

- A. Entire plant, slightly reduced in size.
- B. Legume magnified a little less than twice, showing the position of the calyx and the withering-persisting petals.
- C. Wings and keel separated to show the shape of the keel and the relative size of the two.
- D, E and F. Young flower, banner, and calyx magnified a little less than five diameters.

PLATE LVII.

Hebecea caespitosa.

- A. Entire plant, separated from the thick mat of stems and leaves.
- B. Flower dissected to show the position and relative size of the parts, and especially the insertion of the petals and stamens.
- C. Flower, magnified five diameters and slightly reduced.
- D. Pistil spread open to show the placentae.

PLATE LVIII.

Brodiaea Pardy.

- A. Entire plant. The upper part of the leaves wanting.
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- A. *C. viride.* B and C. Calyx and corolla of *C. viride* enlarged.
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NEW MALLOPHAGA, II,—FROM LAND BIRDS; TOGETHER WITH AN ACCOUNT OF THE MALLOPHAGOUS MOUTH-PARTS.

(With Plates Ix Ixxiii.)

BY VERNON L. KELLOGG.

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THE MOUTH-PARTS OF THE MALLOPHAGA.

The mouth-parts of the Mallophaga are of the biting Orthoptero-Neuropterous type; that is, they are of that generalized kind of insectean mouth-parts in which there are free, strong, laterally working mandibles, free jaw-like maxillæ composed of distinct basal sclerites, articu-

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lated terminal lobes and segmented palpi, and a labium composed of the fused second maxillæ with similar basal and terminal sclerites and segmented palpi. But the Mallophagous mouth-parts represent a modified, a specialized condition of this simple type, in which the reduction of the maxillæ with the complete loss of their palpi and (in one suborder) the loss of the labial palpi, so confuse, at first glance, the homologies of the various structures, as to make the proper understanding of the mouth-parts a matter requiring some special attention.

Nitzsch, the first student of the Mallophaga, misunderstood the structure of the mouth-parts, holding the labial palpi to be maxillary palpi (see figs. 1, 2 and 3, plate lx), and his error was not corrected until Grosse*, in his careful dissections of *Tetraophthalmus chilensis* [= *Menopon titan*], made the matter plain.

† Rudow gives a most confused account of the mouth parts, having evidently made very superficial observation, although he declares himself to have made a most careful and exhaustive study of them. He concluded, from observation of the hypopharynx, that the Mallophaga should be classed with the sucking insects, and particularly with the Hemiptera. ‡ Melnikoff thought the peculiar chitin structure in the pharynx (referred to later as the œsophageal sclerite) to be homologous with the sucking structures of the Pediculidæ, and therefore held the Mallophaga to be true sucking in-

* Grosse, Franz. Beiträge zur Kenntniss der Mallophagen. Zeitsch. f. wiss. Zool., vol. xlii, 530, p. pl. xviii, 1885.

† Rudow, Fred. Beobachtungen über Lebensweise u. Bau der Mallophagen o. Pelzfresser. Zeitschr. f. ges. Naturwiss., vol. xxxv, 1870, pp. 288-298.

‡ Melnikoff, N. Beiträge zur Embryonalentwicklung der Insekten. Archiv. f. Naturgesch., 1869, p. 136.

sects. * Denny, † Giebel, ‡ Piaget and § Taschenberg add nothing in their monographs to our knowledge of the mouth-parts. Giebel repeats Nitzsch's explanation of them; Piaget refers the palpi of the Liotheidæ to the maxillæ, and also says the labium of the Philopteridæ has 2-segmented palpi, referring doubtless to the paraglossæ; Taschenberg in his passing reference to the mouth-parts repeats Piaget's statements. ¶ Grosse was the first to understand and to explain what seems really to be the true structure and homologies of the mouth-parts. He first indicated the labial character of the conspicuous palpi which are present in all of the Amblycera, called the labial palpar-like processes paraglossæ (see figs. 4 and 5, plate lx, *pg.*), and gave some account of that sclerite in the œsophagus, which to my mind is so suggestive in its bearing on the phylogeny of the group. An abstract of Grosse's paper, by Prof. Geo. Macloskie, was published in the "American Naturalist," vol. xx, p. 340.

The following detailed accounts, with accompanying figures, of the mouth-parts of *Ancistrona gigas* P., *Læmbothirium* sp., *Eurymetopus taurus* N., and *Goniodes cervinicornis* G., are based on dissections made in my laboratory by Mr. R. E. Snodgrass, and are mostly in the words of his notes. The drawings also were made by Mr. Snodgrass.

* Denny, Henry. Monographia Anophororum Britannicæ, 1842, London.

† Giebel, Christoph. Insecta Epizoa, 1874, Leipzig.

‡ Piaget, E. Les Pédiculines, 1880; Supplement, 1885, Leyden.

§ Taschenberg, O. Die Mallophagen, 1882, Halle.

¶ Grosse, Franz. l. c.

THE MOUTH-PARTS OF ANCISTRONA GIGAS.

(Plate Ix, figs. 6-12.)

In this form the full number of mouth-parts is present, and all are complete except the maxillæ, these lacking palpi and distinct sclerites. The labium is well developed and much longer than wide. It extends along nearly the whole length of the ventral surface of the head, the anterior border being situated far forward, leaving only the tips of the mandibles visible. When the palpi are parallel to the plane of the head their extremities project a little beyond the anterior lateral margin.

The *labium* (plate Ix, fig. 7) consists of three distinct parts, the ligula, mentum and submentum together with prominent palpi. The mentum is the largest sclerite and bears the four-jointed palpi. It is somewhat wider than long, and is incompletely divided into three lobes, one placed medially and the others on each side of this. The median portion has the anterior border straight or a little concave, and articulates with the ligula. Each lateral lobe is narrow and projects anteriorly beyond the median portion which is much wider. Each bears distally a palpus. The latter is composed of four short joints of about equal length, but the second is rather thicker than the others. The lateral outlines of the mentum are roundly convex. The median lobe forms, in part, a concavity on the surface of the labium, but its posterior part forms a wide elevation, continues externally with the elevated lateral lobes, and is sharply marked off from the posterior part of the sunken portion. This elevated posterior border bears a pair of large, strongly chitinized, backward-projecting structures, each being a sort of fork, with two prongs articulated at their bases (plate Ix, fig. 7, *pr.*). One of the prongs in each fork lies dorsal of and a little within the other. This

dorsal prong is attached by its base to the mentum near the hind margin of the latter. From the posterior border of the mentum a deeply emarginated fold extends backward between the two forks, and is attached to the inner edge of the dorsal prong of each. In the young the emargination is much less, the fold being merely roundly concave posteriorly. In this stage it is attached for its full length along the median line to the submentum. In each fork the dorsal prong is rather flattened dorsoventrally: its outer edge is rounded inward proximally and outward distally, while the inner edge presents the same outlines, only in different order, so that the whole is doubly bent, first inwardly and then outwardly. The curvatures, however, are only slight, and the distal one is more marked than the other. The prong is much wider at its base than elsewhere, and tapers off very much distally. It ends by a triangular expansion, having one side of the triangle facing posteriorly and inwardly. At the base is an oval fossa, and in this the outer prong is articulated so as to allow of considerable movement. At the anterior outer corner of each fossa a large strong hair arises and extends outward and backward, being two-thirds or three-fourths the length of the fork. The ventral prong is more cylindrical than the other and tapers but little. It is almost straight, or slightly curved inwardly near the middle. Its base, however, curves dorsally, to be articulated with the other piece, as just described. It ends by a bluntly rounded termination which is very slightly expanded. Its dorsal surface is covered by numerous fine, closely arranged, rounded ridges. Proximally these lie almost longitudinal, but they gradually become more transverse, so that the terminal ones form an angle of about thirty degrees with a transverse line through their inner ends. The ridges meet each other along the median

line of the prong at an increasing angle from in front backwards. The forks are less chitinized in young specimens, but very pale colored ones have them comparatively strongly chitinous, so that they appear very dark, while the rest of the outer parts are white.

The ligula is a short sclerite, divided into glossæ and paraglossæ. The glossæ are two rounded lobes, with a shallow concavity between them. They bear a few short hairs. External to the glossæ are the paraglossæ which are also two small simple lobes. They are separated from the glossæ a little more deeply than the latter are from each other, and like them are covered by a few small hairs.

The submentum is a simple sclerite back of the mentum, and mostly concealed by the forks and connecting fold from the latter.

The *maxillæ* (plate lx, fig. 8) are very weak, unchitinized structures, lying entirely within the mouth cavity, and concealed by the other mouth-parts on account of their very reduced size. Each consists of a basal undivided portion, somewhat roughly triangular in outline, and of two distal, soft fleshy lobes. The outer lobe is the larger of the two, and its inner edge lies ventral to the outer edge of the smaller lobe. Both lobes are longer than wide. There are no hooks or points of any nature, and no hard chitinous parts. The lobes appear to be galea and lacinia, but in the adult form there is nothing to show that these are what they are, and that they are not simply the result of a secondary division of a simple fleshy lobe, which is the common form of maxilla in the group. The basal portion shows no indication of being composed of two sclerites. The rudimentary condition and soft weak structure of the maxillæ apparently must render them of little or no function.

The *mandibles* (plate lx, figs. 6, 9 and 10) are large and strongly chitinized structures, and evidently perform an important part in the feeding habits of the insect. They are somewhat roughly triangular in profile, having each two points anteriorly and internally, opposing those of the mandible of the opposite side. They lie in a plane parallel to the head. The left one has its anterior surface smooth and a little convex. From the inner edge, a little back of the anterior angle, there projects inwardly and forward a short rounded process. Anterior to this and ventral to it the sharply terminated anterior angle of the mandible forms the second point or tooth. This one is very sharp compared with the other. The ventral surface is concave ventral to the posterior tooth and behind the anterior one. The latter is continuous down the ventral surface as a high wide ridge along the outer side. The posterior part of this surface is also elevated, and at the inner posterior angle is continued inward as a long and somewhat slender projection into the mouth cavity: this tapers distally, but terminates bluntly. At its base are two teeth projecting forward into the concavity on the ventral surface of the mandible just described.

The mandible is articulated to the head by a condyle and a facet. The condyle is on the posterior ventral edge, near, but some distance internal, to the outer posterior angle of the mandible. It is a rounded knot projecting backward. The facet is situated on the dorsal surface near the same angle of the mandible as the condyle. It, however, is not situated on the posterior edge, but somewhat further forward on the dorsal surface; but it lies in the same anteroposterior dorsoventral plane as the condyle. It faces posteriorly and outward, being situated on an elevation, and the cavity is rather shallow. The right mandible is a little smaller than the left but is

otherwise very similar to it. There are the same two teeth, but the posterior one is a little thicker than on the left side. The concavity on the ventral side is not so extensive, and the projection from the inner posterior angle is shorter and thicker. The articulatory condyle is similar in position, but is perhaps a little larger. The facet, however, is relatively more external. In each mandible there is a considerable extent beyond a line drawn from the condyle to the facet, but this is much shorter than that in the opposite direction: i. e., inwardly. Each mandible is supported by two large chitinous processes (plate lx, fig. 9, *d. ch. r.* and *v. ch. r.*), arising from a common thick base which is attached to both the ventral and the dorsal wall of the head. One of these processes lies ventral to the other, and, in the case of the right mandible, a little internal to it. The ventral projection bears terminally a socket and the dorsal one a condyle; these articulate respectively with the condyle and facet of the mandible. The mandible is thus supported on an axis above which is all its weight; and further, the greater part of the latter falls on the inner side of the axis when the mandibles are in the resting position. To the posterior edge of the mandible, near the inner angle but still some distance from it, is attached, movably, a slender chitinous rod. This rod passes posteriorly outward and dorsally, and is attached to the dorsal wall of the head by bundles of muscle-fibers. To the outermost projecting angle of the mandible are attached directly other but much smaller muscles. These have their insertion also on the wall of the head, back of the mandible. These various inequalities noticed on the two sides of the mandibular axes make the strength of the closure of the mandibles much greater than that of the opening.

There are several internal mouth structures rather cu-

rious in form, and whose functions are not definitely apparent, although they probably serve in some way for rasping or comminuting the food, or perhaps for holding it.

In the ventral wall of the pharynx is imbedded a chitinous rod or shaft, bearing two prongs at each end (plate lx, fig. 11, and fig. 6, *hy.*). The shaft is rather long and slender, with a swelling posterior to the middle. The posterior prongs are curved outward and backward, and also a little upward around the œsophagus. Their bases are very wide but they soon become narrower. Terminally each is somewhat expanded and ends bluntly. The anterior half of the wide basal portions is much thinner than the rest, and the shaft appears between the two as a wide elevated ridge, continuous with the posterior thickened borders. A large oval foramen, having its long axis extending from within outwardly and posteriorly, is situated between the thin part, the thickened shaft, and the posterior elevated margin. The anterior fork projects into the mouth, dorsal to the anterior end of the labium, in the position of a hypopharynx. The prongs of this bifurcation are much smaller than those of the other and project outward and forward. The entire length of the structure in a specimen measured is .52 mm. The part projecting is about a fifth of the whole. All but this latter part is imbedded in the ventral wall of the pharynx and is not visible from above. It is evident that it must be developed from an invaginated portion of the cuticle which became strongly chitinized and constricted off from that lining the mouth. The two anterior prongs have on their anterior edges each a padlike, soft, unchitinized structure. Each pad is distally surmounted on the dorsal surface by a large cluster of rather long, thick, curved processes, radiating from a common center and curving upwards.

All have their concave borders facing one another and the center from which they spring. Along the convex surface of each is a fringe of cilia inclined distally. The rest of the pad is covered by short, thick projections, lying with their long axes parallel to the surface and curving over to the dorsal side, where they become scale-like in form. Between this hypopharynx and the labium is a fold of membrane from which project the anterior ends of two other structures. There are two chitinous rods (plate lx, figs. 6, *fk*, and 12) whose anterior forked ends project through this fold and lie beneath and a little external to the hypopharynx. They may be exposed by removing the labium. Each lies ventral to all the other organs in the head. Posteriorly they diverge from each other and pass backward, ventral to the lower edge of the tentorium, and are attached to the ventral wall of the head by muscles. They are very slender and delicate on account of their thinness and being not very strongly chitinized. Anteriorly each is rather expanded and flattened dorsoventrally, but posteriorly becomes narrower and more cylindrical. The outer prong of the anterior bifurcation is wide and thin, the other is longer, narrower, a little curved outwardly, and rather more chitinous than any other part of the whole rod. The bifid part projects out of the fold as described, but very little if any of the shaft. The cuticle covering the fold is continuous with that over the pads on the fork of the hypopharynx, and is covered by small sharp-pointed papillæ, having enlarged bases, and projecting forward.

THE MOUTH-PARTS OF *LÆMOBOTHRIUM* SP.

(Plate lxi, figs. 1-5.)

The *labium* of *Læmobothrium* sp. (plate lxi, figs. 1 and 4) consists of submentum, mentum, palpi, and ligula. The labium as a whole occupies two-thirds of the length of the ventral surface of the head. Its anterior border lies in front of the bases of the antennæ, and extends also considerably farther forward than the bases of the mandibles; hence the latter are almost concealed by the labium.

The submentum (plate lxi, fig. 4, *sm.*) is a transversely narrowed sclerite very convexly rounded posteriorly, and slightly concavely rounded laterally where it joins the temporal sclerites. The anterior border is more decidedly concave and articulates with the convex posterior border of the mentum. The submentum is a little wider than half its length, and on the whole is somewhat narrowly shield-shaped. In front of the submentum is the mentum (plate lxi, fig. 4, *m.*). This sclerite is wider than long and is somewhat oval in outline, with the long axis transverse; the latter is a little in front of the middle point. The lateral and posterior borders are very convex, and the sclerite may also be regarded as being an isosceles triangle with the angles very much rounded, and the apex pointing backward. Laterally there are two short thick, anterior prolongations, *ff*, one on each side. These bear the short four-jointed labial palpi. Each segment of the palpus is rather short and cylindrical and bears a few hairs. The terminal one is shorter than the others and forms a rounded termination to the palpus. The ventral surface of the mentum is produced downward into a large saccular or pouchlike distention which is almost as wide and long through its greatest diameters as

the mentum itself. Where the pouch joins the mentum, however, it is narrower than it is a short distance below; it therefore expands a little ventral to its dorsal border. In a mounted specimen the pouch may be pressed down flat against the rest of the labium, and then its anterior border appears to be a fold of membrane extending over the ventral surface of the ligula from the anterior edge of the mentum. Within this pouch are two large glands (plate lxi, fig. 5) lying side by side, one on each side of the median line. They are narrower anteriorly where they open into the mouth cavity near the anterior edge of the labium. Posteriorly they become enlarged and turn outward.

The ligula is composed of glossæ and paraglossæ. The glossæ are flattened lobes, one on each side of the middle line, and separated from each other for about two-thirds their length. Each is about as wide as long, and the anterior border slopes slightly outward from within. The outer borders are straight. The paraglossæ lie just exterior to the glossæ. Each is conical with the end truncated, and is a little longer than the glossæ.

The *maxilla* (plate lxi, figs. 1, *mx.*, and 3) are simple lobes expanded distally but narrow at the base. Each projects inwardly and forward, and lies just back of the mandibles of the same side. The ends are exposed in front of the labium. The length is much greater than the greatest width, and the borders are all convex except the posterior two-thirds of the outer, which is a little concave. The anterior and inner edges form a continuous curve, and along these borders the maxilla is strengthened by a chitinous thickening. Along the anterior margin and the anterior part of the inner, is a series of chitinous teeth which are not very sharp and have their points mostly directed inwardly. Each is a continuation of a plication, or thickening, on the maxilla outside the chitinous mar-

ginal thickening and perpendicular to it, the latter lying close to the edge, just back of the teeth. Near the base of the maxilla on the inner side is attached a large muscle, as large as the maxilla itself. This large muscle and the strong teeth seem to indicate that the maxilla is not functionless, but that it plays some part in the mastication of the food.

The *mandibles* (plate lxi, fig. 2) are the same in general shape and position as those of *Ancistrona gigas*. Those of the two forms present corresponding processes, and in each they lie in a plane parallel with the head. They are in both triangular in general outline viewed dorsoventrally.

The right mandible of *Læmobothrium* has at its anterior inner corner a large, strongly chitinized tooth, which is a continuation inward and forward from the ventral surface of a strong anterior thickening of the mandible. Posterior to this is a second tooth, just as in *Ancistrona*, continuous with the dorsal surface. This, however, instead of being regularly rounded is in *Læmobothrium* very wide, especially at the base, and is of the form of a truncated cone. The inner, or free end, is roughened by several short blunt cusps. This tooth, however, very evidently is the same thing as the posterior tooth of *Ancistrona*; the positions on the mandibles are identical.

From the inner posterior angle is a thick blunted process extending inward. It is rather short and terminally rounded. This process is present also in *Ancistrona gigas*. The outer posterior angle is truncated, and at its inner corner, projecting from the ventral surface, is an articulating condyle. This is some distance from the outer corner, and to the latter is attached the extensor muscle. The condyle projects backward and a little outward, and fits into a socket of the head. Dorsal to this on the head

is a condyle which articulates with a facet on the dorsal side of the mandible. This facet is more external than the condyle of the mandible, and is also farther forward. In all these points the mandible is extremely similar to the corresponding one of *Ancistrona*. The retractor muscle is attached directly near the inner posterior angle.

The left mandible is in general similar to the right, and agrees with the corresponding mandible of *Ancistrona* in the same way as the right one does, although the two are rather less alike than those of *Ancistrona gigas*.

The posterior tooth of the left mandible is continuous from the dorsal surface, but is very small compared with the anterior one, and is sharp-pointed compared with the corresponding tooth on the right side. The anterior tooth is much the same as that on the right side, or is perhaps a little smaller. Back of it is a depression on the inner part of the ventral surface; this is bounded behind by an elevation which is continuous inwardly as a slender projection from the ventral surface, just as in the case of *Ancistrona gigas*. This process is thick at its base but tapers distally to the rounded termination. Its anterior border is convex, but on the distal half of the posterior margin is a rather deep, rounded concavity. To the outer angle of the base is attached the extensor muscle. This is rather large on each side of the head. Internal to the attachment of the extensor muscle is the articulating condyle, and dorsal to the latter the rather large facet. These articulate as on the other side, with a facet and condyle, respectively, of the ventral aspect of the head.

THE MOUTH-PARTS OF EURYMETOPUS TAURUS.

(Plate Ixii, figs. 1-8.)

There are many striking differences between the mouth-parts of this form and those of either *Ancistrona* or *Lamobothrium*. The dissimilarity is most noticeable in the labiums. *Ancistrona* and *Lamobothrium* both belong to the suborder Amblycera, while *Eurymetopus* and the next form to be described, *Goniodes*, belong to the suborder Ischnocera, and the differences presented by these four genera are typical for the two groups.

In *Eurymetopus taurus* the labium (plate Ixii, figs. 1 and 6) is reduced in size, and very much crowded back on the posterior aspect of the head. Instead of covering over the mandibles ventrally, it leaves them entirely exposed, its anterior border reaching only about as far forward as their posterior articulations.

On the posterior half of the median ventral surface of the head is a large unchitinized space. This is bounded laterally by the temples, posteriorly by a narrow, gular sclerite, presenting an obtusely angulated, convex, anterior border, and anteriorly in appearance by the mandibles, although it is really not bounded at all in front. The area is somewhat heart-shaped, having the apex forward, for the boundaries formed by the temples are convergent forward.

The membranous labium stretches across the posterior half of this space, while the part in front of the labium forms the mouth-opening. The labium is composed of the full number of sclerites, and of these the submentum is the largest. It is much wider than long; is unchitinized and membranous, and is attached all around, except in front, to the edges of the space just described. Its lateral edges are convex and rounded, while the posterior border is angularly emarginated to receive the convex

margin of the gula. Its posterior angles are much rounded. Anteriorly it presents a concave border of which the lateral portions are free, but the median part bears the mentum. The submentum, on account of its anterior and posterior concavities, is much constricted in the middle.

The mentum is a comparatively narrow, transversely elongated, unchitinized sclerite, attached posteriorly to the submentum, but having its lateral borders free. The anterior outer angles are rounded. The median portion of the anterior border bears the glossæ and paraglossæ. These are not separated by any suture from the mentum, and hence there is no distinct ligular sclerite. The glossæ are two small oval lobes situated on each side of the median line and close to each other, being only slightly separated. Each bears four or five large, strong hairs situated on small basal segments. External to each glossa is a rather deep fossa in the mentum. In these fossæ are situated the paraglossæ. These are cylindrical structures having the outer ends somewhat enlarged, and bearing six or seven large, strong, two-jointed hairs like those on the glossæ. The paraglossæ are rather strongly chitinized compared with the rest of the labium; they appear dark while the other parts are white. Each is directed outward, forward, and downward. With the exception of the hairs on the glossæ and paraglossæ there are almost none on the labium. Two small ones situated on basal joints occur on the mentum, one just back of each glossa. The oddly shaped, cylindrical paraglossæ, having the stiff, thick, two-jointed hairs on the flattened outer ends, are very characteristic of the suborder Ischnocera. In undetached labiums there often appears to be a narrow sclerite between the sclerites which have been called mentum and submentum, but in the mounted specimen this does not appear.

The *maxillæ* (plate lxii, fig. 4) are simple, fleshy, unchitinized lobes attached to the lateral parts of the mouth-cavity, back of the mandibles. They show no indication of division into different sclerites. Near their bases they are somewhat thickened; the distal ends are weak and almost membranous, in mounted specimens they generally appear twisted and distorted. On account of the position of the labium the maxillæ are mostly exposed, only the bases being concealed. Each projects forward and inward.

The *mandibles* (plate lxii, figs 1 and 5) present a very strange appearance, both on account of their shape and their position. They are large, heavy, and strongly chitinized, and very remarkably different from those of *Ancistrona* and *Læmobothrium* in the way they are attached to the head. In these two genera the mandibles lie in a plane parallel to the head, and move in this plane. In order that this may be so, their articulating surfaces are in the same or nearly the same dorsoventral line. In *Eurymetopus taurus* there are two articulating surfaces as before, but the mandibles move in a plane which forms a large angle with the horizontal plane of the head. To accommodate this action the articulating surfaces lie one in front of the other. The plane of the mandible is, however, not at right angles to that of the head, and consequently the anterior articulation is a little dorsal to the posterior one. In the next form to be described, *Goniodes cervinicornis*, the mandibles are almost or quite at right angles to the head, thus presenting an advance in this respect beyond *Eurymetopus*. In either of these two genera the mandibles may be regarded as being the same, typically, as in the Amblycera; but that each has been revolved on an axis passing from the tip of the inner basal process to the articulating condyle,

until the anterior margin becomes the ventral margin. All the apparent differences may be reconciled by this view. In accordance with it the articulating surfaces lie as they should. Further, the mandibles being as in the other genera, two-toothed, the posterior rounded tooth of *Ancistrona*, arising from the inner dorsal margin, lies in this form on the anterior inner aspect, in front of, and dorsal to the larger tooth.

The left mandible has also the long slender process at the inner part of the base, as in *Ancistrona* and *Læmbothrium*; but, as would be expected, this arises from the dorsal aspect of the base. Since, however, in *Eurymetopus* it is very long and slender, it is bent backwards so as to lie parallel with the head. In *Goniodes cervinicornis*, however, it is shorter and projects inwardly.

The mandibles of *Eurymetopus taurus* are entirely exposed on the ventral surface of the head, not even their bases being covered by the labium. They are thick and have a clumsy appearance. The anterior articulating surface is a large facet situated at the anterior outer angle of the mandibles, on the dorsal surface. A rounded process projects over it from below. The posterior outer part of the mandible, bearing the condyle by which it is articulated posteriorly, is greatly prolonged backward, forming a long process bearing the condyle at the extremity. The latter fits into a chitinous socket on the ventral surface of the head. Some distance in front of this is a condyle which fits into the facet of the mandible. The process above referred to, arising from the inner dorsal aspect of the left mandible, curves inwardly and posteriorly. It is very wide at its base but rapidly diminishes distally, and ends by a slightly enlarged extremity, free in the mouth cavity. The ventral tooth of each mandible is large and thick, and bluntly pointed. The dorsal

tooth is shorter than the other, not so thick, and has a rounded termination. Its anterior border is just visible from the ventral side of the head, in front of that of the ventral tooth.

In *Eurymetopus* and in a large number of other genera of the Mallophaga there occurs a very curious pharyngeal sclerite with accessory structures, within the cavity of the head. It is not intended here to explain the origin or function of these, but merely to describe them.

The sclerite referred to is a thick, strongly chitinous structure situated in the ventral wall of the pharynx, and is probably a greatly modified portion of its chitinous cuticle. In a mounted specimen it is plainly visible through the head from either the upper or the lower side. Lying ventral to the sclerite are two structures which appear to be glands, and are connected with it by a duct. All three of these structures are visible through the head of cleared and mounted specimens, and lie just back of the anterior edge of the labium.

This *oesophageal sclerite* (plate lxii, figs. 1, 2, 3 and 7) is in general form cup-shaped, having the hollow part turned upward and forming a depression in the floor of the pharynx, since its interior is simply a part of the pharyngeal cavity. The ventral surface is very convex, being almost hemispherical. The anterior end is truncated, but from each of the two anterior angles thus formed there projects forward, outward, and dorsally, a large dorso-ventro-laterally flattened process, which lies in the lateral wall of the pharynx, the two partly surrounding the cavity of the latter. Each of these processes is expanded distally, and sends a long, rounded, and bluntly terminated projection backwards. These latter processes lie parallel with and a little external to the lateral margins of the body of the sclerite, their outer edges being visible from

the ventral side. Posteriorly there is a thick, rounded, median process which projects backward from near the dorsal edge of the sclerite, but still some distance below it, so that it is free from and not imbedded within the wall of the pharynx.

