31. Studies on the Anoplura and Mallophaga, being a Report upon a Collection from the Mammals and Birds in the Society's Gardens.—Part II.* By Bruce F. Cummings, British Museum (Natural History).†

(Text-figures 1–36.)

**SYSTEMATIC:**

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**STRUCTURES:**

Snodgrass (1), in 1899, pointed out certain broad features of divergence in the internal anatomy among the larger divisions of the Mallophaga, such as the Anoplura, the Ischnocera, and the family Trichodectidae. Recently, Harrison (2) has claimed the existence of a large accessory sac of unknown function in connexion with the male reproductive organs as the chief and most reliable character for separating the family Boophilidae from all other Mallophaga. In 1910 Mjøberg's sketches of the male reproductive system in several Mallophaga (6) offered the systematist an inducement to compare such organs as the vesicula seminalis, the ductus ejaculatorius, and the spermatheca, in order to discover the extent of their divergences in different species and genera. In the following paper some evidence on this subject is brought