The sclerite, viewed ventrally, is somewhat shield-shaped in profile. The body is almost semicircular, with a small segment taken off in front by the anterior truncation referred to. Posteriorly there projects the median rounded process, and anteriorly on each side the anterior lateral processes. The latter give to the anterior profile an emarginated appearance. In the middle there is a longitudinal light colored area, due to the cavity on the dorsal side, the floor of which, being thinner than the other parts, transmits more light in mounted specimens. This area is expanded near the front, contracted from side to side posteriorly, and rounded before and behind. Along the median line there is a narrow linear area still lighter in color, due to a groove in the bottom of the dorsal hollow.

The dorsal surface of the sclerite is, as already described, excavated, and is doubly so, there being one cavity situated within another. The upper of these is a shallow depression, having its edges rather oval in outline. In front it extends very near the anterior borders of the sclerite, but on the sides the edges of the cavity and those of the sclerite are considerably separated; and that portion of the dorsal surface between these two is rounded outwardly and ventrally. This space is narrowed again posteriorly, but not so much as in front. The inner cavity is situated in the floor of the other. It is much deeper, and its walls are steep, meeting the interrupted walls of the other at a considerable angle. It is this deeper cavity that forms the light colored area

noticeable on the sclerite when viewed from the ventral side by means of transmitted light. It is much longer than broad, and its widest diameter is in front of the middle. Anterior to this the dorsal edges form a rounded outline, but back of it they are a little concave and approach each other posteriorly. The posterior end is narrow and rounded. The walls of the cavity are concave, steeper in front and behind than elsewhere. The bottom slopes a little downward posteriorly, so that the cavity is deepest behind. Running longitudinally along the bottom is a narrow groove; this begins in front at the bottom of the anterior wall, and extends backwards from an aperture which is the opening of a duct into the sclerite.

To the sides of the shallower cavity are attached two large, laterally compressed, chitinous, pyramidal structures, one on each side, whose ventral surfaces are not quite so divergent as the walls of the cavity to which they are attached, or perhaps better, from which they arise. The bases of these are very wide, but dorsally they become rapidly narrowed and pass upwards around the oesophagus, or pharynx, as two chitinous bands. Their dorsal ends are attached by large muscles to the dorsal wall of the head.

The sclerite is about as wide as long, or sometimes a little longer. The dimensions of one specimen measured are as follows: Length of the body, .097 mm.; width, .108 mm.; length of posterior projections, .02 mm.; distance which anterior processes extend in front of anterior border of the main part of body, .0227 mm.

The gland-like structures (plate lxii, figs. 1, 7 and 8) before referred to, lie ventral to the sclerite, and the inner halves overlap its outer portions (fig. 7). Their outer edges also lie a little dorsal to their inner edges, so that they ex-

tend slightly around the outer margins of the sclerite. Each is an oval structure, having the long diameter extending from within outwards and backwards. The ventral surface is convex, and the dorsal surface concave, while the whole is very much flattened dorsoventrally. Each is invested in a thin chitinous envelope, and is seated upon the ventral anterior surface of a chitinous pedicle which is expanded where it receives the gland. The expanded portion of the pedicle is thin and convex ventrally, so as to fit the dorsal concavity of the gland; and the middle of its shallow dorsal concavity lies below and external to the outer edge of the sclerite. Back of the glands the pedicle extends backward and outward, but not so much in the latter direction as the long axis of the gland, so that the two form an obtuse angle inwardly. The part of the pedicle not having the gland attached is about as long as the other part, and it is somewhat more chitinous. It tapers backward, but ends in a foot-shaped expansion, with the toe turned outward. To this is attached a large, wide muscle which extends backward to its origin in the posterior part of the head cavity. At the posterior end of the gland, on the ventral surface, a duct arises which passes forward, attached closely to the gland, to its anterior end; here it leaves the gland and continues forward, but soon turns inwardly and dorsally, and then posteriorly, meeting and fusing with the duct from the gland of the other side. This common duct then runs backward to the sclerite, which it enters as already described. The relative positions of the glands and sclerite vary somewhat, since they are evidently movable structures, judging from the attached muscles, and hence, also, the duct varies in position; but all such changes are slight. The free portion of the duct consists of an inner chitinous tube continuous with that

soldered to the glands, but in addition to this there is an outer portion composed of a series of closely set, chitinous rings, surrounding the tube. Each gland is about as wide as the sclerite, but is considerably longer.

THE MOUTH-PARTS OF *GONIODES CERVINICORNIS*.

(Plate lxi, figs. 6 a.)

In *Goniodes cervinicornis* as in *Eurymetopus taurus* the mouth-parts are crowded far back on the ventral surface of the head, so that the bases of the mandibles lie posterior to the bases of the antennæ, instead of in front of them, as in most of the Amblycera.

The *labium* (plate lxi, fig. 7) has its anterior border between the bases of the antennæ, and hence it is very much shortened from before, back. The part which seems to have suffered most in the crowding is the mentum. It is narrow and not distinctly separated from the ligula, and is farther aborted by having lost its palpi. This condition is true not only in the genera *Eurymetopus* and *Goniodes*, but holds for the Ischnocera generally.

The main sclerite of the labium is the submentum. This is a large unchitinized sclerite, having a straight posterior border and a very concave anterior border. The sides present an obtusely angulated, convex margin. The anterior border is so deeply and roundly concave that it forms almost a semicircle. Its most posterior part is as far back as the middle of the lateral edge of the sclerite; hence there is a narrow portion projecting forward on each side. These reach as far anteriorly as a line joining the middle of the bases of the antennæ. The rest of the labium is situated in the concavity of the anterior part of the submentum. It consists of the fused mentum and ligula (plate lxi, fig. 7), and is divided into three lobes, two lateral and one median. The median lobe is almost

square, and has its anterior border slightly emarginated and the anterior outer angles projecting a little. This lobe is thus composed of the glossæ, which are separated only by the anterior emargination. The lateral lobes are rounded and bear the cylindrical paraglossæ. These are almost identical with the paraglossæ of *Eurymetopus*, being also more strongly chitinized than the rest of the labium, and bearing on their slightly expanded ends a few strong hairs with basal segments. They project ventrally and a little inward and forward, the distal ends being nearly always seen first on focussing down on a specimen toward the ventral surface.

Back of the submentum is a narrow gular sclerite continuous across the median line from the lateral portions of the head.

The *maxillæ* (plate lxi, fig. 6) are soft unchitinized structures lying within the mouth cavity. Each is divided into three lobes: one basal, another terminal, and the other between these two. By the basal lobe the maxilla is attached to the wall of the head, and it projects inward into the mouth cavity. It is irregularly round in outline and is entirely unchitinized. The middle lobe is of about the same size as the first, and is joined to the latter by a constricted neck. This lobe projects forward and inward within the cavity of the mouth. The third lobe is the largest and is oval in profile, with the long axis at right angles to that of the middle lobe, to which it is attached by a narrow neck at its inner and posterior aspect. This lobe, as well as the middle one, is entirely unchitinized. It projects out of the mouth cavity, and lies close behind the mandible of the same side.

The *mandibles* (plate lxi, figs. 8 and 9) are large and strong; their bases lie some distance back of those of the antennæ; they hang downward from the head in a

plane almost perpendicular to it, but inclined very slightly forward; their tips meet in the middle line, so that they form an arch over or ventral to the mouth-opening. The anterior lateral projections of the submentum extend forward beyond the bases of the mandibles, and the glossæ and paraglossæ lie just back of their posterior margins. Hence the mentum, ligula and mandibles are all enclosed in the anterior semicircular border of the submentum.

The right mandible is triangular in dorsoventral section. The ventral part is thickened and prolonged inwardly at the inner ventral angle, forming two large thick, bluntly pointed teeth. These are separated from each other only by a slight emargination, and they lie one anterior to the other. The anterior of these probably corresponds with the dorsal tooth of the mandible of *Ancistrona gigas*; if so, it has changed its position so that its tip is as far forward as that of the posterior tooth, and these two have become fused into a single process. The anterior tooth, however, does not reach quite as far inwardly as the posterior one, and is also a little dorsal to it. Both of these positions correspond with those of the dorsal tooth of *Ancistrona gigas* and *Læmobothrium*. A large thick process projects inwardly from the inner dorsal angle. This very evidently corresponds with the extremely similar process from the posterior inner angle of the right mandible of *Ancistrona*, and with the less similar but certainly homologous process of *Læmobothrium*. This projection is the inner end of a posterior thickening of the mandible which bears near the outer angle of the base, on the posterior aspect, the articulating condyle. This projects dorsally, and fits into a socket on the ventral side of the head. On the anterior side of the mandible, somewhat more ventral than the condyle, is the articulating facet into which fits a condyle from the ventral surface

of the head. The facet presents the peculiarity of having no inner wall, and is separated only by a constriction from a large cavity in the anterior thickened part of the mandible. This cavity is elongated in a line extending from the facet to the two teeth of the mandible. The posterior wall of the cavity is very thin.

Attached to the dorsal border of the inner angle of the mandible is a large thin chitinous plate (plate lxi, fig. 9, *ch. pls.*). This plate is thickened proximally and appears here darker than the rest. This part is also narrow, but distally the plate expands and becomes very thin and transparent. The distal border is not definite, being very thin and generally irregularly broken away. Attached to this plate are the retractor muscles of the mandible. The plate and muscles extend dorsally and very slightly backward from the mandible, since they lie in the same plane as the latter. From the outer posterior angle of the mandible there extends dorsally and outward a slender, very thin, chitinous structure, which bears the extensor muscles of the mandible. These two sets of muscles are attached to the dorsal wall of the head. The left mandible is very similar to the right. The two teeth are more separated and are sharper. The process projecting inwardly from the base is slenderer and longer than on the right mandible. It arises a little ventral to the dorsal inner angle, and is slightly rounded ventrally, while the tip is again turned a little in the same direction. The muscles are attached in the same way as in the case of the right mandible. To the dorsal inner border of each mandible there is attached, also, internal to the attachment of the plate, a fringe of large muscle fibers; these appear to be a second set of retractor muscles.

In *Goniodes cervinicornis* there is a pharyngeal sclerite and pair of glands which are in every way similar to those

of *Eurymetopus taurus*. Besides these, however, there are two forked rods projecting into the mouth cavity, as in the case of *Ancistrona gigas*. These rods are extremely slender and difficult to dissect, but they lie just dorsal to the labium, and pass forward beneath the œsophagus, and ventral to the glands connected with the pharyngeal sclerite. Only the bifid tips project into the mouth. Near the anterior end muscle fibres are inserted which pass forward and downward to their origin on the dorsal side of the labium. These evidently serve to draw the rods forward. Those of *Ancistrona gigas*, which is enormous amongst Mallophaga, are almost invisible to the naked eye, being weakly chitinized, and only .5 mm. long by .05 broad at the widest place. Only one specimen of the species of *Læmobothrium* described was had for dissection, and the rods may have been present but overlooked. Also it cannot be stated that they do not occur in *Eurymetopus taurus*. It is to be noticed that the genera *Ancistrona* and *Goniodes* belong to the two different subgroups of the Mallophaga.

RESUMÉ.

From these detailed accounts of the mouth-parts of four genera of Mallophaga, equally divided between the two principal groups of the order, we may confidently make a summary statement of the condition of the mouth structures of the Mallophaga.

The mouth-parts are confined to the ventral aspect of the much flattened head, the frontal margin of the head being formed by the greatly developed clypeus. The labrum is the foremost of these ventrally located mouth structures, and is well developed, serving for prehension, and in some cases as a disk or platelike sucker for attach-

ment. It appears as a simple flap lying in front of, and, when at rest, partly over the mandibles.

The *mandibles* are large and strong, usually roughly triangular in profile, with at least one projecting sharp-pointed tooth, and one or two blunter teeth. Each mandible presents a characteristic facet and a condyle which articulate with two strong chitinous rami attached one to the ventral wall of the head and one to the dorsal wall. One ramus articulates by a condyle with the facet of the mandible, and the other by a facet with the condyle of the mandible. The mandibular muscles are exceptionally large. In the two genera of the suborder Amblycera, the mandibles lie in a plane parallel to the horizontal plane of the head, while in the two genera of the suborder Ischnocera, the mandibles project in a plane nearly or quite at right angles with the horizontal plane of the head. This remarkable difference is probably characteristic of the two main groups of the order. The mandibles, though varying somewhat in shape in the two groups, are essentially similar in general character and in manner of articulation; the articulations in the Amblycera lie in a dorso-ventral line, while in the Ischnocera they lie in a cephalo-caudal line; if, however, the Amblycerous mandibles be assumed to be rotated through 90° , so that the anterior aspect becomes directed ventrally, all of the apparent differences in position of features and manner of articulation between the mandibles of the two suborders become reconciled.

The *maxillæ* are greatly reduced, the basal and terminal sclerites so fused as to make it almost impossible to differentiate them, and the structure so feebly chitinized as to appear usually as a soft, small membranous lobe, lying almost wholly concealed within the mouth cavity. The inner border is sometimes chitinized, especially dis-

tally, and bears few to many small teeth. Sometimes the distal part of the maxilla is two-parted and these two parts may represent the galea and lacinia of the typical maxilla of the orthopterous type. The maxillary palpi are completely lost, there being no indication of them on any of the maxillæ examined.

The *labium* (see, in addition to figures previously referred to, plate lxiii, figs. 1, 2, 3, 5, and 6) shows some considerable variation in the two suborders. In the Amblycera it is a larger and more complete structure than in the Ischnocera. A distinct submentum, mentum, and ligula are always present, the ligula consisting of the two terminal lobes, glossa, and paraglossa of each constituent half of the labium, united at their bases. With the Amblycera conspicuous 4-segmented palpi rising from a basal segment-like palpifer are always present; while with the Ischnocera palpi are wanting. The ventral or other surface of the labium is in some forms (see *Ancistrona gigas*) provided with strong backward-projecting, pointed, sometimes bipartite processes, as with *Ancistrona gigas*, *Menopon tridens*, *Menopon robustum*, and others. These processes must subserve some holding on or clasping function.

A hypopharynx of elaborate structure was observed in *Ancistrona gigas*, but not in the other species dissected. Grosse refers to a delicate membranous fold of the ventral wall of the mouth, which in some forms projects beyond the ligula as the hypopharynx.

The "forks" observed in *Ancistrona* and in *Goniodes*—genera representing both suborders of Mallophaga—because of their similarity to the familiar "forks" of the Psocidæ are of exceptional interest, and have not heretofore been referred to in the literature of the Mallophagous mouth-parts. Most plainly discernible in *Ancistrona*,

they are very small, fine, chitinous rods lying inside of the mouth above the labium, whose posterior ends are attached to the ventral wall of the head by muscles and whose anterior ends are shortly forked or bifurcated, and project through the lining of the ventral wall of the mouth, thus lying free and uncovered in the mouth cavity. Although not observed in the other two genera of Mallophaga dissected, it is not at all certain that they are not present, their extreme minuteness and delicacy making their discovery a matter of difficulty.

The œsophageal sclerite and glands are also structures of extreme interest from their probable identity with similar structures in the Psocidæ. They do not appear to be present in all the Mallophagous genera; but I have observed them in a majority of the genera, viz., *Docophorus*, *Nirmus*, *Lipeurus*, *Eurymetopus*, *Goniodes*, *Goniocotes*, *Gibelia*, *Oncophorus*, *Trichodectes*, *Colpocephalum*, and *Menopon*; also in Piaget's figures of *Akidoproctus* the sclerite is indicated. I have found the sclerite and glands absent in *Ancistrana*, *Nitzschia*, *Trinoton*, *Læmobothrium*, and *Physostomum*. It will be noted that the sclerite and glands are present in all Ischnocera examined, and in two of the Amblycerous genera; while in a number of other Amblycerous genera the structures are wanting. In *Læmobothrium*, where the sclerite is wanting, there is a pair of glands in the labium, evidently quite distinct from the œsophageal glands so far referred to. This œsophageal sclerite is a thickening of the chitinous intima of the pharynx, and appears as a bonnet-shaped sclerite lying on the ventral wall of the pharynx, with hollow part upward, with median groove closed behind, projecting processes at the anterior angles, and a pair of long slender "bonnet string" pieces, which project dorsally and pass on either side of the pharynx, or œsophagus, upward and

around it, and attach by their ends to the dorsal wall of the head. Opening into the median groove from its ventral side is a small duct, which, followed to its source, is seen to come from the union of a pair of ducts, each one of which comes from an oval gland lying ventral to the sclerite, and fitting into a concavity on the anterior end of a weakly chitinized, pedicle-like structure, which projects backward and is attached by a foot-shaped expansion to a large, strong muscle. This sclerite, which I call the "œsophageal sclerite," shows distinctly through the dorsal and ventral walls of the head, so that it is usually a conspicuous feature in the markings of the head, appearing as a V- or U-shaped mark with thickened sides (see this mark in the various figures illustrating the systematic part of this paper). It is this sclerite which has been called in the monographs of the European writers the labium, and in my "New Mallophaga, I," I have constantly referred to it by the same name. It is this sclerite, too, undoubtedly, which is the subject of Melnikoff's references, in his embryological memoir, to a sucking apparatus. Grosse refers to this sclerite as the Schlundskelett, and describes it, briefly, in *Tetraophthalmus chilensis* (= *Menopon titan*) and *Goniodes dissimilis*. He found also a chitin thickening of the dorsal wall of the pharynx, immediately above the ventral sclerite.

The mouth-parts of the Mallophaga are distinctly fitted for biting; there are no mouth structures which lend any probability to the old theory that the Mallophaga took food by sucking. The peculiar pharyngeal structures, while not yet understood in point of function, are not at all of a character to suggest anything like a sucking function. Grosse comes to no definite conclusion regarding the function of these œsophageal sclerites, but he says: "Ich schliesse aus seinem Bau, dass derselbe nicht zum Saugen,

sondern zur Ergreifung und zur Führung der aufgenommenen Federtheilchen dient." All of my observation, as far as it goes, tends to substantiate the belief, based on the structure of the mouth-parts, that the Mallophaga take all their food by biting. I have seen them biting off and eating the bits of feathers, and the crop content, which shows plainly through the skin of many specimens, is always composed of tiny bits of feathers.

COMPARISON WITH THE MOUTH-PARTS OF ALLIED INSECTS.

It should be of interest now to compare the mouth-parts of Mallophaga with the mouth-parts of those insects which have been placed in recent classifications nearest to the Mallophaga. Since the breaking down of Erichson's catch-all order, Pseudo-Neuroptera, the association of the Mallophaga, Termitidæ, Perlidæ, Embidæ, and Psocidæ, into the order Platyptera has been, until very recently, the usually accepted interpretation of the place of the Mallophaga among insects. The most recent classifications assign to the Perlids, Termites and Mallophaga ordinal rank. Undoubtedly the Mallophaga are to find their affinities among the members of the group Platyptera, and it is, therefore, with the mouth-parts of these insects that I shall attempt to compare the Mallophagous mouth-parts.

THE MOUTH-PARTS OF THE TERMITIDÆ AND THE PERLIDÆ.

(Plate Ixiv, figs. 1-4.)

The Termitidæ (White Ants) present a racial or generalized condition of the simple Orthoptero-Neuropterous type of biting mouth-parts; free, strong, toothed mandibles, working meso-laterally; maxillæ (plate Ixiv, fig. 2)

well developed, with distinct cardo, stipes, palpifer, 4-segmented palpus, and both terminal lobes, the lacinia sharply two-pointed, and the outer hoodlike galea fleshy; labium (plate Ixiv, fig. 1) with elongate elliptical submentum, mentum, 3-segmented palpi, and ligula showing in each half both glossa and paraglossa. The Termite species whose mouth-parts I figure to illustrate the general character of the Termite mouth structures is *Termitopsis angusticollis*, a large form common in California.

The Perlidæ, as the Termitidæ, present the generalized biting type. In the adult Perlids, to be sure, the mouth-parts seem to be hardly functional, being reduced to a semimembranous condition, with some correlated changes in form. In the nymphs, however, the usual Orthopteroform is shown. I have figured the mouth structures of a nymph of *Perla* (plate Ixiv, figs. 3 and 4). The mandibles of the adult are very small and but slightly chitinized.

THE MOUTH-PARTS OF THE PSOCIDÆ.

(Plate Ixiv, figs. 5-11.)

The mouth-parts of the Psocidæ present a modified or specialized type of biting mouth-parts. They have been the subject of some study and some dispute, and perhaps are not yet fully understood. An especially confusing feature is the presence of the "forks," and characteristic and little understood organs are the paired "lingual glands" lying "within the tongue." The best paper on the Psocid mouth-parts is one by Edward Burgess,* in which special attention is given the forks and the lingual glands.

* Burgess, Edward. The Anatomy of the Head, and the Structure of the Maxillæ in the Psocidæ. Proc. Bost. Soc. Nat. Hist., 1878, vol. xix, p. 291, pl. viii.

In the two subfamilies of the Psocidæ, the winged Psocinæ and the degraded, wingless Atropinæ, the attitude of the head varies from a hanging or vertical position in the Psocinæ to the nearly horizontal position of *Atropos*. With the change from vertical to horizontal position there goes a marked flattening of the head, so that the head of *Atropos* (plate lxiv, figs. 5 and 7) in its horizontally projected attitude, its flattened condition, and the limiting of the mouth-parts to the ventral aspect of the head, shows both in its relation to the body of the insect and in its own shape and condition, a great similarity to the horizontal, flattened head of the Mallophaga. The clypeus of *Atropos* is large, projecting far forward, and, as in the Mallophaga, forms the frontal margin of the head, the labrum lying on the ventral aspect of the head (plate lxiv, fig. 5). All the mouth-parts lie on the ventral aspect of the head (plate lxiv, fig. 5). The mandibles (plate lxiv, figs. 5, 6, and 8) are strong, toothed, and present distinct protruding condyles wholly similar in position and general character to those of the Mallophaga (see plates lx-lxiii). The maxillæ (plate lxiv, fig. 5) I do not understand, but there are no conspicuous terminal free lobes; there is a large basal part, and articulating with it the conspicuous 4-segmented palpi. The fork is long and slender, projecting farther forward than the front margins of the closed mandibles. The labium (plate lxiv, fig. 5) shows a large elongate submentum, a hexagonal mentum, and a ligula composed of two large, free outer lobes, and a median bilobed part composed of the inner lobes of the two sides partly coalesced. According to Burgess what I have called outer lobes are the reduced 1-segmented palpi. In addition the œsophageal sclerite (described hereafter for *Psocus* under the name "œsophageal bone") shows through the basal part of the labium.

Burgess has studied the mouth-parts of *Psocus* in detail, and for the sake of his accounts of the forks, and of the œsophageal sclerite and lingual glands, those structures so characteristic of the Psocidæ, and probably—certainly, in the case of œsophageal sclerite and lingual glands—quite as characteristic of the Mallophaga, I quote from his paper referred to, as follows:—

"The maxilla in *Psocus* is hinged to the head by a small obscure piece which is immovably soldered to a larger joint. The first piece represents, probably, the cardo of a typical maxilla (plate lxiv, fig. 10, *c*) and the second the stipes (*p*). The stipes bears outwardly the 4-jointed maxillary palpus, while inwardly is hinged a thick, fleshy lobe, broad at the base, but soon contracting and curving inward. The tip is flat and has a broad, oval outline on the inside, and is strengthened by several imbedded chitinous rods and other pieces. This lobe, by its position and shape, is doubtless homologous with the ordinary outer maxillary lobe, or galea, of the other Orthoptera. Behind the lobe, that is between it and the tongue, lies the 'horny process' of Westwood's description, or 'fork,' as I shall call it. This is a slender, more or less curved chitinous rod with a forked bifid tip, and two or three times as long as the outer lobe (plate lxiv, figs. 9 and 10, *f*). The distal portion of the fork, about one-third or less of its length, projects through the lining membrane of the mouth. At this point the fork is stoutest, and from it, it tapers to either end, the outer portion being stouter than the inner. The membrane where it is united with the fork is delicate and elastic, thus permitting the fork to be projected forward or drawn back at will. Within the head the fork is held in position by muscles inserted on its base, which unite it with the lobe and stipes of the maxilla, and by a ligament which runs

backward to the top of the head. Of these muscles one is inserted on the base of the lobe; two others are inserted apparently within the stipes; by their contraction the fork is thrown forward out of the mouth, or moved about. The backward-running cord, which is double, is apparently neither muscular nor the tendon of a muscle, but simply an elastic ligament to draw the fork back, and probably the membrane pierced by the fork aids in the same movement. The fork is still further held in place by the flexor muscles of the stipes and lobe which pass behind it and serve to bind it down against the lobe.

"In the maxilla we have recognized cardo, stipes, and outer lobe, and one naturally asks if the fork is the homologue of the inner lobe of the typical maxilla, or an independent organ. At present I must incline to the latter view, although some may regard the absence of anything else to represent the inner lobe as sufficient evidence of their homology. But there is no articulation of any kind between the fork and the outer lobe, and the peculiarity of the muscular connections seem rather to favor the idea that the fork may represent an independent organ.

"The maxillæ and mandibles occupy the lower half of the large oral cavity which opens above into a thick-walled œsophagus. Below the opening of the œsophagus lies a bone which may be fancifully likened to a lady's bonnet upside down (plate lxiv, fig. 11 and *æ. b.* fig. 9); the high front lies along the oral cavity at about half way up; two narrow extensions, representing the bonnet strings, run forward and upward, embracing the œsophagus. The great bundles of short muscles filling the large vaulted clypeus (plate lxiv, fig. 9) are attached to the ends of these strings, and by their contraction close the œsophagus. Just below the 'front' a fine duct opens which is the common duct of a pair of lingual glands,

presently to be described. Just below this bone there is a double elevated ridge covered with short hairs (plate lxiv, fig. 11).

"The lower lip (plate lxiv, fig. 10) is composed of an oblong mentum (*m*) bearing a larger labium (*lb*) narrowed at the base, then expanding so as to have a bisinuate, almost S-shaped lateral outline; the lower edge bears two short, broad lobes, and two stumpy, one-jointed *palpi (*l. p.*). The labium in profile (plate lxiv, fig. 9) is very thick, and the lower edge is divided into two narrow laminæ, while still a third lamina, well separated from the first two, forms the tongue (plate lxiv, fig. 9, *t*). Within the tongue lie a pair of peculiar organs which may be called the lingual glands (plate lxiv, figs. 9 and 10, *l. g.*); these can be seen through the semitransparent mentum and labium, as in plate lxiv, fig. 10, offering an irregular, obovate outline. A short duct from the lower end of each gland leads into a common duct (*l. d.*) which opens in the œsophageal bone as already described.

"The ducts curve over the lower end of the glands and run up their posterior surface, to which they are soldered nearly to the top. The line of the ducts, together with the lateral outlines, give the glands a three-cornered shape, somewhat like that of a butternut. A little triangular cap fits on the summit of each gland, and on it is inserted a suspensory muscle, the upper end of which is attached to the cranium (plate lxiv, figs. 9 and 10, *g. m.*). The specimens at my command have not been fresh enough to study the histology of these organs, but they seem to be composed of an outer sack, with a thin tough wall which

"*With Westwood I regard these pieces as true palpi, and not as a second pair of labial lobes."

is light yellow and has a slightly roughened or granular surface. The interior is filled with cells, and perhaps may be glandular. The excretory ducts are thick-walled and strengthened by circular threads, as is often the case with the salivary ducts of *insects."

Scudder in his note "on the structure of the head of *Atropos*," in "Psyche," 1877, vol. ii, p. 49, gives a different account of the fork, saying that "instead of forming a single, simple, rodlike process, this inner lobe [=fork] is three or four times as long as has been presumed, and is two-jointed, the apical point lying, when the organ is at rest, beside the basal joint, which is attached to the maxilla at the extreme base of the latter; the basal joint is directed backward and lies almost directly beneath the basal portion of the apical joint." Mr. Scudder believes that the fork is without any doubt homologous with the customary inner lobe, or lacinia of the maxilla. As will be noted in the foregoing quotation from Burgess, this author believes Scudder's account of the fork as a two-segmented organ to be erroneous, and he inclines to the belief that the fork is an independent organ, and not a part of the maxilla.

COMPARISON AND CONCLUSIONS.

But little special attention need be given to the comparison of the mouth-parts of the Mallophaga with those of the Termitidæ and Perlidæ. The last named families (or orders) show the simple Orthoptero-Neuropterous

"*The salivary ducts in most insects open by distinct apertures into the œsophagus; still, they unite into a common duct in many Diptera and some Orthoptera (see Siebold, Anat. Invert.). Siebold excepts only *Mantis* among the Orthoptera, but *Blatta*, *Termes* and the *Acrydians*, at least, must be added. The occurrence of salivary glands confined within the head is also unusual, but not without precedent."

type of mouth-parts, and offer besides this no special resemblances to the Mallophagous condition. There is no indication in the mouth-parts of the Termitidæ, wingless and specialized though the Termites are, of modifications in the direction of the Mallophagous mouth-parts. In fact, considering the food habits of the Termites and the specialization (by degradation) of their bodies, the mouth-parts show a surprising faithfulness to the simple usual Orthopteropterous type.

It is in the comparison of the Mallophagous mouth-parts with those of the Psocidæ that such interesting resemblances and parallel or homologous structures appear as to give basis for a belief in the near relationship of the two groups.

The comparison of the mouth-parts of the Mallophaga and the Psocidæ is not made here for the first time. In 1887 Dr. A. S. Packard read a paper before the American Philosophical Society entitled: "On the Systematic Position of the Mallophaga," in which he makes such a comparison. Dr. Packard based his paper on the studies of Melnikow and Grosse on the Mallophaga, and of Burgess on the Psocidæ, and on his (Packard's) own studies. In this paper attention is called to the general similarities shown in the two groups in the position of the mouth structures, due to the great development of the clypeus, in the shape of the mandibles, in the reduction of the maxillæ, etc.

In the light, however, of the preceding detailed accounts of the mouth-parts of *Ancistrona*, *Læmobothrium*, *Eurymetopus* and *Goniodes* (Mallophaga), with their detailed descriptions of the œsophageal sclerites and glands, and the "forks" of *Ancistrona* and *Goniodes*, the comparison of the Mallophagous and Psocid mouth structures may profitably be carried farther than has yet been done.

The flattening of the head, with the great development of the clypeus, and the restriction of the mouth-parts to the ventral aspect of the head, so characteristic of the Mallophaga, is quite as characteristic of *Atropos*, the wingless, degraded Psocid. Among the winged Psocidæ the head hangs vertically, and although there is a similar great development of clypeus, there is less flattening of the head and less general resemblance. The peculiar condition of the labrum in the Mallophaga, lying as it does on the ventral aspect of the produced clypeus, finds an identical repetition in *Atropos*; a point which Packard seems to have overlooked when he says that the Mallophaga differ from the Psocids in having the labrum covered by the clypeus. In the winged Psocidæ the head is not horizontal as with the Mallophaga and *Atropos*, and the labrum is attached to the ventral margin of the clypeus.

The mandibles of *Atropos* present a really striking similarity with those of the Amblycerous Mallophaga. The details of teeth, condyles, facets, and musculature are extraordinarily alike.

The maxillæ of the Psocidæ are greatly reduced, retaining, however, a well developed palpus. In the Mallophaga the reduction of the maxillæ is carried still farther, the palpi having become completely atrophied.

The labium of the Psocidæ (of *Atropos* in particular) and of the Mallophaga is modified along essentially similar lines. One important distinction, however, is the presence of well developed labial palpi in one suborder of the Mallophaga.

Not brought out in any previous discussion of the Mallophagous mouth-parts, and, perhaps, more striking than the points of resemblance so far noted; is the practical identity of the œsophageal sclerite and accompanying

glands of the Mallophaga, with the characteristic "œsophageal bone" and glands of the Psocidæ. The comparison of these structures in the two groups reveals an agreement in position and character so nearly identical as to preclude any supposition of independent origin. Also, there is to be noted the presence, in certain genera of the Mallophaga, of a pair of "forks," very much reduced in size, and not yet well understood. These forks seem very like the familiar and characteristic Psocid forks, so far apparently found among no other insects.

It is not intended to discuss here, at all, the probable relationship of the Psocidæ and Mallophaga, simply to point out the peculiar and interesting similarity of mouth structures, as so far brought out in the study of the groups. It is of interest to note in this connection the rather similar food habits of the two groups, the Psocidæ feeding on dry, dead organic matter, such as wood and paper, dried insects, and dried bird and mammal skins; and the Mallophaga feeding on the dry, dead dermal scales, hairs, and feathers of mammals and birds. I have found *Atropos* not infrequently in the nests of birds.

DESCRIPTIONS OF NEW SPECIES.

DOCOPHORUS.

Docophorus taurocephalus n. sp. (Plate lxx, fig. 1.)

Two males and a female from an American Rough-legged Hawk, *Archibuteo lagopus sancti-johannis* (Lawrence, Kansas). A member of the group dilatoclypeati, found on eagles and hawks and characterized by the more or less prominent, uncolored frontal expansion of the clypeus. The new form resembles Nitzsch's *gonorhynchus* (Giebel, Insecta Epizoa, p. 70), from *Astur*

nisus, in the emargination of the clypeus, and it shows, also, what Piaget affirms to be merely an individual character, the effacement of a distinctly limited signature, as spoken of by Nitsch. The new form is markedly larger than *gonorhynchus*, and the male has no transverse linear blotch on the last segment.

Description of male. Body, length 2.06 mm., width 1 mm.; strongly colored.

Head, length .78 mm., width .78 mm.; thus being very large in proportion to the size of the body; front with shallow emargination, the projecting lateral parts angulated; clypeus expanded laterally behind these frontal angles, and the uncolored expanded portion bearing two conspicuous, longish hairs; a short marginal hair just in front of the suture, and two longish hairs rising on dorsal surface and projecting beyond margin between suture and trabeculae; trabeculae broad, not reaching beyond end of segment 1 of antenna; eye projecting, pendulous, with angulated cornea, and bearing a hair; temporal margins flatly rounded and bearing four long hairs, and on occipital side of posterior angle a short hair; occipital margin nearly straight, bare; general color of head light translucent brown; signature indistinctly limited, its lateral margins obscured by the strong inner bands; antennal and occipital bands strongly marked and continuous; ocular bands distinctly indicated; suture distinct, interrupting the antennal bands; antennal and inner bands paling anteriorly; temporal regions brown, with narrow darker outer margin.

Prothorax short, broad, with uneven rounding sides, and a single hair in each posterior angle, the angle being slightly tumid; broad, apparently divided, lateral bands pale outwardly, and bending in along the posterior margin of the segment. Metathorax short, with sinuous, very

obtusely angled posterior margin, bearing on the mesal third eight weak, non-pustulated hairs, and in the lateral angles two longer and stronger hairs; large, transverse, lateral blotches separated by a narrow, uncolored, mesal, linear space widening anteriorly; legs pale brown, with dark brown markings on dorsal margins of femora and tibiae.

Abdomen broadly elliptical, short, segments projecting little or not at all at sides, and with two to three long hairs in posterior angles; a single transverse series of hairs on dorsal surface of each segment; lateral transverse blotches large, and with pointed inner ends; lateral bands darker, not distinctly limited; posterior margin of last segment flatly rounded, with numerous longish hairs which are confined to the lateral portions of the margin.

Female. Body, length 2.53 mm., width 1.04 mm.; head, length .87 mm., width .87 mm.; the lateral abdominal blotches much shorter, the hind body tapering posteriorly, and the ninth segment narrow, uncolored, tapering behind, and narrowly angularly emarginated so as to produce two short acute points.

Docophorus alienus n. sp. (Plate lxxv, fig. 2.)

Found on a Yellow-shafted Flicker, *Colaptes auratus* (Lawrence, Kansas). This species does not resemble any of Nitsch's or Piaget's *Docophori* taken from woodpeckers, but belongs to Piaget's group *latifrontes*, found on the cuckoos. The group is characterized, according to Piaget, by the width and emargination of the clypeus, and by the large size of the posterior legs. The clypeal characters are presented by this new form, but the posterior legs are not especially enlarged.

Description of the male. Body, length 1.62 mm., width 7 mm.; the only specimen is a recently moulted

one, so that the chitinization is incomplete, and the color is nearly lacking. If it were not for the well marked clypeal characters, which indicate its affinities unmistakably, I should not describe the specimen.

Head, length 56 mm., width 53 mm.; front broad, angularly emarginated; two submarginal hairs between the suture and the anterior angles of the clypeus, of which the hinder is much the longer; a short hair at the suture, and three short ones in front of the trabeculae; the trabeculae very long, reaching to end of segment 2 of antennae; eye prominent, with a hair and black fleck; four longish hairs on temporal margin; occipital and antennal bands pale, but evidently to be well chitinized; signature broad, emarginate on anterior margin.

Prothorax short, with rounding angles, and with single hair in posterior angles; indications of strong, even, lateral bands. Metathorax obtusely angled on abdomen, with a series of pustulated hairs along posterior margin; indications of large lateral blotches. Legs concolorous with body.

Abdomen broadly elliptical, with long hairs in posterior angles of segments, and one transverse row of hairs across each segment; lateral transverse blotches are indicated, and narrow dark lateral bands are present; transverse blotches extending across segment 8; genitalia short, broad, confined to segments 8-9.

Docophorus incisus n. sp. (Plate lxx, fig. 3.)

Found on a Bluebird, *Sialia sialis* (Lawrence, Kansas), and on a Cedar Waxwing, *Ampelis cedrorum* (Lawrence, Kansas).

General characters of *communis*, but with front of clypeus narrower and deeply emarginated; signature with anterior margin emarginated and unevenly chitinized;

temporal angles more convexly rounded; metathorax obtusely angled on abdomen, and with transverse blotch, with posterior margin not parallel with the posterior margin of the segment; thorax relatively broader than in *communis*. Measurements of male: Body, length 1.72 mm., width .75 mm.; head, length .59 mm., width .56 mm. Female: Body, length 2.12 mm., width .90 mm.; head, length .63 mm., width .63 mm.

Docophorus domesticus n. sp. (Plate lxx, fig. 4.)

Males, females, and young taken from the Purple Martin, *Progne subis* (Lawrence, Kansas). Most nearly like Nitzsch's *excisus* (Giebel, *Insecta Epizoa*, p. 88, pl. xi, figs. 1, 2, 3) found on *Hirundo urbica* and *Cypselus apus*, but markedly larger. Piaget calls *excisus* one of the smallest *Docophori* known, and gives the average length of the males as 1. to 1.1 mm., and of the females as 1.2. My specimens average in length, males, 1.47 mm., females, 2 mm.

Description of the male. Body, length 1.47 mm., width .59 mm.; thorax and head pale golden brown, with light brown markings; abdomen darker, with large dark brown lateral blotches.

Head, length .5 mm., width .48 mm.; front of clypeus emarginated rather squarely, the bounding mesal angles of the clypeus nearly rectangular; a longish prominent hair rising from the dorsal surface near the margin in each rounded latero-anterior angle of the clypeus, a short marginal hair behind it, another at the suture, two others close together and rising from the dorsal surface near the margin behind the suture, and a single short, marginal hair just in front of the trabeculae; the trabeculae large, acutely pointed, reaching middle of segment 2 of antennae; antennae, if projected backwards, reach the

posterior margin of the head; eye prominent, with a longish hair; temporal margin with one hair behind, but close to the eye, and two other hairs and two prickles; occipital margin sinuous, bare; signature indistinct, with anterior margin emarginate; no distinct posterior point; occipital bands brown, forking; antennal bands pale smoky brown, interrupted.

Prothorax with rounding sides and angles, rather long, and with a single hair near each end of posterior margin; a broad, even, translucent, lateral band. Metathorax rather long, angulated on abdomen, with a series of pustulated hairs along posterior margin and a broad, lateral, brown band along the antero-lateral sides. Legs robust, pale brown, with dark brown marginal markings and few scattered hairs.

Abdomen broadly elliptical, segments projecting slightly laterally, with one to two or three long hairs in the posterior angles; dorsal surface with numerous weak hairs arranged in transverse lines, a single series on each segment; segments 1-7 with large, dark brown, transverse, lateral blotches, each blotch with an uncolored stigmatal spot, and a few demi-pustulations with hairs along the posterior margin; segment 8 with a curving transverse blotch entirely across segment, and segment 9 wholly colored; a broad uncolored suture between segments 8 and 9; the chitinized parts of the genitalia distinct, short, broad; posterior margin of ninth segment rounded (parabolic) with a few longish hairs.

Female. Body, length 2 mm., width .84 mm.; head, length .56 mm., width .56 mm.; last segment of abdomen with slight angular emargination; genital blotch large, conspicuous.

Docophorus distinctus n. sp. (Plate lxxv, fig. 5.)

Many specimens, males, females, and young, from the American Raven, *Corvus corax sinuatus* (Colorado). This form belongs to the *corvinicola* infesting the Corvini and is of the type *atropicti* characterized by the whitish ground color of the body, and sharp black markings. The new species differs from Nitzsch's *atratus* (Giebel, Insecta Epizoa, p. 81, pl. ix, fig. 10) from *Corvus frugilegus* by the long hairs of the clypeus; from Nitzsch's *ocellatus* (Giebel, Insecta Epizoa, p. 81, pl. ix, figs. 7 and 8), from *C. cornix* and *C. corone*, by lacking the strongly marked bands on the temples, and by the short signatures; and differs from Piaget's *albidus* (Les Pediculines, p. 48, pl. iii, fig. 6) from *C. scaptilatus* by the pustulated hairs of temples and metathorax.

Description of the male. Body, length 2 mm., width 1.06 mm.; ground color whitish with distinct, sharply defined, black markings.

Head, length .63 mm., width .72 mm.; very broad in front and truncate; five long marginal hairs on each side of forehead, one at base of antennæ, one in eye, one just behind the eye, and three on the temporal margins; occipital margin straight, bare; antennæ with segment 1 large and swollen, segment 2 slender and longest, segments 3-5 short, subequal and colored dark brown, segments 1-2 uncolored; signature very short, or at least with only a short, oblong, anterior part colored; antennal bands broad, irregular, interrupted at the suture, and with subparallel inner bands; occipital bands very distinct, diverging and meeting the expanded basal extremities of the antennal bands; ocular bands narrow, distinct, and extending around behind the eye; a shield-shaped occipital signature showing through.

Prothorax narrow, with strong, black, lateral borders,

and a fainter narrow diagonal line running inward and backward from each side; the pericoxal and intercoxal lines of prosternum showing through; one hair in each posterior angle. Metathorax angulated on abdomen, with a series of pustulated hairs along posterior margin; antero-lateral sides with strong black border; postero-lateral sides with paler, brown, linear, tapering blotch. Legs concolorous with body, with black marginal and annular markings.

Abdomen very broadly elliptical, suborbicular; not turbinate; with long weak hairs in posterior angles; last segment flatly rounded behind; the transverse lateral blotches smoky brown, with darker lateral borders, large uncolored stigmatal spots, and about six demi-pustulations along the posterior margin of each blotch; some of the outermost of these pustulations are complete; many weak hairs on dorsal surface; genitalia showing distinctly in segments 6-9, broad and shortly three-pronged posteriorly; segment 8 with transverse blotch entirely across segment; segment 9 uncolored.

Female. Body, length 2.5 mm., width 1.34 mm.; head, length .72 mm., width .81.; abdomen more elongate, the lateral transverse blotches a little shorter, the posterior margin of the last segment with shallow emargination; last segment with two short, longitudinal, lateral blotches; a broad semielliptical genital blotch with backward-projecting mesal point showing through from below.

Docophorus transpositus n. sp. (Plate lxx, fig. 6.)

A single female from a Cow Bunting, *Molothrus ater* (Lawrence, Kansas). This new *Docophorus* is a member of Piaget's group *forficulati*, whose members have been found hitherto only on the Psittacinæ. The distinguishing character of the group is the forcipated clypeal front.

This forcipated clypeus is found also in *D. pertusus* N. (on *Fulica*) of the group *emarginati*.

Description of female. Body, length 2 mm., width .9 mm.; forehead light golden brown, hindhead dark brown, thorax and abdomen strongly blotched with dark brown, abdomen with interrupted narrow, black, lateral bands.

Head, length .56 mm., width .59 mm.; front with a subcircular emargination enclosed in front by mesad-projecting, acute, forceps-like points; no marginal hairs on forehead excepting three or four short ones just in front of trabeculæ; the trabeculæ are rather long, reaching beyond end of segment 1 of antenna; eye with a hair; temporal margins with two longish hairs and a short one between them; occipital margin sinuous, bare; signature broad and very pale, and indistinct anteriorly, with a short, obtuse, posterior point which is darker colored; antennal bands broad, short, paling into general color of forehead; ocular bands fairly distinct, as also the occipital bands; temporal regions dark brown with narrow blackish border outwardly; a narrow black occipital border.

Prothorax with rounding sides and angles, with a single weak hair in each posterior angle; broad, dark brown lateral borders paling outwardly and darkest in posterior angles; two indistinct narrow dark lines running diagonally inward from each lateral border. Metathorax with rounding lateral angles, obtusely angled on abdomen and with a series of pustulated hairs along posterior margin; two linear transversal blackish blotches projecting inward from each side, the anterior blotch much the larger and more distinct. Legs dark brown with blackish marginal markings and semiannulations at extremities of femora.

Abdomen obovate, sides somewhat turbinate but with the projecting angles rounded; segments 3-6 with two

or three short hairs in posterior angles, segment 7 with one hair in angle; segment 8 much narrower than segment 7 and somewhat retracted into it; segment 9 hardly visible, being almost wholly concealed within segment 8; segment 1 with complete transverse blotch deeply medianly emarginated on its anterior margin; segments 2-7 with lateral, dark brown, transverse blotches separated by the paler median third of the body surface and blunt within; each blotch with a distinct uncolored stigmatal spot, but without pustulated hairs; blotch of segment 8 extending entirely across segment; four longitudinal rows of weak nonpustulated hairs, two rows in median paler space, and one row in each lateral series of transverse blotches; distinct, black, lateral bands widening posteriorly and segmentally interrupted.

Docophorus evagens n. sp. (Plate lxvi, fig. 2.)

Taken from the Downy Woodpecker, *Dryobates pubescens* (Lawrence, Kansas). This *Docophorus* is a member of Piaget's woodpecker infesting group *angustifrontes*, characterized by the anterior narrowing of the head with small trabeculæ, and the elongate Nirmoid form of the body. It departs from the more typical forms of the group, however, in the relatively wide clypeal front.

Description of male. Body, length 2 mm., width .62 mm.; body color pale yellowish brown, with narrow dark brown marginal markings.

Head, length .53 mm., width .47 mm.; triangular but relatively longer, and with wider frontal apex than in other *Docophori* of this group; two very short hairs in anterior clypeal angles, one at suture and two in front of trabeculæ; the trabeculæ are acute and reach to the end of segment 1 of antennæ; antennæ slender; eye not prominent, with a hair and small black fleck; temporal

margins with two longish hairs; occipital margin weakly concave, almost straight and bare; narrow antennal bands, and temporal borders shining dark brown.

Prothorax short, with narrow marginal band and no hairs. Metathorax acutely angled on abdomen, the angle produced; beginning in lateral angle five long hairs along each latero-posterior margin, the mesal third of the posterior margin being free from hairs; a narrow, indistinct, lateral border. Legs concolorous with body, with narrow, dark brown, marginal markings. Sternum with narrow distinct intercoxal lines.

Abdomen elongate, subparallel-sided; a single longish hair in posterior angles of segments 3-4, and two hairs in angles of segments 5-8; two hairs also in middle of lateral margin of segment 8; segment 9 uncolored, narrowed and slightly emarginated behind; narrow, translucent, brown lateral bands, and faint indications of median transversal blotches which are probably the light brown transversal blotches of the under side showing through.

Docophorus jungens n. sp. (Plate lxvi, fig. 4.)

Found on two specimens of the Flicker, *Colaptes auratus* (Lawrence, Kansas). The new form belongs to Piaget's group *angustifrontes*, found on the woodpeckers, and presents the characteristic narrow clypeal front, the small trabeculæ, and elongate Nirmoid body. The members of the group undoubtedly stand in the position of gradatory forms between *Docophorus* and *Nirmus*.

Description of the male. Body, length 1.75 mm., width .65 mm.; very pale brownish, with darker marginal markings.

Head, length .56 mm., width .50 mm.; triangular, with narrow, anteriorly tapering clypeus which is concave in

front; two short hairs just beyond the anterior angles, one short hair at the suture, and two slightly longer ones in front of the rather small trabeculae; eye distinct, with a long hair; temporal margins flatly convex, with two long hairs; occipital margin weakly concave and sinuous, bare; ground color of head pale yellowish brown with narrow dark brown antennal bands, pale colored signature and narrow brown temporal margins fading out posteriorly; oesophageal sclerite showing through, and occipital bands indicated, especially at their posterior ends.

Prothorax small, with slightly rounded rectangular posterior angles and straight posterior margin, with one hair in posterior angles; pale lateral borders which bend inward at posterior angles. Metathorax short, broad, angulated on abdomen, with indistinct lateral blotch and six hairs along each latero-posterior margin arranged in two groups of three each. Legs concolorous with the pale body, with darker marginal blotches on femora and tibiae.

Abdomen narrow, with few longish hairs in posterior angles of segments and a transverse series of a few longish hairs across each segment interrupted in the middle; lateral bands translucent pale brown, the segmental portions passing the sutures and projecting somewhat inward; indications of median transverse bands; last segment conspicuous, projecting, flatly rounded behind, and with a few longish hairs; genitalia showing through body wall.

Female. Body, length 1.93 mm., width .68 mm.; head, length .56 mm., width .58 mm.; abdomen more elongate and subparallel-sided; eighth segment with transverse blotch entirely across segment; ninth segment slightly angularly emarginate behind.

Docophorus californiensis n. sp. (Plate lxvi, fig. 6.)

Numerous specimens, male, female, and young from several specimens of the California Woodpecker, *Melanerpes formicivorus bairdi* (Palo Alto, California). Another member of the *angustifrontes*, of same size and outline as the last, but with strong and characteristic markings. It is very like *D. superciliosus* N. (Giebel, Insecta Epizoa, p. 94, pl. x, fig. 3), the type of the group taken by Nitzsch, Denny, and Piaget from *Picus major* and *P. viridis*. It appears to differ from *superciliosus* in the possession of hairs in the posterior angles of the prothorax, in the absence of numerous hairs on dorsal surface of abdomen, and in the sharper and more pronounced markings.

Description of the male. Body, length 1.75 mm., width .62 mm.; pale smoky brown, with dark brown to black bands and blotches.

Head, length .53 mm., width .47 mm.; triangular, forehead tapering, and clypeal front narrow and slightly concave, with two hairs in the anterior angles, one shorter one between angle and suture, a longer one just in front of suture, and two rather long ones in front of trabeculae; eye prominent, with long hair; trabeculae acute, reaching slightly beyond end of segment 1 of antennae; temporal margins with two long hairs and a prickle; occipital margin sinuous, bare; clypeus paler than rest of forehead and hind head; signature pale but distinct; suture distinct; antennal bands, ocular blotch, and anterior temporal border blackish brown; temporal regions and rest of head, excepting clypeus and that part of hind head between the occipital bands, dark brown; oesophageal sclerite distinct.

Prothorax short, projecting considerably beneath head; posterior angles rectangular, with one hair; posterior mar-

gin evenly flatly convex; lateral border curving inwards along posterior margin blackish brown. Metathorax short; lateral angles obtusely rounding; posterior margin with obtuse produced angle and four or five hairs on each side; uneven lateral border and transverse blotch not contiguous to posterior margin, dark brown. Sternal markings consisting of intercoxal lines. Legs concolorous with pale smoky brown of body, with black marginal markings.

Abdomen elongate, about one-third wider than head, with few long hairs in very slightly projecting posterior angles of segments; a few hairs arranged in five uneven, longitudinal rows on dorsal surface; broad, pronounced, blackish, lateral bands, with distinct uncolored stigmal spots and broad transverse blotches extending from band to band on segments 1-8; the blotches on segments 1-2 deeply emarginated medially on anterior margin, and the blotch on segment 7 faint in median part; segment 9 projecting, rounding, with several long hairs on posterior margin and a median blotch; genitalia showing in segments 7-9.

Female. Body, length 1.9 mm., width .72 mm.; head, length .6 mm., width .53 mm.; last segment of abdomen slightly angularly notched.

Docophorus cursor Nitzsch. (Plate lxvi, fig. 1.)

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1861, vol. xvii, p. 527.

Philopterus cursor N., Walckenaer, Hist. Nat. Ins. Apt.; 1844, vol. iii, p. 341.

Docophorus cursor N., Burmeister, Handb. d. Ent., 1835, vol. ii, p. 426; Denny, Monograph. Anoplur. Brit., 1842, p. 101, pl. ii, fig. 1; Giebel, Insecta Epizoa, 1874, p. 75, pl. xi, figs. 5, 6; Piaget, Les Pediculines, 1880, p. 24, pl. i, fig. 5.

Many specimens from a Great Horned Owl, *Bubo virginianus* (Lawrence, Kansas). Nitzsch's type specimens were collected from *Strix bubo*, and he later took speci-

mens from *Strix otus* and *Strix brachyotus*. Denny collected the species from *Otus (Strix) vulgaris* and *Otus (Strix) brachyotus*, and Piaget from *Strix brachyotus* and from *Falco tinnunculus*. Picaglia (Pediculini dell' istituto anatomo-zoologico d. r. Univ. di Modena, Atti d. Soc. d. Nat. di Modena, 1885, ser. iii, vol. iv, p. 13) records *Bubo maximus*, *Otus vulgaris*, *O. brachyotus*, and *Tinnunculus alaudarius* as hosts of *cursor*. There is some discrepancy between Giebel's and Piaget's description of the species, especially touching the lateral emargination of the forehead, a character which, according to Piaget, is noticeable, and which indicates the affinities of *cursor* and the hawk-infesting *Docophori*. My specimens vary noticeably from the descriptions of the Old World forms, especially in the distinctly pendulous eye and the character of the genital blotches. They are also larger than the European specimens. Probably they should be given a varietal name. The species may be recognized by comparison with the figure. In the male the lateral abdominal blotches cover much more of the abdominal surface of course, and the specimens are smaller. My specimens measure—Male: Body, length 1.9 mm., width .75 mm.; head, length .62 mm., width .62 mm. Female: Body, length 2.22 mm., width .9 mm.; head, length .66 mm., width .66 mm.

Docophorus ceblebrachys Nitzsch (Plate lxvi, fig. 3).

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1861, vol. xvii, p. 528.

Docophorus ceblebrachys N., Denny, Monograph. Anoplur. Brit., 1842, p. 92, pl. i, fig. 3; Giebel, Insecta Epizoa, 1874, p. 77, pl. xi, fig. 15; Piaget, Les Pediculines, 1880, p. 29, pl. i, fig. 8.

Numerous specimens from two Snowy Owls, *Nyctea nyctea* (Lawrence, Kansas). Taken by Nitzsch, Denny and Piaget on individuals of the same bird species. A distinctly marked and isolated form peculiar, probably, to

the Snowy Owl. It can be readily recognized by the broad short head, with short broadly truncate forehead, and correspondingly short and broad signature. The genital blotches of the ventral surface of the abdomen of both male and female are also characteristic. There is considerable difference in size of the male and female. The male which I figure measures: Body, length 1.78 mm., width .75 mm.; head, length .53 mm., width .6 mm. Female: Body, length 2.31 mm., width 1.03 mm.; head, length .62 mm., width .75 mm.

Docophorus rostratus Nitzsch. (Plate lxvi, fig. 5).

Zeitschr. f. ges. Naturwiss. (ed. Giebel), 1861, vol. xvii, p. 529.

Docophorus rostratus N., Giebel, Zeitschr. f. ges. Naturwiss, 1861, vol. xviii, p. 296; Burmeister, Handb. d. Ent., 1835, vol. ii, p. 427; Denny, Monograph. Anoplur. Brit., 1842, p. 87, pl. ii, fig. 4; Giebel, Insecta Epizoa, 1874, p. 76, pl. x, fig. 4; Piaget, Les Pediculines, p. 27, pl. i, fig. 7.

Two specimens of this unmistakable *Docophorus*, taken by Nitzsch, Denny and Piaget from *Strix flammea*, the European Barn Owl; taken by me from the American Barn Owl, *Strix pratincola* (Soquel, California). The American Barn Owl has always, until recently, been held to be simply a variety (*Strix f. pratincola*) of the European Barn Owl. The specimen figured by me measures: Body, length 1.97 mm., width .5 mm.; head, length .75 mm., width .53 mm. The species is readily recognizable by its slender abdomen and its very long head, with narrow extended forehead. The head and thorax are longer than the abdomen.

Docophorus communis Nitzsch. (Plate lxvi, fig. 7.)

Germer's Mag. f. Ent., 1818, vol. iii, p. 290.

The following synonymy is that given by Picaglia in his Pediculini dell'Istituto anatomo-zoologico della R.

Universita di Modena, Atti della Societa dei Naturalisti di Modena, Serie 3, vol. iv, 1895.

"Sinonimia—De-Geer. Mem. Ins. vol. vii, tv. 4, f. 9. 1776 (*Ricinus emberiza*)—Schrank. Beit. zur Naturg. p. 117, tv. 5, f. 8. 1776 (*Pediculus curvirostris*)—l. c. p. 117, f. 6 (*P. Pyrrulæ*)—l. c. p. 118, f. 7 (*P. Chloridis*)—l. c. p. 116, f. 9 (*P. citrinella*)—l. c. p. 115, f. 10 (*P. Rubecula*)—Linneo. Syst. Nat. Ed. xiii, v. ii, p. 2922. 1789 (*P. curvirostris*, *Pyrrulle*, *Chloridis*, *Citrinella*, *Rubecula*)—Panzer. Faun. Ins. Germ. p. 51, f. 27. 1793 (*P. Curvirostris*)—Geoffroy. Hist. abr. Ins. v. 11, p. 599. 1800 (*Pediculus Emberiza*)—Latreille. Hist. Gen. v. viii, p. 111. 1804 (*Ricinus Emberiza*)—Fabricius. Sys. Ant. p. 349. 1805 (*P. Emberiza*)—Olfers. De Veg. et. Anim. Corp. Anim. Rep. 1815 (*Nirmus globifer*)—Nitzsch. Germ. Mag. v. iii, p. 290. 1818—Burmeister. Hand. Ent. v. ii, p. 425. 1835—l. c. (*fuscicollis*)—Denny. Anop. p. 70, tv. 5, f. 10. 1842—l. c. p. 82, tv. 1, f. 8 (*palllescens*)—l. c. p. 98, tv. 1, f. 8 (*fuscicollis*)—l. c. p. 104, tv. 5, f. 12 (*Passerinus*)—l. c. p. 106, tv. 3, f. 1 (*Merula*)—l. c. p. 107, tv. 3, f. 3 (*Modularis*)—l. c. p. 108, tv. 2, f. 2 (*Rubecula*)—Walcenær. Hist. Nat. Ins. Apt. v. iii, p. 332. 1844 (*Philopterus*)—l. c. p. 336 (*Philopterus pallescens*)—l. c. (*Philopterus fuscicollis*)—l. c. p. 340 (*Philopterus passerinus*, *merula*, *modularis*, *rubecula*)—Giebel. Zeits. f. ges. Nat. Bd. xvii, p. 298-303. 1861—l. c. (*fuscicollis*) p. 298—l. c. Bd. xviii, p. 298-303. 1861—l. c. p. 298. 1861 (*fuscicollis*)—Giglioli, Jour. of Micros. N. 10, tv. B, f. 9. 1864 (*Mandarinus*)—Giebel. Zeits. f. ges. Nat. Bd. xxvii, p. 116. 1866 (*ornatus*)—l. c. Bd. xxvii, p. 358. 1866—l. c. p. 359 (*fuscicollis*)—l. c. p. 359 (*ornatus*)—Epiz. p. 85, tv. xi, f. 13. 1884—l. c. p. 86, tv. 11, f. 10, tv. 20, f. 4 (*fuscicollis*)—l. c. p. 89 (*ornatus*)—l. c. p. 120 (*Rubecula*, *Modularis*, *Merula*)—l. c. p. 119 (*turdi*)—l. c. p. 91 (*lineatus*)—Piaget. Ped. p. 54, tv. 4, f. 2, 3, 4, 5, 7 (sp. et var.)."

The specific name *communis* given by Nitzsch to a *Docophorus* species or group of closely allied species found commonly on passerine birds, has been retained by Giebel and Piaget as the best, or, at least, most convenient expression of the condition exhibited by the *Docophori* of the type figured by Nitzsch from specimens from *Fringilla linaria*, and by Piaget from specimens from *Motacilla alba* and others. Specimens of this type are the most commonly met with *Docophorus* on

passerine birds, and have been recorded from many species. Picaglia (l. c., p. 16) lists 43 species of European Passeres from which *communis* has been collected. But the variations exhibited by the specimens from the various bird species are many and sometimes striking. Giebel refers to variations exhibited by specimens from certain birds as being sufficient to warrant the founding of new species, but he merely refers to the general character of the variation shown by specimens from *Turdus pilaris*, *Parus major*, *Fringilla chloris*, and *Motacilla alba*. He lists 29 passerine birds representing 15 genera on which *communis* had been found at time of his writing. Piaget holds to the single species *communis*, referring to the variations apparent in any series of specimens, and describes and gives varietal names to 11 varieties. He selects the form found on *Motacilla alba* as typical of the species (believing it to be the same as found by Nitzsh on *Fringilla linaria*) and lists nearly 20 passerine bird species on which he has found *communis* and its varieties.

I have collected specimens of this *communis* species or group of species from the following American passerine birds: the Horned Lark, *Otocoris alpestris*; Red-winged Blackbird, *Agelaius phoeniceus*; Western Meadowlark, *Sturnella magna neglecta*; Lapland Longspur, *Calcarius lapponicus*; Slate-colored Junco, *Junco hyemalis*; Cardinal Grosbeak, *Cardinalis cardinalis*; Bohemian Waxwing, *Ampelis garrulus*; White-rumped Shrike, *Lanius ludovicianus excubitorides*; Brown Thrasher, *Harporhynchus rufous*; and the Robin, *Merula migratoria*—all from Lawrence, Kansas; and also from Bullock's Oriole, *Icterus bullocki*; the California Purple Finch, *Carpodacus purpureus californicus*; the House Finch, *Carpodacus mexicanus frontalis*; the Pine Siskin, *Spinus pinus*; the Arkansas Goldfinch, *Spinus psaltria*; and the Sand-

wich Sparrow, *Amodramus sandwichensis*, from Palo Alto, California.

Variations among the specimens are apparent, but until I can examine a much larger series no attempt can be made to tabulate these variations. The species may be recognized by comparison with the figure in plate lxvi. This specimen, a female, was taken from a White-rumped Shrike, *Lanius ludovicianus excubitorides* (Lawrence, Kansas), and measures: Body, length 2. mm.; width .87 mm.; head, length 6 mm.; width .6 mm.

Docophorus excisus Nitzsch.

Germar's Mag. f. Ent., 1818, vol. iii, p. 291.

Pediculus hirculinus Linnæus, Fau. Suec., 1746, p. 1963; Schrank, Fauna Boica, 1781; Fabricius, Sp. Ins., 1783, vol. ii, p. 483; Linnæus, Syst. Nat., ed. 13, 1779, vol. i, p. 2921.

Ricinus hirculinus Latreille, Hist. Gen., 1804, vol. viii, p. 111.

Philopterus excisus Nitzsch, Germ. Mag. f. Ent., 1818, vol. iii, p. 291; Burmeister, Handb. d. Ent., 1835, vol. ii, p. 425; Walekenaer, Hist. Nat. Ins. Apt., 1844, vol. iii, p. 333.

Docophorus excisus Nitzsch, Giebel, Zeitschr. f. ges. Naturwiss., 1861, vol. xviii, p. 298, l. c. 1866, vol. xxviii, p. 359; Giebel, Insecta Epizon, 1874, p. 88, pl. ix, figs. 1, 2, 3; Piaget, Les Pediculines, 1880, p. 64, pl. iv, fig. 6.

Specimens which may be referred to this long known parasite of the swallows taken from the Cliff Swallow, *Petrochelidon lunifrons*, and from the Tree Swallow, *Tachycineta bicolor* (Palo Alto, California, and Lawrence, Kansas). The American specimens are, however, markedly larger than the European ones and should be designated by a varietal name. Piaget's measurements are, for males, length 1 m., for females 1.1 mm.; the males among my specimens are about 1.3 mm. long and the females 1.5 mm. long. The species of this group (with square emargination of clypeal front) which I have described from the Purple Martin (see page 475, plate lxv, fig. 4) shows all of the general habitus of *excisus*, but is

so conspicuously larger and presents such constant minor differences that I have made it the type of a new species. The figure of it, however, will serve very well as a means of recognizing the American variety of *excisus*.

Var. *major* Kellogg. Male. Body, length 1.3 mm., width .56 mm.; head, length .44 mm., width .40 mm. Female. Body, length 1.49 mm., width .62 mm.; head, length .45 mm., width .42 mm.; the pustulations in lateral abdominal blotches more complete and distinct than in the type form of the species. Males, females, and young found on the Cliff Swallow, *Petrochelidon lunifrons*, and on the Tree Swallow, *Tachycineta bicolor* (Palo Alto, California, and Lawrence, Kansas).

NIRMUS.

Nirmus longus n. sp. (Plate lxvii, fig. 1.)

Taken from the Tree Swallow, *Tachycineta bicolor* (Lawrence, Kansas), and from the Cliff Swallow, *Petrochelidon lunifrons* (Palo Alto, California). A member of the group *interruptofasciati* and allied to Nitzsch's *N. gracilis* (Insecta Epizoa, p. 143, pl. vi, figs. 11, 12), which is only half as large and has but four (Giebel) or two (Piaget) hairs on posterior margin of metathorax, and to Denny's *elongatus* (Monograph. Anoplur. Brit., p. 140, pl. vii, fig. 4), which has the posterior margin of the metathorax "strongly ciliate," the hairs in Denny's figure being ranged thickly along the entire length of the margin. Both of these two allied species were taken from *Hirundo urbica*.

Description of female. Body, length 2.03 mm., width .38 mm.; very elongate, pale yellowish brown, with chestnut brown lateral bands and marginal head markings.

Head, length .37 mm., width .28 mm.; elongate-conical, with narrow truncate front; two very small marginal hairs near the front, and one slightly longer a little distance in front of the trabeculae which are small but distinct; eye flat, with a prickle in its posterior margin; temporal margins flat with a long hair and a prickle; pale golden brown with dark brown narrow antennal bands and temporal borders; oral fossa elongate, expanded behind, nearly uncolored.

Prothorax short, small, oblong, with single short hair in posterior angle, and even lateral borders which bend inward along posterior margin. Metathorax trapezoidal, with lateral margins converging anteriorly; posterior margin straight or weakly convex on abdomen, more curved at each end which projects laterally beyond the abdomen; posterior margin with six longish but weak hairs on each lateral third; indistinct lateral borders with anterior ends more distinct and a diagonal line projecting inward and forward from the posterior angles. No pronounced sternal markings. Legs pale, concolorous with body, with narrow darker marginal markings.

Abdomen very long and apparently slender, although really one-third wider than head; abdominal segments very gradually growing wider until segment 6 is reached, segment 7 slightly narrower, segments 8-9 narrower, abruptly tapering; a single short hair in posterior angles of segments; dorsal surface naked; segments 1-7 with distinct chestnut brown lateral bands; segment 8 of general body color; segment 9 uncolored, emarginated behind, with rounded points.

Male. Two males, which with much hesitancy I assign to this species, taken from a Cliff Swallow, *Petrochelidon lunifrons* (Palo Alto, California), are much smaller than the females. This condition is similar to that pre-

sented by *gracilis*, the males of which are .7 mm. long, while the females are .95 mm. long. The arrangement and number of metathoracic hairs are the same as in the females, and the head characters agree. Measurements of the male: Body, length 1.47 mm., width .43 mm.; head, length .34 mm., width .31 mm.

***Nirmus simplex* n. sp.** (Plate lxxvii, fig. 2.)

Found on a Robin, *Merula migratoria* (Lawrence, Kansas). It belongs to Piaget's group *interruptofasciati*, with antennal bands interrupted, with temples tending to become angular, and with the body blotches indistinctly colored.

Description of female. Body, length 1.77 mm., width .62 mm.; very pale yellowish brown, with darker but inconspicuous markings.

Head, length .53 mm., width .50 mm.; bluntly triangular, the rather narrow clypeal front truncate or very weakly concave; a single short hair in anterior angles and two other shorter ones on lateral margins; trabeculae small, acute; eye flat, with a prickle in posterior edge; temporal margins flatly convex, with a single long hair and two prickles just in front of it; occipital margin straight, bare; signature indistinctly colored, broad, emarginate in front and truncate behind; antennal bands distinct, narrow and finely crenate on inner margin; occipital bands indistinct, narrow, extending to posterior rami of mandibles; temporal margins for a little distance behind eye narrowly bordered; antennae uncolored, fifth segment longer than third or fourth.

Prothorax short, broad, with lateral margins converging anteriorly; a single strong hair in posterior angles; posterior margin flatly convex; rather broad lateral borders, which extend inward along the posterior margin.

Metathorax broad, short, obtusely angled on the abdomen, with a series of non-pustulated hairs along posterior margin; a lateral marginal blotch with a part extending inward. Legs concolorous with body, with only faintly indicated marginal markings.

Abdomen bluntly elliptical, one-fifth wider than the head; with one to two or three weak hairs in posterior angles of segments, and a single transverse series of short weak hairs along the posterior margin of each segment; translucent, smoky brown lateral bands, and pale brown, broad, transverse blotches entirely across all segments; distinct uncolored stigmatal spots; segment 9 uncolored, with two small pale brown lateral blotches, slightly emarginated behind, and with a few longish hairs.

***Nirmus eustigmus* n. sp.** (Plate lxxvii, fig. 3.)

A single female of this well marked form from an Anna's Hummingbird, *Trochilus anna* (Palo Alto, California). The species belong to Piaget's group *interruptofasciati*. It is a much broader and much more robust form than *N. vulgatus*, the *Nirmus* of this group common among passerine birds, and the lateral bands of the abdomen are broad and pronounced.

Description of the female. Body, length 1.84 mm., width .62 mm.; pale yellowish white, with narrow blackish brown head borders, and broad, blackish lateral abdominal bands; indications of pale brown abdominal blotches.

Head, length .42 mm., width .45 mm.; broadly triangular, narrowly truncate in front; a few short weak hairs along margins of forehead, the longest being a pair considerably in front of the trabeculae; trabeculae small and uncolored but distinct; antennae short, segment 2 most

colored, segment 3 next; eye with a prickle; temporal margins with a single long hair and some fine prickles; occipital margin straight, bare; antennal bands blackish brown, not quite meeting in front, leaving a small uncolored space on frontal margin, and bending angularly in at posterior ends; narrow blackish brown ocular and temporal margins, paling gradually inward from margin of head.

Prothorax short, rectangular, with a single hair in posterior angles; blackish brown lateral borders. Metathorax trapezoidal, posterior margin very flatly convex on abdomen, with an angular indication at middle; six pustulated hairs on each outer third of the posterior margin; broad, ill-defined lateral border, with transversal lateral blotch extending from each side. Legs pale, with blackish brown dorsal marginal markings. Sternum with intercoxal lines but no median blotches.

Abdomen, elliptical; broad for this group of *Nirmis*, with posterior angles of segments, uncolored, blunt, projecting slightly; two or three hairs in posterior angles and a series of four longish hairs on the posterior margin of each of segments 2-7; segment 1 without hairs and segment 8 with more than four hairs; whitish, with distinct broad, blackish lateral bands, and pale brownish median blotches; segment 8 without lateral bands, but with narrow transversal median blotch reaching almost entirely across segment; segment 9 uncolored, slightly angularly emarginated behind.

***Nirmis illustris* n. sp.** (Plate lxxvii, fig. 4.)

Found on a Red-winged Blackbird, *Agelaius phoeniceus* (Lawrence, Kansas). This small but striking *Nirmis* does not show special resemblance to any previously described species.

Description of male. Body, length 1.56 mm., width .52 mm.; whitish, with brown median blotches and black marginal bands.

Head, length .37 mm., width .37 mm.; truncate or very slightly convex in front, with two or three very short indistinct marginal hairs; trabeculae small and weak, reaching half way to segment 1 of antennae; eye indistinct, with a fine prickle; temporal margins with two prickles and a weak hair; occipital margin straight, bare; antennae with segment 1 uncolored; other segments dark brown, with wide uncolored sutures; antennal bands narrow, black, angulated almost at right angles and with the black color interrupted just in front of the angulation; bases of antennal bands meeting the inner ends of distinct, narrow, ocular bands whose outer ends meet anterior ends of narrow black temporal borders, with inner margins slightly crenate; short black internal bands parallel with anterior marginal parts of antennal bands; a shield-shaped occipital signature and oblong blotches at its sides showing through from under side.

Prothorax with flatly rounded sides and rounded posterior angles, each angle bearing one small hair; anterior angles containing a large dark brown blotch, and intercoxal lines of sternum showing through as black diagonal lines in posterior angles. Metathorax with rounding margins, rounded on abdomen, with five weak hairs in each lateral fourth of the posterior margin; small black linear blotches in anterior angles, and large irregular black lateral blotches not contiguous to the lateral margins, the sternal markings showing through dark chestnut brown. Sternal markings consisting of intercoxal lines and a median blotch on metasternum. Legs, femora and tibiae with dorsal marginal black markings and a blackish brown annulation near distal extremity; tarsi paler brown.

Abdomen elongate, subparallel-sided, with posterior angles of segments projecting slightly, pointing backward and each bearing two weak hairs; dorsal surface of segments naked; last segment projecting, parabolic behind, with two pairs of long weak hairs and one pair of shorter ones; lateral bands narrow, distinct, black, interrupted, the anterior end of each segmental portion projecting beyond the suture and slightly inward; large median chestnut brown blotches on segments 1-7, each of these blotches (except that on segment 1) nearly crossed by a transverse linear uncolored space; on segments 6-7 the uncolored space is divided into two portions; in addition there are on segments 3-7 a pair of transversal dark brown lines, one on each side of the median line and lying superposed on median blotch, but extending a little farther laterally than the lateral margin of the blotch; some of these markings are on the ventral surface, but show through distinctly; segment 8 has a median blotch and two lateral markings composed of a brown line defining an elongate curving triangle, uncolored within; segment 9 has a median blotch and from its posterior margin two anteriorly projecting lines; distinct, slender, curving side pieces of genitalia limited to segment 8.

***Nirmus vulgatus* n. sp.** (Plate lxxvii, fig. 5.)

This small *Nirmus* of Piaget's group *interruptofasciati* is rather common on Passerine birds. I have taken it from the California Purple Finch, *Carpodacus purpureus californicus*; the House Finch, *Carpodacus mexicanus frontalis*; the Golden-crowned Sparrow, *Zonotrichia coronata*; Gambel's Sparrow, *Zonotrichia gambeli*; the Spurred Towhee, *Pipilo maculatus megalonyx*; the California Towhee, *Pipilo fuscus crissalis*; all from Palo Alto, California; and from the Slate-colored Junco, *Junco*

hyemalis, and the Robin, *Merula migratoria*, from Lawrence, Kansas.

It is allied to Nitzsch's *densilimbus* (*Fringilla carduelis*) (Giebel, *Insecta Epizoa*, p. 138), Piaget's *deficiens* (*Les Pediculines*, Supplement, p. 23, pl. iii, fig. 3) from *Cyanapolius cooki*, and other similar forms.

Description of female. Body, length 1.62 mm., width .41 mm.; pale, with distinct narrow blackish brown lateral bands and marginal head markings, and pale chestnut median abdominal blotches.

Head, length .37 mm., width .29 mm.; conical, with narrow parabolic front, without hairs; trabeculae very small and uncolored but distinct; eye flat, with a fine prickle, and another just at its posterior margin; temporal margins with one longish hair and two prickles; occipital margin straight, bare; no signature; a longitudinal oral fossa expanded laterally behind; whole head narrowly bordered along lateral margins with blackish brown, the border turning angularly inward at antennal fossae; a pale shield-shaped occipital signature showing through from below.

Prothorax narrow, quadrangular, with a single hair in posterior angles; narrow lateral blackish brown border, most strongly colored in anterior and posterior angles. Metathorax almost as wide as head, with flatly rounding posterior margin, with six hairs along each lateral third of this margin, a small transversal linear blackish blotch in anterior angle, and a larger lateral irregular curving blackish blotch in middle of lateral regions of segment. Legs with pale brown ground color, mostly tinged with translucent smoky brown and with darker marginal and annular markings.

Abdomen elongate, slender, subparallel-sided, not tapering posteriorly until segment 8 is reached; with short

weak single hairs in posterior angles of segments and naked dorsal surface; pale ground color, with narrow, distinct, dark brown lateral bands and paler broad, rectangular transverse blotches, darker on posterior segments; a rather broad uncolored median longitudinal line; segment 1 with transverse blotch entirely across segment; segment 9 uncolored, narrowly notched, and with few long but weak hairs.

Male. Body, length 1.47 mm., width .4 mm.; head, length .33 mm., width .28 mm.; last abdominal segment protruding, narrowly rounded, with a pair of hairs (one longish, one short) on each side of the middle of the posterior margin; genitalia composed of narrow bars, and showing through in segments 8 and 9.

Nirmus discocephalus Nitzsch. (Plate lxvii, fig. 6.)

Germer's Mag. Entomol., 1818, vol. iii, p. 291.

Nirmus discocephalus Nitzsch, Burmeister, Handbuch d. Ent., 1835, vol. ii, p. 430; Denny, Monograph. Anoplur. Brit., 1842, p. 113, pl. ix, fig. 10; Giebel, Insecta Epizoa, 1874, p. 127, pl. vii, fig. 10; Piaget, Les Pediculines, 1880, p. 129, Supplement, 1885, p. 18, pl. ii, fig. 7.

My specimens, taken from a Bald Eagle, *Haliaeetus leucocephalus* (Lawrence, Kansas), may be referred to this characteristic *Nirmus* species of the eagles, found by Nitzsch, Denny and Piaget on the European Gray Sea Eagle, *Haliaeetus albicilla*; but the variations in number of metathoracic hairs and in other particulars make it desirable to distinguish the forms from the American bird by a varietal name. The descriptions and figures of Nitzsch, Denny and Piaget differ from one another with regard to the shape of the head, number of metathoracic hairs, etc., to a surprising degree, in view of the fact that all the specimens examined were from the same bird species.

Var. *amblyus* Kellogg. Males, females, and young from the Bald Eagle, *Haliaeetus leucocephalus* (Lawrence, Kansas). Male, body, length 1.56 mm., width .60 mm.; head, length .47 mm., width .46 mm. Female, body, length 2 mm., width .75 mm.; head, length .52 mm., width .53 mm. Characters of the species as described by Piaget (Supplement, 1885, p. 18, pl. ii, fig. 7), but with head not longer than wide, eyes with a hair, prothorax with a long hair in each posterior angle, metathorax with a spine in each lateral angle and six long hairs on each lateral fourth of the posterior margin.

Nirmus fuscus Nitzsch. (Plate lxvii, fig. 7.)

Zeitschr. f. ges. Naturwiss. (ed. Giebel) 1861, vol. xvii, pp. 523-525.

Nirmus fuscus N., Denny, Monograph. Anoplur. Brit., 1842, p. 118, pl. ix, fig. 8; Giebel, Insecta Epizoa, 1874, p. 123, pl. viii, fig. 2; Piaget, Les Pediculines, 1880, p. 130, pl. x, fig. 9.

Specimens of a large variety of this *Nirmus* of the Eagles and Hawks from Swainson's Hawk, *Buteo swainsoni*; from the Marsh Hawk, *Circus hudsonius*; and from the American Roughlegged Hawk, *Archibuteo lagopus sancti-johannis*—all from Lawrence, Kansas. The American form of *fuscus* (if it be not a new species, indeed) differs markedly from the European type or any of its rather many varieties by being much larger, my specimens being fully one-third larger than the *fuscus* specimens taken from *Buteo vulgaris* by Nitzsch and Piaget. If the various species of Giebel, *fuscus*, *stenorhynchus* and *leucopleurus* (Insecta Epizoa, pp. 124, 129), be only varieties of *fuscus* as Piaget believes (Les Pediculines, p. 131), then *fuscus* has been taken from *Buteo vulgaris*, *Milvus atolius*, *Falco brachydactylus*, *Parus carolinensis*, *Aquila naevia*, *Circus rufus*, *Milvus iclinus*, *Ardea gularis*! (Piaget), *Archibuteo lagopus*, *Circus cyaneus*, *Circus aruginosus* and *Milvus regalis*. If in addition

rufus N. with its numerous varieties belongs to the same species, nine or ten more hawk hosts should be enumerated. Without doubt this *Nirmus* type (elongate, with circumfasciate head, broad transverse median abdominal blotches, and distinct lateral bands with the segmental parts passing the sutures) is not yet at all understood. My specimens show the sharp, narrow emargination of the anterior margins of the first and second median abdominal blotches, which has been given as characteristic of *rufus* N. In size, however, the American specimens are distinct from any of the Old World members of the *fuscus* group. The female specimen I figure is from a Marsh Hawk, *Circus hudsonius*, and measures: Body, length 2.4 mm., width .62 mm.; head, length .6 mm., width .5 mm.

LIPEURUS.

Lipeurus introductus n. sp. (Plate lxxviii, figs. 1 and 5.)

Six females, two males, and an immature specimen from a Silver Pheasant, *Phasianus nyctemerus*, received by the Department of Zoology of this University from Mr. A. C. Robison of San Francisco. This Old World pheasant was introduced into America some years ago and it is now breeding wild in parts of the country. This *Lipeurus* species is of the type of *variabilis* N. (Giebel, *Insecta Epizoa*, p. 219, pl. xvi, fig. 3; Piaget, *Les Pediculines*, p. 364, pl. xxix, fig. 4; Denny, p. 164, pl. xv, fig. 6), showing the characteristic median abdominal blotches with concave sides and the striking sexual differences; but despite the fact that Piaget finds *variabilis* an extremely variable form and common to several pheasant hosts, I cannot fairly refer my specimens to this species, because of the much greater size, my specimens being one-third longer than the type forms of *variabilis*,

and because of numerous minor differences, such as the definite and characteristic number and arrangement of the long hairs of the metathorax, the presence of a hair on the temporal margins of the head, and the character of the genital blotch of the female.

Description of the female. Body, length 2.8 mm., width .66 mm.; colored and marked like *variabilis*; whitish, with distinct black lateral borders and chestnut median abdominal blotches concave on the sides.

Head, length .66 mm., width .5 mm.; in general like *variabilis*, but without ocular bands, or rather with large, subcircular ocular blotches in place of ocular bands (Giebel found merely "ein schwarzer Punkt" in *variabilis*); temporal margins not bare as in *variabilis*, but with a prickle behind the prominent eye, and a distinct hair and a prickle at the posterior angle.

Metathorax with a single long hair in the apex of the posterior angle, and just inside of this a white space with four long hairs (two in *variabilis*).

Abdomen not wholly bare except in angles, as Piaget's description of *variabilis* says, but with two longitudinal submedian rows of weak hairs, each in a small but distinct clear spot; the characteristic small triangular genital blotch of the female of *variabilis* is wanting, being replaced by a short, broad, oblong blotch which is united to the ventral segmental blotch preceding it, this segmental blotch being united also with the one preceding it.

Male. Body, length 2.5 mm., width .5 mm.; head, length .56 mm., width .4 mm.; with the strangely shaped head of *variabilis*, wider in front of the antennæ than across the temples; distinct black antennal bands, ocular blotches, and borders of posterior angles of temples running along posterior margin and terminating in a subcircular head; trabeculae (wanting in female) peculiarly

slender, finger-like; the great antennæ with large first segment with slender blunt horn-like appendage nearer the base than tip; third segment also appendaged. Metathorax with an additional long pustulated hair on posterior margin on each side, just inside of white space bearing four long hairs. Brown median abdominal blotches broader than in female, separated from the black lateral bands by a narrow whitish space; the strongly chitinized genitalia extending through segments 5-8; broadest in segment 5, tapering in segments 6-7, and uniform, narrow, two-pointed in segment 8.

Lipeurus snodgrassi n. sp. (Plate lxviii, fig. 2.)

A single female specimen of this strongly characterized *Lipeurus* from the Red-backed Rufous Hummingbird, *Trochilus rufous* (Palo Alto, California). This species resembles no other *Lipeurus* at all closely, though in the shape of the head and its peculiar length of forehead, in the short metathorax and heavy abdomen, there is suggested an affinity with *Lipeurus macrocephalus* Kellogg, taken from the Western Nighthawk, *Chordeiles virginianus henryi* (Palo Alto, California). See plate lxviii, fig. 3.

Description of female. Body, length 2.2 mm., width .56 mm.; whitish with sharp, black, rather broad lateral margins on head, thorax, and abdomen; abdomen with oblong, transverse, median, smoky brown blotches.

Head, length .55 mm., width .37 mm.; very long but not slender, and tapering but little; the forehead exceptionally long compared with hind head, the distance from antennæ to frontal margin being greater than from antennæ to occipital margin; front rounded, with lateral margins nearly parallel; suture obsolete; four short hairs on each side on the front or anterior part of lateral margin, and two short hairs in front of the short but distinct

uncolored trabecula; antennæ rather long, slender; segment 2 longest and very slender, especially at base, segment 3 slightly longer than segment 4, and segment 5 slightly longer than segment 3, segments 3-5 colored, with uncolored distal extremities; eyes small, but slightly produced, and with a hair; temporal margins very slightly convex, with two long hairs; occipital margin straight, bare; lateral margins of forehead and hind head bordered with black, widest on temples, and with uneven inner margin on forehead; the lateral borders of forehead pass the anterior lateral angles but do not run clear across the front, although a clear, slightly colored, even chitin band borders the entire clypeal front; mandibles and œsophageal sclerite distinct, dark brown, and an occipital signature acutely pointed anteriorly showing through from under side.

Prothorax short, quadrangular (that part not covered by the head), with rounding posterior angles and straight posterior margin; without hairs; whitish, with broad black lateral borders. Metathorax short, but little longer than prothorax, broader than long, with diverging sides which are slightly concave anteriorly, and straight, bare, posterior margin; the posterior angles with five long hairs in two groups of two and three, rising from white spaces, the group of two hairs really situated on the outer part of posterior margin; segment white, with broad lateral borders which are widest in posterior angles and extend inward, tapering along the posterior margin, not reaching the middle of the segment; metasternum with a brown median blotch; legs whitish, with distinct blackish border on femora and tibiæ, and annulations on femora; coxæ almost wholly colored, and tarsi brown.

Abdomen elongate, subparallel-sided, with a few longish hairs on dorsal surface; whitish, with sharply marked

lateral bands with short sharp irregular inward projecting processes; segment 3-6 with oblong, median, brown blotches, darker on segments 5-6 and not reaching the lateral bands; segment 8 with a narrow angulated or curving transversal black line connecting the lateral bands; segment 9 uncolored or whitish, angularly but not deeply emarginated.

Lipeurus macrocephalus n. sp. (Plate lxviii, fig. 3).

Many specimens taken from a Western Night Hawk, *Chordeiles virginianus henryi* (Palo Alto, Calif.). This species shows an affinity with *Lipeurus hypoleucus* N. (taken by Nitzsch in 1814 from *Caprimulgus europæus*, and first called by him *Nirmus concolor*, and then *N. hypoleucus*, under which name Giebel, *Insecta Epizoa*, p. 146, pl. viii, fig. 5, and Denny, *Monograph. Anoplur. Brit.*, p. 141, pl. vi, fig. 8, refer to it; and finally correctly removed by Piaget, *Supplement*, p. 66, pl. vii, fig. 3, to *Lipeurus*) by the general outline, the hairs of the head, and the character of the thoracic segments. The new species differ from *hypoleucus* distinctly, especially in the shape of the head and the character of the signature. Oddly enough Piaget was unable to find a male among his specimens, and among the twenty-seven specimens of the new species taken from the single individual of *Chordeiles* examined there is no male.

Description of female. Body, length 3 mm., width .66 mm.; fuscous, with dark rusty brown lateral bands on abdomen and thorax, and distinct occipital and antennal bands of head.

Head, length .65 mm., width .5 mm.; forehead as long as hind head, tapering but little and flatly convex, almost truncate in front; suture distinct, both at margins and behind signature; four short hairs in front of suture, the

one next to the most anterior being the longest; behind the suture two longer hairs; and rising from the base of the trabeculæ a long hair from the prominent eye, and two very long hairs and two prickles on the temporal margin; occipital margin flatly concave, nearly straight, bare; antennæ slender, all segments weakly colored, with uncolored tips; trabeculæ small but distinct, uncolored; brownish white, with signature and temples brown, and distinct occipital and interrupted antennal bands blackish brown; the signature is broad and short, obtusely angled behind, and shows a number of small whitish subcircular spots; internal bands (*i. e.* margins of the ventral furrow running anteriorly from the mouth) showing through faintly.

Prothorax quadrangular, a little broader than long, with slightly diverging sides, and straight, bare, posterior margin; no hair in posterior angles; ground color that of the head, with narrow uncolored median longitudinal line forking at anterior end; broad dark rusty brown lateral borders. Metathorax but little longer than prothorax, with diverging sides; lateral margins with a slight but distinct rounding concavity near anterior end; posterior margin straight; posterior angles with three longish hairs, and a group of two on posterior margin near the angle; these two and two of the three in angle pustulated; ground color of segment same as or slightly darker than prothorax, with uncolored median longitudinal line, and lateral irregular dark brown lateral borders, narrower than those of prothorax. Legs long, coxæ elongate, brown, with whitish distal ends; femora and tibiæ concolorous with pale ground color of thorax, with rusty brown marginal markings. Sternal markings composed of rather short, broad intercoxal lines between pro- and meso-legs, connecting with a short, narrow

transverse median blotch; on metasternum oblong intercoxal blotches, and a large median blotch longer than wide and pointed posteriorly.

Abdomen elongate, subparallel-sided; segments 1, 7 and 8 short; segment 9 very short; posterior angles of segments with a series of five longish fine hairs arising from very small but distinct pustulations near the posterior margin of each segment; beyond this series at each end and near the posterior margin a longer, stronger hair on larger pustulation; all segments except segment 9 with a broad chestnut brown transverse blotch covering all of the segment; stigmatal spots clear; narrow dark rusty brown lateral bands; sutures uncolored; segment 9 uncolored, with two faint brownish lateral blotches, weakly angularly concave behind, without hairs, except two very short prickles, one on each half of posterior margin,

***Lipeurus baculus* Nitzsch.** (Plate lxxviii, figs. 4 and 6.)

Germer's Mag. Entomol., 1818, vol. iii, p. 293.

Pulex columbae majoris Redi, Opusculorum pars I, sive experimenta circa generationem Insectorum, 1686, pl. ii; Albin, Nat. Hist. Spiders and Other Curious Insects, 1736, pl. xliii.; Schrank, Enumeratio Insectorum Austriae, 1781; Geoffrey, Hist. abrégée des Insectes, 1762, vol. ii, p. 599.

Pediculus columbae Linnaeus, Systema Naturae, 1767; Fabricius, Systema Entomologiae, 1775.

Nirmus filiformis Olfers, De Veg. et Anim. Corp., 1817, p. 90; Lyonnet, Rech. s. l'anat. et les met. d. diff. esp. d. insectes, 1832, p. 273, pl. xiii, fig. 10.

Lipeurus baculus Nitzsch, Burmeister, Handbuch d. Entomologie, 1832, vol. ii, p. 434; Denny, Monograph. Anoplur. Brit., 1842, p. 172, pl. xiv, fig. 3; Gurlt, in Mag. f. d. ges. Thierheilk., vol. viii, p. 424, pl. viii, fig.; Nitzsch (ed. Giebel) Zeitschr. f. ges. Naturwiss., 1866, vol. xxviii, p. 379; Giebel, Insecta Epizoa, 1874, p. 216; Piaget, Les Pediculines, 1880, p. 303, pl. xxv, fig. 2; Taschenberg, Die Mallophagen, 1882, p. 123; Giraud, Bull. de la Soc. Ent., 1859, p. 140; Osborn, the Pediculi and Mallophaga affecting man and the lower animals, Bull. No. 7, Div. of Ent., U. S. Dept. of Agric., 1891, p. 38, with fig.

Lipeurus bacillus Nitzsch (ed. Giebel) Zeit. f. ges. Naturwiss., 1861, vol. xviii, p. 305; Giebel, Insecta Epizoa, 1874, p. 215, pl. xvi, figs. 8, 9; pl. xx, fig. 3.

Lipeurus antennatus Giebel, Insecta Epizoa, 1874, p. 213.

Lipeurus angustus Rudow, Zeitschr. f. ges. Naturwiss., 1870, vol. xxxvi, p. 137.

Specimens of this long known parasite of doves and pigeons taken from a domestic pigeon, *Columba livia*. I follow Piaget and Taschenberg in their refusal to recognize as species the numerous variants observed. The definition of this species presents a case similar to that presented by *Lipeurus squalidus* (see discussion of *squalidus*).

I figure the female and head of male, not alone for the convenience of American students, but because the previously published figures of this species are faulty. Piaget figures the male. Osborn's figure, undoubtedly well drawn, is spoiled in the printing. Piaget is in error in attempting to correct Giebel's statement that there are four small clavate appendages on the frontal part of the clypeus. Piaget declares there are but two such appendages; in my specimens there are distinctly four. The female specimen figured by me measures: body, length 2.5 mm., width .37 mm.; head, length .42 mm., width .28 mm.

***Lipeurus dissimilis* Piaget.** (Plate lxxviii, fig. 7.)

Les Pediculines, 1880, p. 359, pl. xxix, fig. 1.

Two specimens, one immature, from a Bob-white *Colinus virginianus* (Lawrence, Kansas). Piaget described the species from specimens taken from the same bird species in the Zoological Garden of Rotterdam. My specimens differ from Piaget's description in some particulars. Piaget says, "l'œil nu;" my specimens have a distinct longish hair in the eye; the lateral bands

of the abdomen distinctly pass the suture in my mature specimen; Piaget says that the bands do not pass the sutures.

The species may be recognized by its general similarity in form and appearance to *Lipeurus docophoroides* Piaget, of the California Quail (see pl. lxviii, fig. 8). *Dissimilis* differs from *docophoroides* in having the head more rounded in front, the abdomen longer and broader, and in the absence of pustulations at the bases of the hairs. My specimen (mature) measures: Body, length 2.4 mm., width 1.03 mm.; head, length .6 mm., width .53 mm.

Lipeurus docophoroides Piaget. (Plate lxviii, fig. 8.)

Les Pediculines, 1880, p. 357, pl. xxviii, fig. 9.

Two female specimens of this striking *Lipeurus*, taken from a California Partridge, *Callipepla californica* (Mountain View, California). Piaget found his specimens on individuals of the same bird species in the Zoological Garden of Rotterdam. The species is a transition form between *Docophorus* and *Lipeurus*. Piaget says of it: "La forme du thorax, des pattes en général et de l'abdomen, la présence des trabécules indiquent une transition au genre *Docophorus*; l'antenne, la fossette, l'implantation du coxis au bord du thorax, l'étranglement du métathorax, la forme du dernier segment ♂ attachent cette espèce aux *Lipeuri*."

The species may be recognized by its pointed conical head, with black and dark brown bands and markings, by its Docophoroid body, with distinct black lateral bands on thorax and abdomen, and by its whitish ground color and dark chestnut brown transverse lateral blotches, with pustulated hairs and large uncolored stigmatal areas. The specimen figured by me measures: Body, length 1.93 mm., width .78 mm.; head, length .56 mm., width .51 mm.

GONIODES.

Goniodes cervinicornis Giebel. (Plate lxix, fig. 1.)

Insecta Epizon, 1874, p. 199.

Goniodes cervinicornis G., Piaget, Les Pediculines, 1880, p. 272, pl. xxii, fig. 6.

Numerous specimens from a Silver Pheasant, *Phasianus nyctemerus*, sent to the Department of Zoology of this University by Mr. A. C. Robison of San Francisco, Calif. This large and striking *Goniodes* of the pheasants (Giebel's specimens were found by Kollar on *Phasianus nyctemerus*, and Piaget has found it abundantly on *Tragopan satyrus*) is characterized by the peculiar bipartite appendage on the first segment of the antenna of the male. It may be readily recognized by comparison with the figure of the female which I give. My specimens measure; Male: Body, length 3.34 mm., width 2 mm.; head, length .9 mm., width 1.32 mm. Female: Body, length 3.75 mm., width 2. mm.; head, length 1.03 mm., width 1.34 mm. These measurements are markedly greater than those given by Piaget; his male specimens averaging 2.75 mm. long, and the females 3.1 mm. long.

Goniodes mammillatus Rudow. (Plate lxix, fig. 2.)

Zeitsch. f. d. ges. Naturwiss., 1870, vol. xxxv, p. 483.

Goniodes mammillatus Rudow, Taschenberg, Die Mallophagen, 1882, p. 25, pl. i, figs. 1, 1a, 1b.

Two females from a California Partridge, *Callipepla californica* (Mountain View, California). This striking species was first described by Rudow from a specimen taken from *Pelecanus ruficollis*! (a dried skin in some museum). Taschenberg, who collected a number of specimens from *Callipepla californica* (skins?), says: "Wenn die Art wirklich wie Rudow angiebt, auf *Pelecanus ruficollis* angetroffen ist, so ist es in Folge zufälliger

Uebertragung geschehen." The species may be recognized by the broad abdomen and the striking angulated lateral bands of the abdomen, each segmental portion projecting diagonally forward and inward and ending in an indistinctly limited paling brown blotch. Taschenberg says that the head of the male is a little longer than broad, with deep emarginations at the bases of the antennæ, and with strongly angulated temporal margins between which the head is a little narrower than it is just in front of the antennæ. The female figured by me measures as follows: Body, length 2.25 mm., width 1.16 mm.; head, length .62 mm., width .72 mm.

GONIOCOTES.

Goniocotes creber n. sp. (Plate lxix, fig. 3.)

An extraordinary number of specimens on a Silver Pheasant, *Phasianus nycthemerus*, presented to the Department of Zoology of this University, by Mr. A. C. Robison of San Francisco. In addition to the great number of individuals of this *Goniocotes* on the bird, there were present in more than ordinary numbers the giant *Goniodes cervinicornis*, *Lipeurus introductus* n. sp. and *Menopon monostæchum* n. sp. The short feathers of the neck, especially of the throat, were literally covered with the eggs of some one of these species. This *Goniocotes* resembles in general characters Giebel's species *chrysocephalus* (Insecta Epizoa, p. 189), a common *Goniocotes* of Pheasants, found so far on *Phasianus colchicus*, *nycthemerus*, *sommeringii*, *pictus*, and *Euplocamus ignitus*, but is a markedly larger species.

Description of the female. Body, length 1.6 mm., width .87 mm.; pale yellowish brown, with darker head and with dark brown head markings, and lighter lateral bands which are peculiarly curved so as to enclose a less chitinized space.

Head, length .44 mm., width .6 mm.; front broad, convex, with ten short prickles; antennæ in a shallow emargination with second segment longest and the fifth longer than third or fourth, which are about equal; eye prominent, with a prickle; the slightly protruding, rounded temporal margins with a prickle and two strong hairs; posterior margin concave in middle, with obtuse angles at each end of the concavity; head brownish, with darker narrow marginal frontal bands ending posteriorly on each side in an expanded darker spot inside of antennal emargination; mandibles and œsophageal sclerite dark brown; an irregular brown ocular blotch and a sinuous dark brown occipital border along the concave curve of the occipital margin.

Prothorax very narrow, short, trapezoidal, with lateral margins converging anteriorly, and posterior margins flatly convex; the latero-posterior angles are slightly produced and acute, and each bears a strong hair; indistinct brownish lateral borders. Metathorax with blunt lateral angles, each with two strong hairs; posterior margin obtusely angled on abdomen, and bare except for two hairs near the lateral angles. Legs concolorous with body, with dorsal marginal markings and some scattered spines.

Abdomen broadly elliptical; posterior angles of segments projecting and bearing, except on segment 1, one to three rather short, strong, finely pointed hairs; segment 1 longest at sides but short in middle because of the backward projecting angulated thorax; middle region of abdomen pale to uncolored, faint lateral transverse blotches and conspicuous lateral bands, which on all segments except segment 1 are curved so as to enclose a small uncolored space; the curved band projects inward and forward, passing the suture; the last segment

flatly rounded behind, with a slight angular emargination, the margin bordered by a narrow uncolored space.

Male. Body, length 1.15 mm.; width .7 mm.; head, length .34 mm., width .47 mm.; abdomen as wide as long, suborbicular; median uncolored region of abdomen relatively larger than in female; lateral transverse blotches no more distinct than in female, but lateral bands more strongly chitinized; posterior margin of abdomen broad, straight, with projecting rounded ninth segment in the middle; posterior border of ninth segment colored, the margin with a few short strong hairs; genitalia extending far forward.

Goniocotes compar Nitzsch. (Plate lxxix, fig. 4.)

Germer's Mag. Entomol., 1818, vol. iii, p. 294.

Pediculus bidentatus (?) Scopoli, Ent. Carn., 1763, p. 385.

Philopterus compar Nitzsch, Walckenaer, Hist. Nat. Ins. Apt., 1844, vol. iii, p. 358.

Goniocotes compar Nitzsch, Burmeister, Handbuch d. Ent., 1835, p. 431; Gurit, Mag. f. d. ges. Thier., 1842, vol. viii, p. 117, pl. iv, fig. 2; Denny, Monograph. Anoplur. Brit., 1842, p. 151, pl. xiii, fig. 2; Giebel, Zeitsch. f. ges. Nat., 1861, vol. xviii, p. 305; l. c., 1866, vol. xxviii, p. 389; Giebel, Insecta Epizoa, 1874, p. 183, pl. xii, fig. 8; Piaget, Les Pediculines, 1880, p. 284, pl. xix, fig. 10; Taschenberg, Die Mallophagen, 1882, p. 69; Osborn, The Pediculi and Mallophaga Affecting Man and the Lower Animals, 1891, Bull. 7, Div. of Ent., U. S. Dept. Agri., p. 33, fig. 19.

Specimens taken from a Domestic Pigeon, *Columba livia* (Lawrence, Kansas). This well known *Goniocotes* of the Domestic Pigeon has been found by Piaget on *Columba palumbus* and *C. phasianella*, and by Denny on *Columbus wnas*, *C. palumba* and (a variety, Denny thinks) on *C. turtur*, as well as on the various races of the domestic pigeon. It is a small form, only about 1 mm. long, whitish, with a pale brownish border along the lateral margins of the abdomen and thorax; the temples are angled and bear two very long backward-projecting

hairs. The posterior margin of the metathorax is angulated and the angle projects so far backward that it nearly cuts the first abdominal segment in two. Professor Osborn's figure is faulty in representing the metathorax with straight posterior margin. The male figured by me measures: Body, length 1.06 mm., width .48 mm.; head, length .34 mm., width .37 mm.

PHYSOSTOMUM.

Physostomum microcephalum n. sp. (Plate lxx, fig. 1.)

A single female from the House Finch, *Carpodacus mexicanus frontalis* (Palo Alto, California). Not common on its host, as I have a record of twelve other individuals of *Carpodacus* from which Mallophaga were taken, but on none of them was this *Physostomum* again found. The new species approaches the general type of *P. agonum* N. (Giebel, Insecta Epizoa, p. 255), from *Sylvia rubecula* and *S. succia* more nearly than it approaches any other of the Old World species.

Description of female. Body, length 3.6 mm., width 1.25 mm.; head small; abdomen large and exceptionally broad; head markings pale, ill-defined; distinct brown lateral bands; paler colored large median transverse abdominal blotches.

Head, length .66 mm., width .72 mm., thus being wider than long, which is exceptional in *Physostomum*, and being especially small in proportion to the size of the whole body; front flatly rounded, and sides of forehead weakly concave; prickles on front, one hair on margin at extremity of transverse clypeal suture, and a few very short hairs and two longer ones along margin before the eye; eye distinct, with a black fleck; palpi passing the margins of head; the blunt lateral flaps slightly passing the margin; temples not produced very far backward, with a little

narrowed tip at the apex of the posterior angle; temporal margins with three longish hairs and a few short ones; markings weakly colored, a pale chestnut brown.

Prothorax, with distinct lateral angles, in apex of which a spine and a long hair; another long hair near rounded posterior angle, and two spines on margin in front of lateral angle; segment whitish, with faint brownish tinges on lateral borders and elsewhere. Metathorax with weak concavity on lateral margins in front of the middle; two hairs in the posterior angles, and some scattered short spines on margin and dorsal surface of anterior half (mesothorax) of segment; color of prothorax, with brown lateral borders narrowing anteriorly. Legs concolorous with thorax, with narrow darker marginal color.

Abdomen large, expanding in the middle half, and broad and bluntly rounded behind; not very long single hairs in the posterior angles, and on the dorsal surface just inside of the colored lateral bands a double longitudinal row of weak hairs; whitish, with distinct brown lateral bands and large oblong median abdominal blotches, darkest on segments 5 and 6.

Physostomum sucinaceum n. sp. (Plate lxx, fig. 2.)

Three females from a Western Flycatcher, *Empidonax difficilis* (Palo Alto, California). A small *Physostomum*, the smallest I have taken.

Description of female. Body, length 2.84 mm., width .81 mm.; ground color pale amber instead of whitish, as is usual with *Physostomum*; brownish lateral bands, and head markings not strongly colored.

Head, length .53 mm., width .5 mm.; front rounded, with usual few hairs; palpi short, barely passing the margins of head; temples produced backwards and acutely angled with three longish hairs and some short ones;

clypeus clear, almost uncolored; head markings dark brown, but not very sharp; eye with black fleck.

Prothorax with almost no lateral angles, the angles being very obtuse and flattened; two spines and a long hair in the angles and another long hair near the posterior angle; posterior margin of segment concave; a brownish submarginal lateral border. Metathorax with a few small spines along lateral margins, and a longish hair near posterior angles. Legs whitish, paler than body color.

Abdomen with sides only flatly convex, subparallel; single hairs on posterior angles of segments and a longitudinal row of small hairs, one on each segment, on each side inside of the lateral band; lateral bands pale amber brown, not much darker than ground color of body; faint median transverse blotches, apparently nearly square.

Physostomum angulatum n. sp. (Plate lxx, fig. 5.)

Two females taken from a Kingbird, *Tyrannus tyrannus* (Lawrence, Kansas), and one female from a Fox Sparrow, *Passercella iliaca* (Lawrence, Kansas).

Description of female. Body, length 5. mm., width 1.3 mm.; pale golden, with narrow dark brown lateral bands on abdomen and thorax, and few dark brown head markings; the largest *Physostomum* yet found.

Head, length 1 mm., width .94 mm.; front flatly convex, without marginal hairs, sides with two short hairs on dorsal surface near and projecting over the margin even with base of antennæ, and at same place two similar submarginal ventral hairs, and two shorter hairs on margin in the very slight ocular emargination; occipital angles acute and much produced posteriorly (extending nearly to middle of prothorax), bearing three long hairs; occipital margin is thus very concave and is without hairs; palpi projecting beyond margin by half of last segment;

labral lobes inconspicuous, not projecting beyond margin of head; a distinct, curved, dark brown blotch bounding inner margin of antennal fossa; in front of it two paler blotches, the anterior being the larger, and a narrow dark brown occipital border; the rest of head concolorous with the body or paler.

Prothorax hexagonal, the angles rounded, the lateral angles with a longish weak hair and a spine; a distinct, brown, submarginal border laterally, which turns inward at its anterior end and is looped. Metathorax longer than prothorax, with gently sinuous sides, without distinct marginal hairs (a short projecting hair or spine near the posterior angle is not strictly marginal); posterior margin straight; anterior angles with irregular brown blotch, a linear, diagonal blotch on each side near middle, and submarginal lateral bands continuous with those of the abdomen. Legs long, slender, concolorous with the body.

Abdomen elongate-elliptical, truncate anteriorly, with sharply marked dark brown to black submarginal lateral bands composed of segmental parts separated by diagonal sutures and slightly laterally displaced; posterior angles of segments with one or two weak hairs; vulva convex.

Physostomum australe n. sp. (Plate lxx, fig. 4.)

One female from a Western Nonpareil, *Passerina versicolor* (Cameron County, Texas), resembling *angulatum* in marking but smaller and head comparatively shorter and narrower anteriorly, hence more tapering; with abdomen with median blotches which are wanting in *angulatum*.

Description of female. Body, length 4 mm., width 1.06 mm.; almost uncolored, with yellowish tinge strongest on head and thorax; with sharp black lateral markings and pale brown median abdominal blotches.

Head, length .68 mm., width .7 mm.; front narrow, flatly convex, without hairs; sides with a distinct rounding emargination even with the mouth parts; ocular emargination filled by the conspicuous eye; occipital angles not so acute as in *angulatum*, but projecting backwards nearly to lateral angles of prothorax, and with three longish hairs. Markings similar in position to those of *angulatum* but more pronounced; antennal fossa entirely rimmed and connected with occipital border by a short occipital band; in front of the antennal fossa three blotches (instead of two as in *angulatum*), the most anterior being a short band projecting inward from the lateral margin.

Prothorax with the constriction in front of lateral angles especially marked and the angles with one or two spines but no hair; general color of the segment golden brown, with black submarginal lateral bands. Metathorax with a rounded swelling on anterior third of sides, without marginal hairs and with markings resembling those of *angulatum*, viz., irregular black blotches in anterior angles, submarginal lateral bands continuous with those of abdomen, and two short linear blotches lying inside of the lateral bands which are in this species entirely disconnected from the bands and are but slightly diagonal. Legs pale with distinct narrow black margins on femora and indistinct narrower tibial margins.

Abdomen; segments with one long hair on lateral margin near posterior angle; posterior margin of last segment with hairs composing the delicate fringe unusually long; uncolored to pale golden, with uniform submarginal lateral black bands (more nearly continuous than in *angulatum*, the diagonal sutures and lateral displacement of the various segmental portions being less marked);

on segments 1-7 a pale brown median blotch, the blotches on segments 4-5 being larger; vulva convex.

Physostomum diffusum n. sp. (Plate lxx, fig. 3.)

One female taken on the Sandwich Sparrow, *Passerculus sandwichensis*, and several males and females taken on the Golden Crown Sparrow, *Zonotrichia coronata* (near Stanford University, Calif.); also two females and a young specimen (variety *pallidum* Kellogg) from a *Junco* sp. (Lawrence, Kansas). This species differs from the preceding two species described in having the lateral abdominal bands distinctly marginal (as is the case with the species of Piaget, Nitzsch, and Denny), and in this it resembles the European species. It has the very long, backward-projecting, occipital angles, as in *angulatum* and *australe*, which is a character shown by but few of the European forms.

Description of female. Body, length 4 mm., width 1.09 mm.; white, with dark brown to black marginal lateral bands on abdomen and thorax, and few black head-markings; the labral lobes large and projecting.

Head, length .8 mm., width .7 mm.; front rather broad, flatly convex, without marginal hairs, sides nearly straight but slightly constricted even with the projecting labral lobes; a single projecting submarginal hair near middle of head, with a very short hair barely reaching margin close to it; in the small ocular emargination several short hairs; occipital angles acute, with two long hairs; the palpi barely project beyond the lateral margin of the head but the labral lobes are large and project conspicuously beyond the margin; markings consisting of a small black ocular fleck, a dark brown blotch on inner margin of antennal fossa, and in front of it two smaller blotches, the anterior the least distinct; a narrow, interrupted,

smoky, occipital margin, indications of occipital bands, and a narrow, indistinct smoky margin of the temples.

Prothorax hexagonal, with anterior and posterior margins weakly concave; in the obtuse lateral angles a hair and two spines; segment white with a narrow submarginal black band, the margin outside of it being more or less suffused with smoky brown. Metathorax with a slight lateral swelling on the lateral margin near the anterior end, bearing a few short pale brown spines; in the posterior angles a single, longish, weak hair; segment white, with a narrow, submarginal, lateral band, outside of which on posterior half of segment the margin is smoky brown. Sternal markings consisting of an intercoxal line, long and curving forward, on metasternum, and two faint median lines on prosternum. Legs, white.

Abdomen. Posterior angles with a single longish hair and a shorter weaker one on lateral margin of each segment of segments 5-8; last segment flatly rounded with two pairs of hairs, and the posterior fringe distinct; dorsal surface without hairs, or with very few; segments white, with broad, black, marginal, lateral bands fading out on eighth segment; indications of narrow, transverse, linear, median blotches at the sutures; under side of abdomen with pale brown, median blotches on segments 5-6.

Var. *pallidum* Kellogg. Two females and a young specimen taken from a *Junco* sp. (Lawrence, Kansas) may be referred to this species but they show varietal differences. The body color is pale golden, the markings are brown, not black, and the middle region of the whole abdomen is pale brownish; of the head markings only the ocular fleck and the bounding blotch on inner rim of the antennal fossa are distinct.

COLPOCEPHALUM.

Colpocephalum chrysophæum n. sp. (Plate lxxi, fig. 1.)

Found on three out of seven specimens of Samuels' Long Sparrow, *Melospiza fasciata samuelis* (Palo Alto, California).

Description of female. Body, length 1.35 mm., width .7 mm.; golden brown with blackish brown bands and margins, and rusty brown transverse blotches.

Head, length .28 mm., width .5 mm.; broadly parabolic in front; one short hair on each side of the middle, then a longer one, then a short one, then a very long one, then two longish ones; the palpi project by at least the last two segments; the ocular emargination is distinct but not acute inwardly; the eye is large, emarginate, and with a distinct black fleck; ocular fringe distinct; temples projecting, rounded, rather narrow, with several long hairs of different lengths, of which two are very long and equal; on the occipital margin of the temples another very long hair and two or three shorter ones; middle part of occipital margin with a few long hairs; head tinged with fuscus with black, curving, broadly linear, ocular blotch and narrow curving transversal black line subparallel with frontal margin of clypeus; occipital and inner bands forming a brownish H in middle of head, the lines being broad and slightly curving; in the anterior part of the H a brown blotch, and a tapering brown triangle projecting backward from the cross bar of the H; four small pale to uncolored circular spots, one at each end of the cross bar of the H, and the two others outside of but contiguous to the anterior legs of the H.

Prothorax broad, short, with a strong hair in the lateral angles and two spines, and ten longish hairs ranged along the posterior margin; the transverse chitinized bar is

especially narrow and distinct, and the curving longitudinal lines beyond the ends are sharply defined and black. Metathorax with posterior margin straight and with about ten longish weak hairs ranged along it; darkest along the short anterior margin and in the latero-posterior angles. Legs pale, with sharply defined marginal markings, especially on the coxæ and on the long slender tibiae of middle and hind legs. Sternal markings consisting of a small median triangle with linear wings on prothorax, and of black, distinct, angulated, intercoxal lines between meso- and meta-coxæ.

Abdomen ovate, broad at both ends; long hairs in posterior angles of segments, and short hairs, not numerous, on dorsal surface; all segments with a broad, brown, transverse blotch extending entirely across segment, covering almost the whole surface; the sutures, however, are broad and uncolored; lateral bands narrow, black, fading inwardly into the transverse blotches; last segment broad, flatly convex behind, with a fringe of short hairs.

Male. Body, length 1.09 mm., width .5 mm.; head, length .25 mm., width .4 mm.; conspicuously smaller than the female; genitalia extending through segments 5-9, in shape a heavy two-pronged fork.

Colpocephalum osborni n. sp. (Plate lxxi, figs. 2 and 3).

Many specimens, males, females and young, from a White-tailed Kite, *Elanus glaucus* (Palo Alto, California), resembling *C. dissimile* Piaget (*Les Pediculines*, p. 520, pl. xliii, fig. 4), taken from *Alivus aegyptius* (Museum of Leyden), and *C. tricoloratum* Nitzsch (Giebel, *Insecta Epizoa*, p. 263), taken from *Alivus ater*. Named for Prof. Herbert Osborn of Iowa, who has contributed to the knowledge of American Mallophaga.

Description of male. Body, length 1.31 mm., width

.5 mm.; golden brown, with distinct, broad, black, occipital bands with expanded extremities, and dark brown, transverse, abdominal blotches with black lateral ends.

Head, length .31 mm., width .5 mm.; rather large compared with whole body, just as wide as widest part of abdomen; front broad, flatly rounded, with seven hairs on each side of the median line, four of which are grouped together in front of the ocular emargination; last segment of antenna broad, with slightly concave terminal margin projecting beyond margin of head; ocular emargination pronounced, the deepest point being acutely angled; an ocular fringe; swelling rounded temporal margins, with several hairs of different lengths, three being about equal and longest; occipital margin concave, with four hairs; golden brown, with large black subcircular ocular blotches and triangular occipital blotches connected by the broad, paler (reddish brown) occipital bands; the occipital blotches connected by an even, strongly colored, broad, occipital border; clypeus with two blackish brown blotches connected with the ocular blotches and mandibles by colored areas but little darker than the ground color of head.

Prothorax short, extending laterally even with the outer margin of the occipital blotches of the head, with a hair and spine in each lateral angle, and eight hairs along the flatly convex posterior margin; concolorous with ground color of head. Metathorax short, with flatly convex posterior margin, bearing a series of short, weak hairs; a transverse chestnut-brown blotch across posterior half of segment, expanding and darker at lateral ends. Legs with distinct dark brown markings.

Abdomen bluntly elliptical, third segment widest, with segments projecting but little laterally; many short hairs along sides and on dorsal surface; segments 1-8 with

broad, transverse, dark chestnut-brown blotch entirely across segment, darkest laterally, with sharp black angulated lateral bands, especially noticeable on segments 3-8; last segment without noticeable blotch, bluntly rounded behind, without numerous hairs.

Female. Body, length 1.47 mm., width .63 mm.; head, length .3 mm., width .5 mm.; with abdomen obovate, tapering posteriorly; abdominal blotches darker laterally but paler in the middle; lateral bands not angulated and wider; last abdominal segment elongate, tapering, with narrow flatly convex posterior margin; segment 8 with a group of seven strong curving hooklike hairs, the posterior ones longest, situated on posterior part of lateral margin of segments; posterior margin of this segment with a series of closely set hairs.

Colpocephalum fumidum n. sp. (Plate lxxi, fig. 5.)

A single specimen from a Least Bushtit, *Psaltriparus minimus* (Palo Alto, California). A strikingly dark *Colpocephalum* showing resemblance to some of the *Colpocephali* of the water birds, such as *uniseriatis* Piaget (Les Pediculines, p. 562, pl. xlvii, fig. 2), from an Avocet, *Recurvirostra avocetta*, rather than to any of the few *Colpocephali* hitherto described from passerine birds.

Description of female. Body, length 2.75 mm., width 1.1 mm.; very dark, smoky, with black occipital margin, ocular blotches, and blackish lateral abdominal bands.

Head, length .5 mm., width .75 mm.; forehead large, flatly rounded in front, with numerous short hairs; two longer hairs in angle in front of ocular emargination; the ocular emargination pronounced, angulated, with the anterior margin of the produced temples almost at right angles to the long axis of the head; the eye prominent, almost if not quite divided, the anterior and larger part

lying in the angle of the emargination, the smaller and posterior part lying apparently on the dorsal surface of the temple; ocular fringe distinct, composed of longish hairs; temporal margins with slightly rounded anterior and posterior angles, and slightly convex lateral margin which bears five longish hairs; occipital margin weakly sinuous and concave, with four hairs; fuliginous with black uneven occipital border; small black ocular blotches, and four small circular uncolored spots on forehead, from each of which arise one or more hairs.

Prothorax with bluntly rounded lateral angles, slightly concave latero-posterior margins, and convex posterior margin, the segment produced backward so as to very materially narrow the median part of the mesothorax, with a spine and a long hair in the lateral angles and two separated hairs on the concave lateral margins, the anterior hair being short and weak. Mesothorax separated from metathorax by an uncolored suture, but with extremely slight lateral emargination; no hairs. Metathorax larger than mesothorax, with straight posterior margin, a spine, a weak hair and a strong hair in posterior angles, and posterior margin not with a marginal series of hairs; all the thoracic segments very dark, the ground color same as that of head and darker than that of abdomen; the lateral borders darkest. Legs concolorous with body, robust.

Abdomen long-ovate, segments of equal lengths, a few long hairs in posterior angles, and dorsal surface with posterior margins of segments with single series of hairs set in faint pustulations; ventral surface with series of short fine hairs in small but distinct pustulations; last segment narrowly, flatly convex, with a fringe of fine uncolored hairs; whole abdomen smoky but lighter than head and thorax; black lateral bands paling inwardly.

Colpocephalum flavescens Nitzsch. (Plate lxxi, fig. 4.)

Germer's Mag. Entomol., 1818, vol. iii, p. 298.

Colpocephalum flavescens N., Nitzsch (ed. Giebel) Zeitschr. f. ges. Naturwiss., 1861, vol. xvii, p. 522; Burmeister, Handb. d. Ent., 1835, vol. ii, p. 438; Denny, Monograph., Anoplur. Brit., 1842, p. 206, pl. xviii, fig. 2; Giebel, Insecta Epizoa, 1874, p. 262, pl. xiii, fig. 10; Piaget, Les Pediculines, 1880, p. 515, pl. xlii, fig. 10.

Specimens which should probably be referred to this species from two Bald Eagles, *Haliaeetus leucocephalus*, and an American Rough-legged Hawk, *Archibuteo lagopus sancti-johannis* (Lawrence, Kansas). The male figured by me measures: Body, length, 1.5 mm., width, .6 mm.; head, length .31 mm., width .53 mm. The species may be recognized by the strong distinct blotches and occipital bands and border of the head, and the transversal abdominal blotches.

Colpocephalum subaequale Nitzsch. (Plate lxxii, fig. 1.)

Germer's Mag. Entomol., 1818, vol. iii, p. 299.

Colpocephalum subaequale N., Burmeister, Handb. d. Ent., 1835, vol. ii, p. 438; Giebel, Insecta Epizoa, 1874, p. 265, pl. xiii, figs. 13 and 14; Piaget, Les Pediculines, 1880, p. 527.

Two females from an American Crow, *Corvus americanus* (Palo Alto, California). I did not find this species represented on several other crows shot at Palo Alto and at Lawrence, Kansas, although all of the individuals were infested by other parasites, such as *Docophorus atratus* or *Menopon mesoleucum*. My specimens do not have the dorsal surface of the thoracic segments with scattered long hairs, nor the surface of the abdomen thickly beset with hairs, as Giebel's description (Insecta Epizoa, p. 265) records; but neither are these hairs shown in Nitzsch's figure. Nitzsch's specimens were found on *Corvus corax* and *C. frugilegus*. My specimens do not have the first two segments of the abdomen especially lengthened as in Rudow's *semicinctum* (Zeitschr. f.

ges. Naturwiss., 1869, vol. xxxiv, p. 394), from *Corvus scapularis*. The species may be recognized by the broad black occipital border and occipital bands, ocular and frontal blotches of the head, and by the transverse abdominal blotches of the abdomen, much narrowed in the middle in the male, and divided in the female into a median and two lateral parts. The female figured by me measures: Body, length 1.53 mm., width .63 mm.; head, length .31 mm., width .5 mm.

Menopon decoratum n. sp. (Plate lxxii, fig. 2.)

One male, one female, and a young specimen from a White-tailed Kite, *Elanus leucurus* (Palo Alto, California). A finely marked species not resembling especially any other *Menopon* hitherto taken from birds of prey. No *Menopon* has heretofore been taken from a Kite.

Description of male. Body, length 1.53 mm., width .72 mm.; pale yellowish brown, with dark rusty brown to black markings; distinct transverse bars on abdominal segments, the one on segment 2 especially strongly defined.

Head, length .31 mm., width .66 mm.; robust, more than twice as wide as long; front broad, flatly rounded, with a few short weak hairs, and on the weak swelling in front of the shallow ocular emargination two strong hairs, of which one rises from the dorsal surface; temples expanded, with two longish hairs and three very long ones; occipital margin concave, straight in the middle, with four long hairs: large black ocular fleck; an irregular blackish brown ocular blotch (on base of antennal band), the two connected by a paler curving transverse band, and also connected with the occipital margin by pale, broad, ill-defined occipital bands, the bases of the bands being blackish brown; on the forehead in front of mandibles a pale, short, curving band on each side.

Prothorax irregularly hexagonal, with obtuse lateral angles, and posterior margin flatly convex, with a very obtuse median angle; lateral angles with one very long hair and one shorter one, and a series of eight strong hairs along posterior margin, the terminal hair at each end of the series being exactly in the latero-posterior angle; chitinized transverse bar in anterior part of segment is weakly colored, and the longitudinal bars at its end are indistinct. Metathorax as short as or slightly shorter than prothorax, wider, with posterior margin straight; two long hairs in posterior angles, and a series of shorter weak ones along posterior margin; anterior angles with strongly colored blotch; an ill-defined, short longitudinal blotch projecting back from converging lateral margins. Legs palely colored.

Abdomen broadly ovate, wide and flat behind; posterior angles of segments with two usually long hairs and several short ones; single series of hairs not numerous on dorsal surface; lateral bands blackish brown, broad, interrupted, the segmental portions projecting inward; dark chestnut brown transverse blotches across the segments, with the pale or uncolored sutural bands broad; the colored transverse band of segment 2 is specially strongly marked, and is rather sinuous; last segment with broad, uncolored, posterior border, and with posterior margin straight, with a slight median emargination, and a sparse fringe of hairs of different lengths.

Female. Body, length 2. mm., width .94 mm.; head, length .4 mm., width .7 mm.; perhaps a little darker; the transverse blotches of abdomen better defined; last abdominal segment narrower than in male, and the posterior margin broadly parabolic, with few long, and numerous short hairs.

Menopon robustum n. sp. (Plate lxxii, fig. 3.)

A single specimen found on a Least Bush Tit, *Psaltriparus minimus* (Palo Alto, Calif.). No other specimens of this strange species were found on five other individuals of the same bird species examined. I refer the species to the genus *Menopon*, for it is evidently more closely allied to this genus than to any other one so far established. But it presents a mingling of characters of *Menopon*, *Ancistrona* and *Eureum*; a short broad head with strongly chitinized backward-projecting processes on the ventral surface like *Ancistrona*; a thorax like *Eureum*, and the habitus and general body characters of *Menopon*. If it is to be referred to *Menopon* it ranks with *titan* and *tridens* as anomalous members of the genus, which should be distinguished by subgeneric names, or which should be the provocation for breaking up the already unwieldy genus into several genera. In general shape it resembles *M. subrotundum*, Piaget (Les Pediculines, p. 453, pl. xxxv, fig. 2), from *Gracula sulcirostris*.

Description of the female. Body, length 1.43 mm., width .85 mm.; being thus very broad and short; smoky translucent brown, with broad, transverse, abdominal bands, darker on the lateral margins; head with no well defined bands or blotches except the small ocular flecks; labial projections of under side showing through; head with very long hairs.

Head, length .25 mm., width .6 mm.; very broad and short, crescentic, with narrow rounded ends; front with one very short hair on each side of middle, then two short ones and then three long hairs, the hindmost two being in the lateral angle just in front of the ocular emargination; palpi short, not reaching the margin; the emargination small but distinct, with the eye large, nearly

divided, and with a distinct fleck; the narrow produced temples with five long hairs of which the hindmost three are very long; occipital margin with six hairs, the two outer ones arising submarginally, no distinct head bands or blotches; the occipital margin narrowly bordered with black; on the under side of the head there are two strongly chitinized, backward-projecting, pointed processes arising from the labium (resembling those, but not bipartite, of *Ancistrona*); these processes show through above and give an appearance of faint occipital bands.

Prothorax very large, as long as the head, and three-fourths as broad, with strong, produced, obtuse, lateral angles; posterior margin obtusely angled on the metathorax; a strong spine and a long hair in each lateral angle, and a not well filled series of weak hairs along posterior margin; the transverse chitin bar distinct, blackish brown, and the curving longitudinal chitin bars at its ends distinct, blackish; no well defined blotches. Metathorax with a few small spines along lateral margins and two longish hairs in posterior angles; posterior margin with marginal series of short hairs (like those of abdomen); regions of latero-posterior angles dark brown, the color extending forward narrowly along the lateral margins. Sternal markings composed of a small median blotch on prothorax, with posterior produced point and lateral linear processes; curving intercoxal lines on mesothorax and short straight ones on metathorax, with a broad pale colored median blotch. Legs concolorous with head and thorax, with coxæ distinctly margined with blackish brown; anterior coxæ with blunt processes about as long as but narrower than the coxæ themselves.

Abdomen more golden or yellowish brown than head and thorax; very broadly elliptical; but slightly turbinated; with two or three rather short hairs in posterior

angles; a single transverse series of short hairs along posterior margin of each segment; broad, transverse bands entirely covering each segment; darker at lateral margin, especially on anterior segments; last segment flatly rounded, with fringe of short hairs.

Menopon monostæchum n. sp. (Plate lxxii, fig. 4.)

Specimens from a Silver Pheasant, *Phasianus nycthemerus*, received by the zoological department of this University from Mr. A. C. Robison of San Francisco, California.

The species is like *subæquale*, Piaget (Les Pediculines, p. 463, pl. xxxvii, fig. 5), from *Euplocamus ignitus* in shape of thorax and body, but has only single series of hairs on the abdominal segments (*subæquale* has two series on each segment); in the matter of the hairs of the body the new species is like *uniseriatim*, Piaget (Les Pediculines, p. 464, pl. xxxviii, fig. 4) from *Phasianus pralatus*, but differs from this species in not having the posterior margin or prothorax projecting backward and angulated; in both *subæquale* and *uniseriatim* the females are smaller than the males (according to Piaget), which unusual condition does not obtain in the new species.

Description of the male. Body, length 2.06 mm., width .9 mm.; whitish, with faint brownish tinge; with inconspicuous but distinct markings of blackish brown and chestnut; with numerous long hairs.

Head, length .41 mm., width .7 mm.; front rounded, with indication of median angulation; with about ten marginal hairs of different lengths in front of the ocular emarginations, which are shallow but distinct; palpi projecting; the projecting temporal margins with several long hairs, of which two are very long; occipital margin concave, with eight long hairs; a black ocular fleck and

brown ocular blotch; occipital margin narrowly edged with brown; mandibles and adjacent lateral regions dark chestnut brown.

Prothorax with lateral angles narrowly rounded, and with a longish spine; posterior margin curving at sides, but nearly straight on metathorax, and with a marginal series of strong, long hairs; transverse chitin bar pale to uncolored, but distinct, as also the longitudinal bar at its ends. Metathorax of about same length as prothorax, and but very little if at all wider; with five strong, short spines along each lateral margin, and a series of hairs along the straight posterior margin; lateral margins narrowly bordered with blackish brown, and linear brown blotches projecting backward from anterior angles, and tapering and fading out posteriorly. Legs pale, concolorous with body.

Abdomen elliptical, with segments projecting but little laterally; posterior angles with several hairs of different lengths, the hairs longer on posterior segments until on segments 8-9 some of them are very long; lateral bands with short processes projecting inward, one in middle of lateral margin of each segment and one along each suture; no transverse blotches, or only faint indications of brownish color; last segment broad, rounded behind, with numerous long hairs.

Female. Body, length 2.3 mm., width .9 mm.; head, length .4 mm., width .72 mm.; last segment of abdomen more flatly rounded, with a tuft of hair at each posterior angle and a fringe of hairs of equal size along the posterior margin, giving the tip of abdomen a truncate appearance.

Menopon melanorum n. sp. (Plate lxxiii, fig. 1.)

Taken on a Towhee, *Pipilo erythrophthalmus* (Lawrence, Kansas).

Description of female. Body, length 1.37 mm., width .56 mm.; pale golden brown, with black occipital margin of head, blackish brown ocular blotches and mandibles, and brown transverse abdominal blotches distinct only laterally.

Head, length .31 mm., width .47 mm., rather long in comparison with its width for *Menopon*; front rounded, with usual few short hairs in front of barely projecting palpi, and two longish ones in front of ocular emarginations; the emargination distinct, shallow, and with ocular fringe; temples broad, rounded, with a few hairs of different lengths, including at least one very long hair; occipital margin concave, straight in middle, with two longish and two short hairs; occipital margin narrowly but conspicuously bordered with black; indications of widely separated, translucent, occipital bands, convex outwardly; ocular blotches small, narrow, linear, curving, blackish in middle, paling at each end; a small black ocular fleck; a brown spot on margin outside of each mandible, and connected with mandibles by indistinct brownish bands.

Prothorax with slightly produced blunt lateral angles bearing three spines; nearly straight posterior margin with four longish hairs; the chitin bars indistinct, no blotches. Metathorax with slight lateral emargination, and indications of suture between meso- and metathorax; metathorax with a spine and very long hair in posterior angles, and eight weak hairs along the posterior margin, four on each side of the bare middle part; anterior angles of mesothorax dark brown; otherwise both segments unicolorous, concolorous with pale ground color

of body. Legs concolorous with thorax, with darker indistinct marginal and terminal margins.

Abdomen short, broad, ovate, not turbinate; a single very long hair and a spine in posterior angles of segments; broad, pale brown, transverse bands across all segments but the last, these bands, however, hardly apparent on the middle region of the body, but distinct laterally, the lines of demarcation between pale and darker parts of band rather sharply defined; last segment broad, flatly rounded, uncolored, with a fine fringe of short, uncolored hairs.

Menopon incertum n. sp. (Plate lxxiii, fig. 2.)

Specimens from an American Gold Finch, *Spinus tristis*, and from a Russet-backed Thrush, *Turdus ustulatus* (Palo Alto, California). This is one of these species which might be referred almost indifferently to *Menopon* or to *Colpocephalum*. Because Giebel has referred to a somewhat similar form, *thoracicum* (Insecta Epizoa p. 287) from *Turdus viscivorus*, to *Menopon*, I assign this species to the same genus. The new species differs from *thoracicum* in the hairs of the prothorax, in the straight, not angulated, posterior margin of the mesothorax, in lacking a complete series of hairs along the posterior margin of the metathorax, in the presence of the characteristic spines of the posterior angles of the abdominal segments, and in other particulars. The ocular emarginations of the head are distinct, "fast colpocephalisch," as Giebel says of *thoracicum*.

Description of the male. Body, length 1.16 mm., width .48 mm.; pale brown, with distinct, broad, dark brown, transverse, abdominal bands, and blackish lateral bands; head two-thirds as long as wide.

Head, length .28 mm., width .44 mm.; rather elongate for *Menopon*, with distinct ocular emarginations; rounded

in front, with a few short hairs; two longer hairs (one longer than the other) in front of emargination; ocular fringe distinct; temporal margin with four long hairs, of which two are very long, and a few shorter hairs; occipital margin concave, straight in the middle; palpi projecting slightly; occipital margin narrowly bordered with black; temples clouded; a curving, blackish brown, ocular blotch, and in front of its anterior end a small, blackish brown, submarginal blotch.

Prothorax short, broad, the lateral angle being but little produced, with two short strong spines and no hair, and the posterior angles very obtuse, hardly apparent; the posterior margins flatly convex, with six short strong hairs; segment without distinct colored blotches or border; the transverse chitin bar slender, inconspicuous. Metathorax with fine but distinct suture, separating mesothorax; just behind the suture a transverse series of a few very small spines; posterior angles of metathorax with three spines and a hair, two of the spines projecting laterally, the other spine and hair projecting posteriorly; posterior margin straight, with a marginal series of hairs; the posterior angles of the segment are obtuse and project laterally conspicuously beyond the abdomen. Legs concolorous with body, with ill-defined marginal markings.

Abdomen short, elliptical, lateral margins projecting but little; posterior angles with two short, strong, distinct spines, and usually with a long hair; a broad transverse brown band entirely across each segment, paler in middle, darker at lateral extremities so as to form broad, dark, lateral bands; the sutures broad, uncolored; last segment with uncolored posterior border, flatly convex or almost straight, with a few short hairs, and at each side a long, strong, prominent hair.

Female. Body, length 1.34 mm., width .5 mm.; head, length .31 mm., width .44 mm.; thus being little larger than the male; the posterior margin of last abdominal segment is uncolored, more convex than in the male, and bears a fringe of short, fine, transparent hairs.

Menopon longicephalum n. sp. (Plate lxxiii, fig. 4.)

One male and one female taken from a domestic Pigeon, *Columba livia* (Lawrence, Kansas). Not at all like the uncommon but long known *Menopon* of the Pigeon, *giganteum*, Denny (Anoplur. Brit., p. 225, pl. xxi, fig. 2), or *latum*, Piaget (Les Pediculines, p. 457, pl. xxxvii, fig. 1), but an elongate slender form with head nearly two thirds as long as wide, much like *brevipes*, Piaget (Supplement, 1885, p. 110, pl. xii, fig. 1), from *Crossoptilon mantschuricum*, or *triseriatum*, Piaget (Les Pediculines, p. 460, pl. xxxvii, fig. 3), from *Gallus bankiva*.

Description of male. Body, length 1.5 mm., width .66 mm.; elongate, with narrow tapering head and narrow tapering posterior region of abdomen; whitish, with translucent lateral bands and with inconspicuous head markings.

Head, length .31 mm., width .47 mm.; thus being elongate and narrow for *Menopon*; front parabolic, with one short hair on each side in front of slightly projecting palpi, and one long hair and two short in front of the shallow ocular signature; emargination with ocular fringe running slightly on temporal margin; temples protruding but little laterally, and with one long hair and three short ones; occipital margin weakly concave, with a few hairs of different lengths; small, black, ocular fleck and pale, clear, brownish coloration at side of and behind mandibles.

Prothorax short, broad, with produced lateral angles with a spine in each angle, and a series of fourteen strong, sharply pointed hairs along the convex posterior margin; no blotches. Metathorax short, broad; lateral margin with two or three spines, angles with a hair and nearly straight posterior margin with a series of hairs weaker than those of the prothorax. Legs pale, concolorous with body, with short stiff hairs on femora and tibiae.

Abdomen elliptical, narrow at both ends, with numerous strong hairs in posterior angles of segments and on lateral margins; numerous hairs on dorsal surface; whole abdomen whitish, with narrow, clear, lateral bands, with lateral processes projecting inward from anterior angles of each segment; last segment uncolored, parabolic, with four hairs on posterior margin, two near each end and none in the middle.

Female. Body, length 1.6 mm., width .69 mm.; head, length .31 mm., width .47 mm.; abdomen elongate-ovate, tapering at posterior end, the last segment uncolored, narrowly rounded behind, with a fringe of fine uncolored hairs along posterior margin.

Menopon dissimile n. sp. (Plate lxxiii, fig. 5.)

One male, one female, and one immature specimen, from the Purple Martin, *Progne subis* (Lawrence, Kansas), resembling somewhat *M. rusticum*, Giebel (Insecta Epizoa, p. 288), from *Hirundo rustica* and *H. riparia*, but more than a third larger, without the well marked antennae and ocular bands of *rusticum*, and with spines and hairs on the prothorax, which is bare in *rusticum*. This species and *rusticum* present a *Menopon* type which in the shape and character of the head and thorax and in the sternal markings approaches *Nitzschia*.

Description of the male. Body, length 1.8 mm., width .62 mm.; pale, clear, yellowish brown, with small black ocular flecks, slightly darker thorax, indistinctly indicated lateral bands, parallel inner longitudinal bands, and numerous short, stiff, spiny hairs on dorsal surface of abdomen.

Head, length .35 mm., width .55 mm.; not so much wider than long as usual in *Menopon*; forehead or region in front of ocular emargination long; front flatly rounded, with a few short hairs and two longish ones, one longer than the other on a slight swelling in front of the ocular emargination; the ocular fringe distinct, composed of curving, stiff hairs; temples with anterior angles somewhat produced, and four long and two or three short hairs on the margin; small black ocular flecks; weakly colored, translucent, narrow, curving, ocular blotches, and a weakly colored region outside of each mandible; occipital margin medially, narrowly, weakly colored, translucent, with two short median hairs and a shorter one at each side of these two.

Prothorax hexagonal, almost as long as broad, the lateral anterior sides short, the lateral angles obtuse, but little produced, with two spines and a short, stiff hair; posterior margin slightly angulated in the middle, and with six longish hairs, the terminal one being in the posterior angles of the segment; whole segment slightly darker than the head, with short, transverse, uncolored, chitin bar. Metathorax with lateral emargination and faint sutural line between meso- and metasegments; lateral margins bare; posterior angles with two spines and the terminal one of a series of submarginal hairs which are ranged along the straight or very weakly convex posterior margin; anterior angles and lateral margin slightly darker, but otherwise the whole segment concolorous with prothorax.

Legs with weakly colored, translucent, dorsal margins on femora and tibiae; anterior coxae with bluntly conical processes. Sternal markings ill-defined but apparently composed of longitudinal and transversal narrow bands without median blotches.

Abdomen elongate-elliptical, slightly turbinate, with a strong hair in each posterior angle and a few short hairs along the lateral margins of the segments; dorsal surface with a regular row of short, sharp, spiny hairs on the posterior margin of each segment; on segment 1 no other dorsal hairs; on segment 2 an additional single irregular row across the segment, and on segments 3-8 two additional irregular rows; last segment without rows of short spiny hairs, rounded behind, with four long hairs in lateral groups of two each, and posterior margin with four short, fine hairs; segment 8 has two long conspicuous hairs rising one in the middle of each lateral half of the posterior margin; genitalia of the usual *Menopon* type, an unpaired, long, strong, longitudinal bar with two strong, diverging prongs at posterior angle; ventral surface of abdomen possesses, in addition to transverse rows, groups of short spiny hairs near each lateral margin; on the posterior margin of segment 2 there are a few, four to six, very strong spines in two lateral groups; color of abdomen same as that of head and legs, with narrow, translucent, lateral bands, having two short, rounded, inward-projecting processes in each segment; in addition there is a second inner, narrow, regular, lateral band parallel with the outer margin.

Female. Body, length 2.16 mm., width .81 mm.; head, length .34 mm., width .56 mm.; darker, without second inner lateral band, and with the inward-projecting process of the outer or true lateral band shorter, but the band distinctly darker colored than rest of body, although

subtranslucent; metathorax also with distinct dark subtranslucent lateral bands; dorsal surface of abdomen without short spiny hairs, and with a few longer weak hairs arranged in complete transverse rows on segments 1-3, but decreasing in number on posterior segments; last segment with posterior margin rounded about as in male, but with fringe of closely set, short, weak, finely pointed hairs; ventral surface of abdomen with the lateral groups of short spiny hairs as in male.

Menopon mesoleucum Nitzch. (Plate lxxiii, fig. 3.)

Germer's Mag. Entomol., 1818, vol. iii, p. 300.

Ricinus cornicis De Geer, Mem. Ins., 1778, vol. vii, pl. 4, fig. 11.

Menopon mesoleucum N., Burmeister, Handb. f. Ent., 1835, vol. ii, p.

439; Giebel, Zeitschr. f. ges. Naturwiss., 1866, vol. xxvii, p. 119;

ibid, Insecta Epizoa, 1874, p. 281, pl. xiv, figs. 11, 12; Piaget,

Les Pediculines, 1880, p. 426, pl. xxxiv, p. 7.

A large variety of this species from the American Crow, *Corvus americanus* (specimens from Lawrence, Kansas, and Palo Alto, California). Nitzsch's type-specimens were taken from *Corvus cornix* and *C. corone*. The American specimens are uniformly larger than the type-form (length of *mesoleucum*, male 1.4 mm., female 1.8 mm.; length of var. *americanum*, male 1.7 mm., female 2.12 mm.), and vary from the descriptions of Giebel and Piaget in various particulars.

Var. *americanum* Kellogg. Males, females and young from the American Crow, *Corvus americanus* (Lawrence, Kansas, and Palo Alto, California). Male. Body, length 1.7 mm., width .7 mm.; head, length .34 mm., width .6 mm. Female. Body, length 2.12 mm., width .75 mm.; head, length .37 mm., width .69 mm.

The species may be readily recognized by the marked difference in the sexes, the female having the metathorax produced backward and angulated on the abdomen

(straight in the male), and with the transverse abdominal blotches of the first three or four segments broken in the middle and the lateral parts projecting diagonally inward and backward; in the male the blotches run evenly across the segments. I figure the male.

Nitzschia dubius n. sp. (Plate lxxiii, fig. 6.)

A few specimens from the Chimney Swift, *Chaturapelasgica* (Lawrence, Kansas). Much like *Nitzschia pulicaris*, Nitzsch, from the European Swift, *Cypselus apus*, but differs in lacking the pustulated hairs of temples and abdomen, and in the shape of the metathorax. The specimens are in poor condition and permit of only an unsatisfactory description.

Body, length 2.22 mm., width .88 mm.; elongate, with narrow neck-like prothorax; expanded posterior portion of abdomen with numerous very long hairs; head, thorax and legs pale, abdomen much darker.

Head, length .41 mm., width .72 mm.; shape of head of *pulicaris*, that is, triangular, with rounded front, a shallow concavity of the margin where the palpi project, a shallow ocular emargination, with conspicuous ocular fringe and expanded temples, the margins angulated in front and behind; the margin of forehead with six hairs on each side, the third and sixth being long; the temporal margins with four long hairs weakly pustulated, and a few very short hairs or spines; occipital margin concave, straight in middle, with four longish hairs; ground color pale tawny, with very small, black, ocular flecks, weakly colored, small, brownish, ocular blotches, strongly colored mandibles, and a weakly colored region outside of each mandible.

Prothorax subquadrangular, with shortly produced rectangular angles in lateral margins before the middle, each

angle with two spines and a hair; posterior angles rounded and the nearly straight, slightly sinuous, posterior margin with six weak hairs; a weakly indicated, uncolored, transverse, chitin bar about even with lateral angles; no distinct blotches. Meso- and metathorax fused, although the line of fusion is marked by a lateral emargination and by an indicated transverse suture; posterior angles of metathorax with two spines and a hair; the straight posterior margin with a submarginal series of short and longer hairs interrupted at the middle; on the dorsal surface of the metasegment six short spines arranged in two diagonal series of three each. Legs long, slender, concolorous with thorax, with fringes of short hairs along dorsal margins of femora and tibiae. Sternal markings weakly indicated but of the type described as characteristic of *Nitzschia*, consisting essentially of an open quadrilateral without median blotches.

Abdomen widening posteriorly to segment 6; segment 7 a little narrower than segment 6, and segments 8 and 9 narrowing more rapidly; all segments with two to three spines in posterior angles and long hairs, increasing in length and number on posterior segments, those on segments 6-9 being especially long, numerous, and hence conspicuous; segment 9 short, flatly convex behind, with two very long hairs at each end of posterior margin and a sparse fringe of five uncolored hairs along the margin; narrow, translucent, brownish, lateral bands, and the whole abdomen dark, because crossed by broad transverse bands, almost completely covering the surface: posterior margin of each segment with a series of weak hairs.

DISTRIBUTION.

Concerning the distribution of the Mallophaga, I have little to add to the remarks made in my previous paper. Among the land birds of America there are very few which are identical with the Old World species. On those are found parasites identical, or nearly so, with the Old World Mallophaga of the same hosts. On the domestic pigeon, *Columba livia*, I find *Lipeurus baculus* and *Goniocotes compar*, both common on the European individuals of the same host species. In addition, I find a *Menopon* on the pigeon not met with by the European authors. On the Snow Owl, *Nyctea nyctea*, I find *Docophoros ceblebrachys*, described by Nitzsch from the same host. And there are a few other similar examples.

As among the water birds, where I have found previously described Mallophaga on American birds not identical with Old World species, these parasites have been found, almost always, on American birds very closely related to the European hosts. For example, the characteristic *Docophorus rostratus* Nitzsch, of the European Barn Owl, *Strix flammea*, I have found on the American Barn Owl, *Strix pratincola*. It is of interest to note that the American owl has been until recently ranked as a variety simply of the European species. The striking *Menopon mesoleucum* of the various Old World crows (*Corvus corone*, *frugilegus*, et al.), is found on the American Crow, *Corvus americanus*, though showing such constant differences as to compel me to give it a varietal name. There are several other examples of this condition presented in this paper.

Apparent exceptions to the general statement that American Mallophaga identical with Old World species are found on American hosts identical with or very nearly

related to Old World hosts, are presented by *Docophorus communis* and *Nirmus fuscus*. These two parasite species are found, common, in one case, to many passerine birds, and in the other, to several raptorial birds, which differ generically from the Old World hosts. It will be noted, however, that both of these species have a wide range of hosts in both Europe and America. The fact is that we have to do here, in each case, with a group of closely allied, insensibly gradating forms, rather than with a single well marked Mallophagous species. That this condition has been recognized by the European authors is shown in the cases of both *Docophorus communis* and *Nirmus fuscus*, by the attempts which have been made by Giebel and Piaget to break up these species into several distinct species (Giebel), or into subspecies (Piaget).

Finally with regard to the constant or occasional appearance of the parasites on the hosts, I can add also but little. In the preparation of this paper I have had no such long series of specimens of one bird species as it was my privilege to have of certain species of maritime birds. As an illustration of the varying degrees of prevalence of different parasite species infesting a single bird species, the parasites of *Carpodacus mexicanus frontalis*, the House Finch, may be referred to. Of nine specimens of this bird species examined, six were infested by *Docophorus communis*, four by *Nirmus vulgatus*, and one by *Physostomum microcephalum*. Of three specimens examined of the closely related *Carpodacus purpureus californicus*, the California Purple Finch, *Docophorus communis* was found on each, but no *Nirmus* nor *Physostomum* on any. *Physostomum* as a parasite, however, is not always uncommon on its host, as the case of *Physostomum diffusum*, found on five out of seven specimens of *Melospiza fasciata samuelis*, attests.

Comparing the land birds with the water birds as hosts for Mallophaga, I find that many more individuals among land birds than among water birds are free from parasites, and that among the infested birds the number of individuals of Mallophaga on a single bird individual is much greater among the water bird species than among the land bird species. It is noticeable that the larger land birds such as hawks and grouse show many more parasites than the smaller birds; and to some extent the greater abundance of parasites on water birds may be due to their distinctly larger average size as compared with land birds.

LIST OF HOSTS AND PARASITES.

<i>Colinus virginanus</i> .	<i>Halimæetus leucocephalus</i> .
<i>Lipeurus dissimilis</i> .	<i>Nirmus discocephalus</i> var. <i>amblyus</i> .
<i>Callipepla californica</i> .	<i>Colpocephalum flavescens</i> .
<i>Lipeurus docophoroides</i> .	<i>Bubo virginianus</i> .
<i>Goniodes mammillatus</i> .	<i>Docophorus cursor</i> .
<i>Phasianus nythemerus</i> .	<i>Nyctea nyctea</i> .
<i>Lipeurus introductus</i> .	<i>Docophorus ceblebrachys</i> .
<i>Goniodes cervinicornis</i> .	<i>Strix pratincola</i> .
<i>Goniocotes creber</i> .	<i>Docophorus rostratus</i> .
<i>Menopon monostochum</i> .	<i>Dryobates pubescens</i> .
<i>Columba livia</i> .	<i>Docophorus evagans</i> .
<i>Lipeurus baculus</i> .	<i>Melanerpes formicivorus bairdi</i> .
<i>Goniocotes compar</i> .	<i>Docophorus californiensis</i> .
<i>Menopon longicephalum</i> .	<i>Colaptes auratus</i> .
<i>Elanus leucurus</i> .	<i>Docophorus alienus</i> .
<i>Colpocephalum osborni</i> .	<i>jugens</i> .
<i>Menopon decoratum</i> .	<i>Chordeiles virginianus henryi</i> .
<i>Circus hudsonius</i> .	<i>Lipeurus macrocephalus</i> .
<i>Nirmus fuscus</i> .	<i>Chaetura pelagica</i> .
<i>Buteo swainsoni</i> .	<i>Nitzschia dubius</i> .
<i>Nirmus fuscus</i> .	<i>Trochilus anna</i> .
<i>Archibuteo lagopus sancti-johannis</i> .	<i>Nirmus eustigmus</i> .
<i>Docophorus taurocephalus</i> .	<i>Trochilus rufus</i> .
<i>Nirmus fuscus</i> .	<i>Nirmus snodgrassi</i> .
<i>Colpocephalum flavescens</i> .	

<i>Tyrannus tyrannus</i> .	<i>Zonotrichia gambeli</i> .
<i>Physostomum angulatum</i> .	<i>Nirmus vulgatus</i> .
<i>Empidonax difficilis</i> .	<i>Junco hyemalis</i> .
<i>Physostomum sucinaceum</i> .	<i>Docophorus communis</i> .
<i>Otocoris alpestris</i> .	<i>Nirmus vulgatus</i> .
<i>Docophorus communis</i> .	<i>Physostomum diffusum</i> var. <i>pallidum</i> .
<i>Corvus corax sinuatus</i> .	<i>Melospiza fasciata samuelis</i> .
<i>Docophorus distinctus</i> .	<i>Physostomum diffusum</i> .
<i>Corvus americanus</i> .	<i>Colpocephalum chrysophaeum</i> .
<i>Docophorus atratus</i> .	<i>Passerella iliaca</i> .
<i>Menopon mesoleucum</i> var. <i>americanum</i> .	<i>Physostomum angulatum</i> .
<i>Colpocephalum subaequale</i> .	<i>Pipilo erythrophthalmus</i> .
<i>Molothrus ater</i> .	<i>Menopon melanorum</i> .
<i>Docophorus transpositus</i> .	<i>Pipilo fuscus crissalis</i> .
<i>Agelaius phoeniceus</i> .	<i>Nirmus vulgatus</i> .
<i>Docophorus communis</i> .	<i>Pipilo maculatus megalonyx</i> .
<i>Nirmus illustris</i> .	<i>Nirmus vulgatus</i> .
<i>Sturnella magna neglecta</i> .	<i>Cardinalis cardinalis</i> .
<i>Docophorus communis</i> .	<i>Docophorus communis</i> .
<i>Icterus bullocki</i> .	<i>Passerina versicolor</i> .
<i>Docophorus communis</i> .	<i>Physostomum australe</i> .
<i>Carpodacus purpureus californicus</i> .	<i>Progne subis</i> .
<i>Docophorus communis</i> .	<i>Docophorus domesticus</i> .
<i>Nirmus vulgatus</i> .	<i>Menopon dissimile</i> .
<i>Carpodacus mexicanus frontalis</i> .	<i>Petrochelidon lunifrons</i> .
<i>Docophorus communis</i> .	<i>Docophorus excisus</i> var. <i>major</i> .
<i>Nirmus vulgatus</i> .	<i>Nirmus longus</i> .
<i>Physostomum microcephalum</i> .	<i>Tachycineta bicolor</i> .
<i>Spinus tristis</i> .	<i>Docophorus excisus</i> var. <i>major</i> .
<i>Menopon incertum</i> .	<i>Nirmus longus</i> .
<i>Spinus psaltria</i> .	<i>Ampelis garrulus</i> .
<i>Docophorus communis</i> .	<i>Docophorus communis</i> .
<i>Spinus pinus</i> .	<i>Ampelis cedrorum</i> .
<i>Docophorus communis</i> .	<i>Docophorus incisus</i> .
<i>Calcarius lapponicus</i> .	<i>Lanius ludovicianus excubitorides</i> .
<i>Docophorus communis</i> .	<i>Docophorus communis</i> .
<i>Ammodramus sandwichensis</i> .	<i>Harporhynchus rufus</i> .
<i>Docophorus communis</i> .	<i>Docophorus communis</i> .
<i>Physostomum diffusum</i> .	<i>Psaltriparus minimus</i> .
<i>Zonotrichia coronata</i> .	<i>Colpocephalum fumidum</i> .
<i>Nirmus vulgatus</i> .	<i>Menopon robustum</i> .
<i>Physostomum diffusum</i> .	

<i>Turdus ustulatus.</i>	<i>Sialia sialis.</i>
<i>Menopon incertum.</i>	<i>Docophorus incisus.</i>
<i>Merula migratoria.</i>	
<i>Docophorus communis.</i>	
<i>Nirmus vulgatus.</i>	
simplex.	

EXPLANATION OF PLATES.

PLATE LX.—Fig. 1, Head of *Colpocephalum flavescens*, under side; *a* labrum, *b* labial palpi, *c* maxillary palpi, *d* antennæ (after Nitzsch). Fig. 2, Maxilla of *Trinotum conspurcatum* (after Nitzsch). Fig. 3, Labium of *Trinotum conspurcatum* (after Nitzsch). Fig. 4, Labium of *Tetrophthalmus chilensis* [*Menopon titan*]; *m* mentum, *pl* labial palpus, *g* glossa, *pg* paraglossa, *hy* hypopharynx (after Grosse). Fig. 5, Labium of a *Nirmus*; *g* glossa, *pg* paraglossa (after Grosse). Fig. 6, Head, ventral aspect, with median part of labium cut away, of *Ancistrona gigas*; *lb* labrum, *md* mandible, *lp* labial palpus, *hy* hypopharynx, *fk* labial fork, *af* antennary fossa. Fig. 7, Labium, ventral aspect, of *Ancistrona gigas*; *sm* submentum, *m* mentum, *pr* labial prong, *p* palpifer, *lp* labial palpus, *lig* ligula, *g* glossa, *pg* paraglossa. Fig. 8, Maxilla of *Ancistrona gigas*. Fig. 9, Right mandible, ventral aspect, of *Ancistrona gigas*; *ten* tendon, *mus* muscle, *vch r* ventral chitinous rod, *dch r* dorsal chitinous rod. Fig. 10, Mandibles, ventral aspect, of *Ancistrona gigas*; *c* condyles, *r* right mandible, *l* left mandible. Fig. 11, Hypopharynx of *Ancistrona gigas*. Fig. 12, Left labial fork, ventral aspect, of *Ancistrona gigas*; *mus* muscle.

PLATE LXI.—Fig. 1, Head, ventral aspect, of *Læmbothrium* sp.; *sm* submentum, *m* mentum, *ant* antenna, *clyp* clypeus, *lb* labrum, *md* mandible, *mx* maxilla, *g* glossa, *pg* paraglossa, *lp* labial palpus. Fig. 2, Mandibles, ventral aspect, of *Læmbothrium* sp.; *c* condyles, *r* right mandible, *l* left mandible. Fig. 3, Right maxilla, ventral aspect, of *Læmbothrium* sp. Fig. 4, Labium, ventral aspect, of *Læmbothrium* sp.; *sm* submentum, *m* mentum, *g* glossa, *pg* paraglossa, *pf* palpifer, *lp* labial palpus. Fig. 5, Labial glands of *Læmbothrium* sp. Fig. 6, Left maxilla, ventral aspect, of *Goniodes cervinicornis*. Fig. 7, Labium, ventral aspect, of *Goniodes cervinicornis*; *g* glossa, *pg* paraglossa. Fig. 8, Mandibles, posterior aspect, of *Goniodes cervinicornis*. Fig. 9, Right mandible, posterior aspect, of *Goniodes cervinicornis*; *c* condyle, *ch pls* chitinous plates.

PLATE LXII.—Fig. 1, Head, ventral aspect, with labium represented as transparent, of *Eurymetopus taurus*; *ant* antenna, *tr* trabecula, *md* mandible, *clyp* clypeus, *g* glossa, *pg* paraglossa, *æs* œsophageal sclerite, *lg* "lingual gland." Fig. 2, œsophageal sclerite, dorsal aspect, of *Eurymetopus taurus*; *d* duct, *do* opening of duct, *mg* middle groove, *ant h* anterior horn, *bs* "bonnet string." Fig. 3, œsophageal sclerite, lateral

aspect, of *Eurymetopus taurus*; *ant h* anterior horn, *bs* "bonnet string." Fig. 4, Right maxilla, ventral aspect, of *Eurymetopus taurus*. Fig. 5, Mandibles, ventral aspect of *Eurymetopus taurus*; *c* condyles, *r* right mandible, *l* left mandible. Fig. 6, Labium, ventral aspect, of *Eurymetopus taurus*; *sm* submentum, *m* mentum, *g* glossa, *pg* paraglossa. Fig. 7, "Lingual gland," ventral aspect, of *Eurymetopus taurus*; *d* duct, *æs* œsophageal sclerite, *ch ped* chitinous pedicle. Fig. 8, Left "lingual gland," ventral aspect, of *Eurymetopus taurus*; *d* duct, *ch ped* chitinous pedicle, *mus* muscle, *lg* the gland.

PLATE LXIII.—Fig. 1, Labium of *Colpocephalum* sp.; *sm* submentum, *m* mentum, *pf* palpifer, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 2, Labium of *Trinoton luridum*; *sm* submentum, *m* mentum, *pf* palpifer, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 3, Labium of *Nirmus* sp.; *sm* submentum, *m* mentum, *g* glossa, *pg* paraglossa. Fig. 4, Mandibles, ventral aspect, of *Menopon titan*; *c* condyles, *r* right mandible, *l* left mandible. Fig. 5, Labium of *Physostomum angulatum*; *sm* submentum, *m* mentum, *pf* palpifer, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 6, Labium of *Nitzschia dubius*; *sm* submentum, *m* mentum, *pf* palpifer, *lp* labial palpus, *g* glossa, *pg* paraglossa.

PLATE LXIV.—Fig. 1, Labium of *Termopsis angusticollis*; *sm* submentum, *m* mentum, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 2, Maxilla of *Termopsis angusticollis*; *cd* cardo, *st* stipes, *pf* palpifer, *lac* lacinia, *gal* galea, *mx p* maxillary palpus. Fig. 3, Labium of nymph of *Perla*; *sm* submentum, *m* mentum, *lp* labial palpus, *g* glossa, *pg* paraglossa. Fig. 4, Maxilla of nymph of *Perla*; *cd* cardo, *st* stipes, *lac* lacinia, *gal* galea, *mx p* maxillary palpus. Fig. 5, Head, ventral aspect, of *Atropos* sp.; *sm* submentum, *m* mentum, *mx* maxilla, *mx p* maxillary palpus, *md* mandible, *clyp* clypeus, *lb* labrum, *g* glossa, *pg* paraglossa, *fk* fork. Fig. 6, Mandibles of *Atropos* sp.; *c* condyles, *r* right mandible, *l* left mandible. Fig. 7, Head, dorsal aspect, of *Atropos* sp.; *clyp* clypeus, *ant* antenna, *æs* œsophageal sclerite. Fig. 8, Mandible and mandibular muscles of *Psocus* sp.; *fm* flexor muscle, *em* extensor muscle, *m* molar face of mandible (after Burgess). Fig. 9, Longitudinal section through middle of head of *Psocus* sp.; "cl clypeus, *l* labrum, *mand* mandible, the dotted line ending on the ribbed molar surface which tapers beneath into the sharp cutting edge; *mx* maxilla, *t* tongue, *f* fork, *lb* labium and *lp* its palpus, *m* mentum, *lg* lingual gland and *gm* its suspensory muscle, *æ* œsophagus opening below into the oral cavity at the base of which is the œsophageal bone, *æ b*; *fm* flexor muscle of the mandible and *lm* the muscle of the labrum, *c m* muscles of the clypeus, *gl* supra-œsophageal ganglion" (after Burgess). Fig. 10, Labium, posterior aspect, of *Psocus* sp.; "m mentum, *lb* labium, *lp* one-jointed labial palpus, behind which one sees the tip of the fork, *f*; *c* cardo, *p* stipes having the four-jointed

maxillary palpus, *m x* lobe; through the mentum can be seen the lingual glands, *lg*, with their duct, *ld*" (after Burgess). Fig. 11, (Esophageal sclerite ("subesophageal bone"), frontal aspect, of *Psocus* sp.; *ld* duct of the lingual gland (after Burgess).

PLATE LXV.—Fig. 1, *Docophorus taurocephalus* Kellogg, ♂. Fig. 2, *D. alicinus* Kellogg, ♂. Fig. 3, *D. incisus* Kellogg, ♂. Fig. 4, *D. domesticus* Kellogg, ♂. Fig. 5, *D. distinctus* Kellogg, ♂. Fig. 6, *D. transpositus* Kellogg, ♀.

PLATE LXVI.—Fig. 1, *Docophorus cursor* N., ♀. Fig. 2, *D. evagans* Kellogg, ♀. Fig. 3, *D. cehlebrachys* N., ♂. Fig. 4, *D. jungens* Kellogg, ♀. Fig. 5, *D. rostratus* N., ♀. Fig. 6, *D. californiensis* Kellogg, ♂. Fig. 7, *D. communis* N., ♀.

PLATE LXVII.—Fig. 1, *Nirmus longus* Kellogg, ♀. Fig. 2, *N. simplex* Kellogg, ♀. Fig. 3, *N. eustigmus* Kellogg, ♀. Fig. 4, *N. illustris* Kellogg, ♂. Fig. 5, *N. vulgaris* Kellogg, ♀. Fig. 6, *N. discocephalus* var. *amblyus* Kellogg, ♀. Fig. 7, *N. fuscus* N., ♀.

PLATE LXVIII.—Fig. 1, *Lipeurus introductus* Kellogg, ♀. Fig. 2, *L. snodgrassi* Kellogg, ♀. Fig. 3, *L. macrocephalus* Kellogg, ♀. Fig. 4, *L. baculus* N., head of ♂. Fig. 5, *L. introductus* Kellogg, head of ♂. Fig. 6, *L. baculus* N., ♀. Fig. 7, *L. dissimilis* P., head of ♀. Fig. 8, *L. docophoroides* P., ♀.

PLATE LXIX.—Fig. 1, *Goniodes cervicornis* G., ♀. Fig. 2, *Goniodes mammillatus* Rudow, ♀. Fig. 3, *Goniocotes creber* Kellogg, ♀. Fig. 4, *Goniocotes compar* N., ♂.

PLATE LXX.—Fig. 1, *Physostomum microcephalum* Kellogg, ♀. Fig. 2, *P. sucinaceum* Kellogg, ♀. Fig. 3, *P. diffusum* Kellogg, ♀. Fig. 4, *P. australe* Kellogg, ♀. Fig. 5, *P. angulatum* Kellogg, ♀.

PLATE LXXI.—Fig. 1, *Colpocephalum chrysophæum* Kellogg, ♀. Fig. 2, *C. osborni* Kellogg, ♂. Fig. 3, *C. osborni* Kellogg, abdomen of ♀. Fig. 4, *C. flavescens* N., ♂. Fig. 5, *C. fumidum* Kellogg, ♀.

PLATE LXXII.—Fig. 1, *Colpocephalum subæquale* N., ♀. Fig. 2, *Menopon decoratum* Kellogg, ♂. Fig. 3, *M. robustum* Kellogg, ♀. Fig. 4, *M. monostachum* Kellogg, ♂.

PLATE LXXIII.—Fig. 1, *Menopon melanorum* Kellogg, ♀. Fig. 2, *M. incertum* Kellogg, ♀. Fig. 3, *M. mesoleucum* N., ♂. Fig. 4, *M. longicephalum* Kellogg, ♀. Fig. 5, *M. dissimile* Kellogg, ♀. Fig. 6, *Nitzschia dubius* Kellogg, ♂ or ♀?

LIST OF FISHES COLLECTED AT PORT LUDLOW, WASHINGTON.*

BY EDWIN CHAPIN STARKS.

(With Plates lxxiv and lxxv.)

This paper records the ichthyological results of the last annual dredging expedition made by the Young Naturalists' Association of Seattle, Washington, and the second in which the author, as an honorary member, has taken part. A camp was established this year near Port Ludlow, on Puget Sound, and all the dredging and other collecting was done in that vicinity.

The report of last year† recorded 141 species known from that region. Five new species and four others hitherto unrecorded are listed in the present paper.

The author wishes to express his indebtedness to Dr. Charles H. Gilbert, whose interest and aid made his work possible.

The following species are described here as new to science. The number after each is the number of the type on the register of the Leland Stanford Jr. University Museum. The new genus is indicated by full face type.

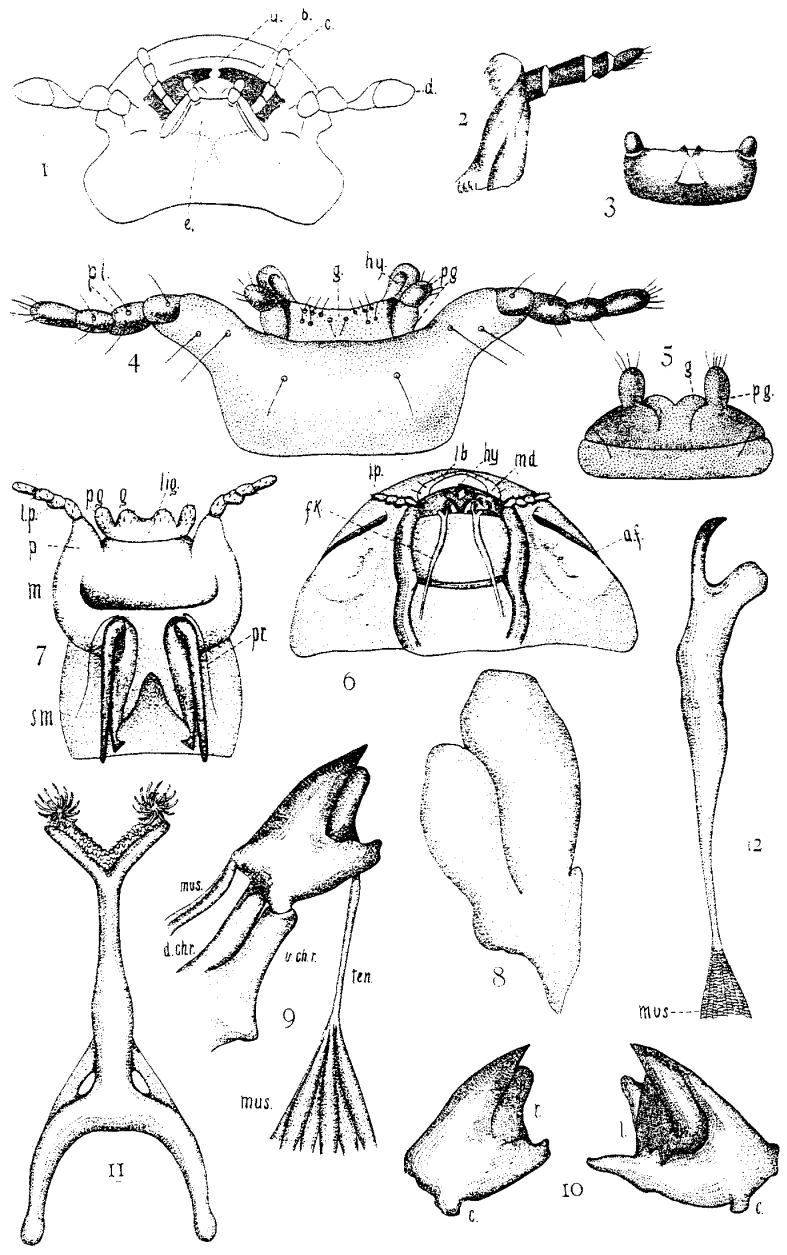
Neoliparis fissuratus. No. 5044.
Artedius asperulus. No. 5046.
Axyrias harringtoni. No. 5047.
Icelinus strabo. No. 5045.
Pallasina aix. No. 5040.

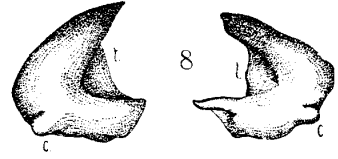
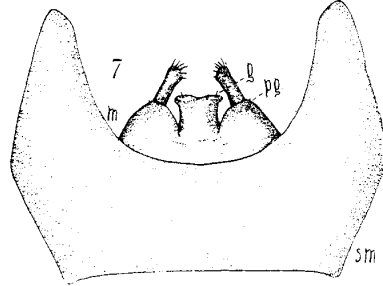
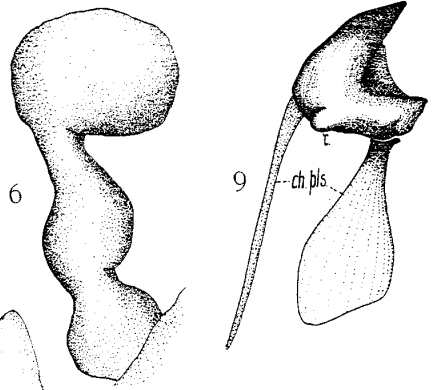
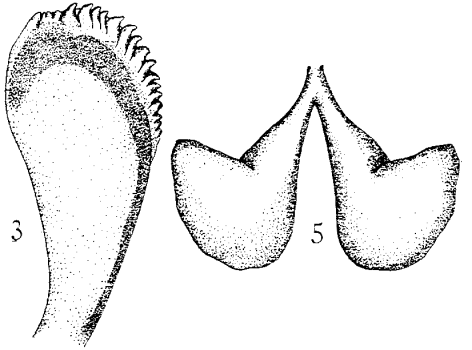
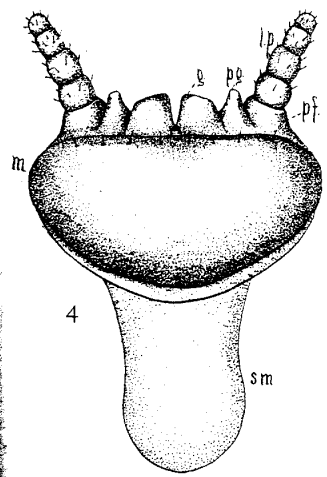
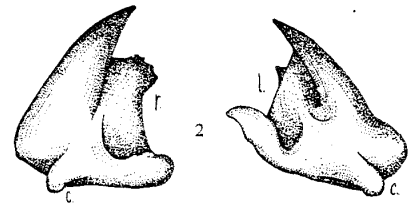
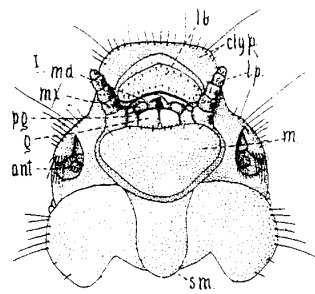
Family SQUALIDÆ.

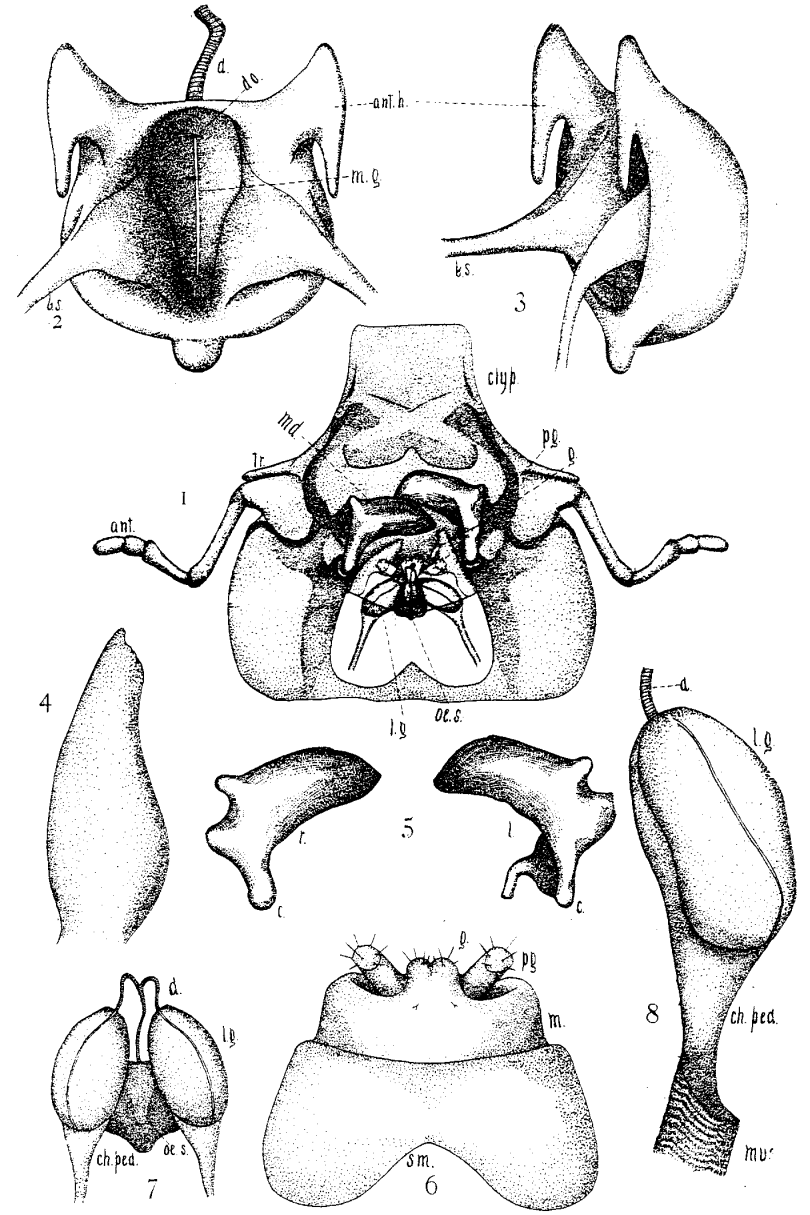
1. *Squalus sucklii* (Girard).

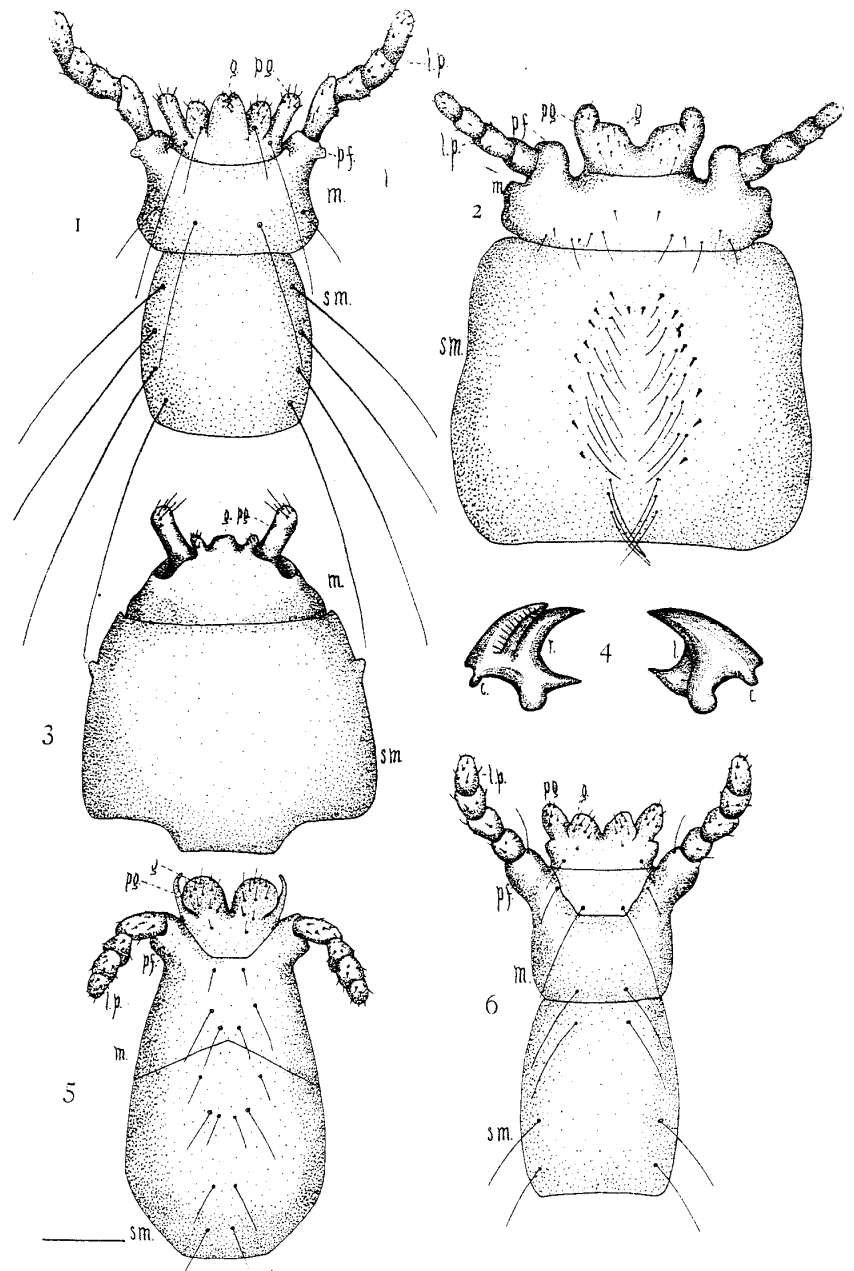
*Contributions to Biology from the Hopkins Seaside Laboratory of the Leland Stanford Jr. University, No. 8.

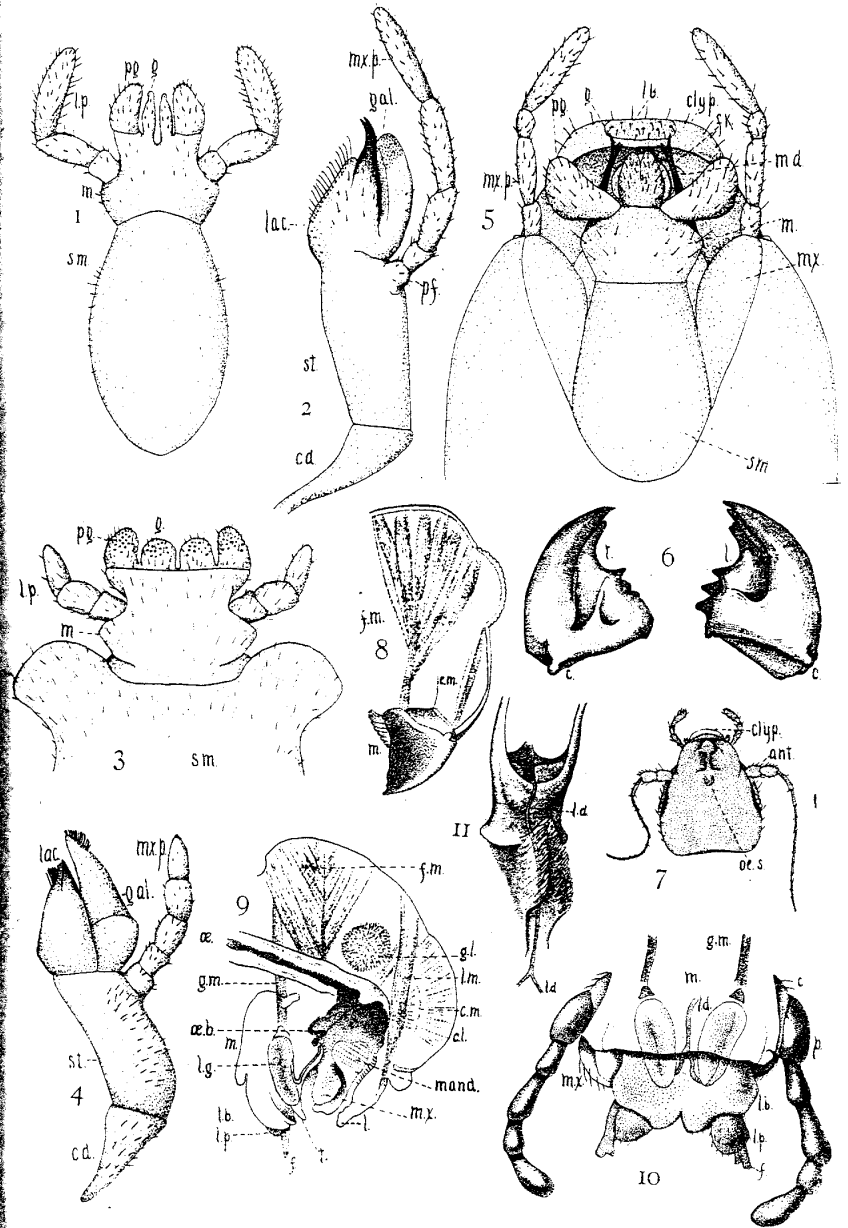
†"The Fishes of Puget Sound," Jordan & Starks, Proc. Cal. Acad. Sci., 2d Ser., Vol. v, 1895.

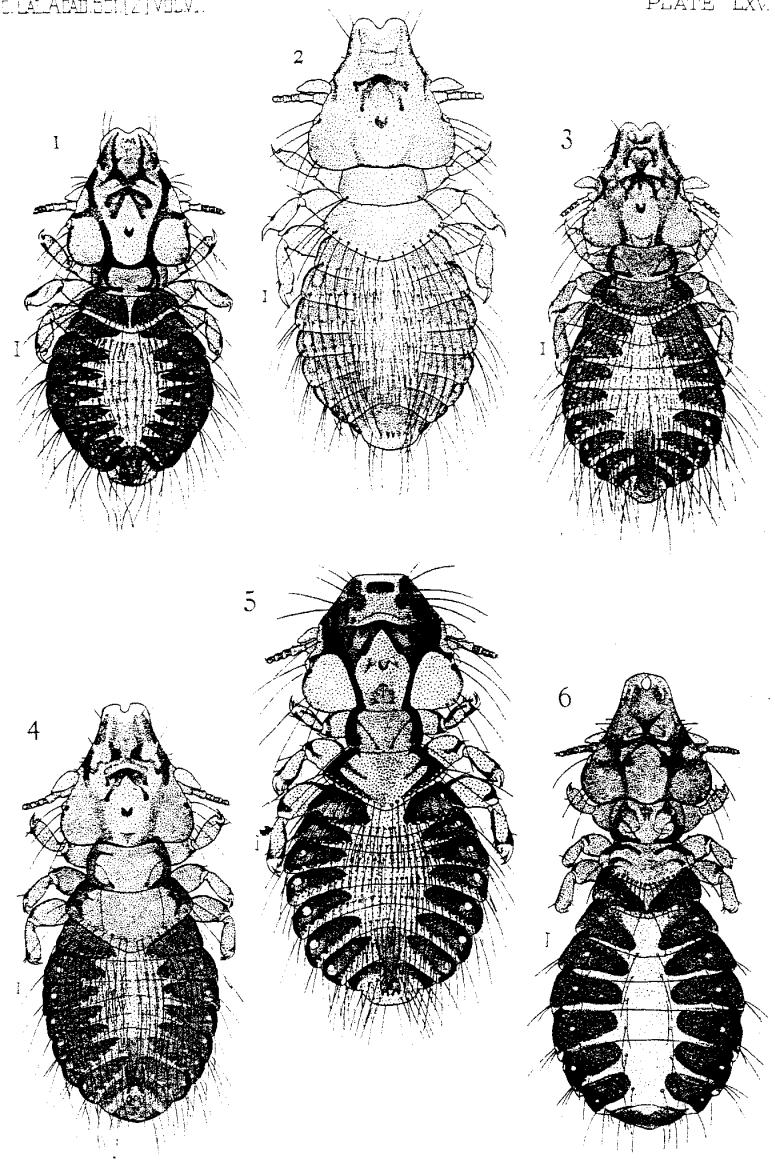


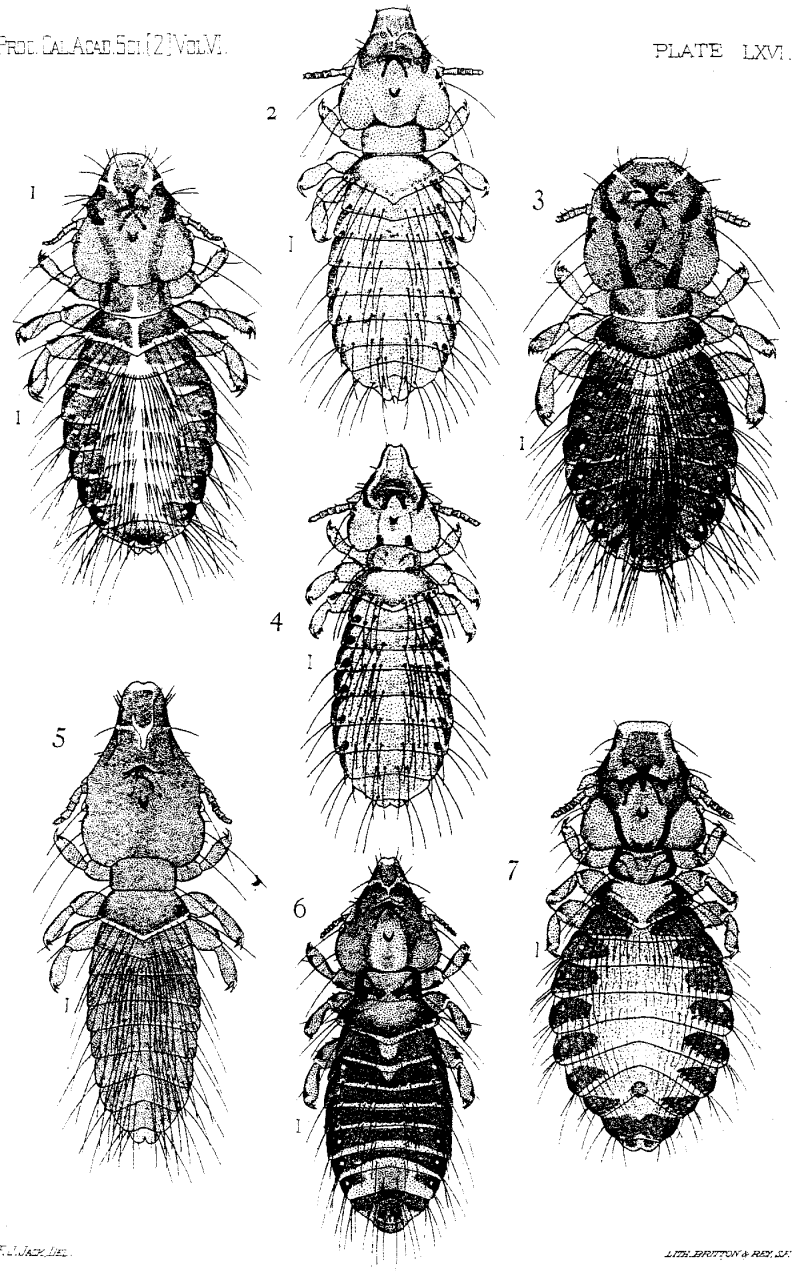












H. J. JACK, ILL.

LITH. BRITTON & ROSE, SAN FRANCISCO.

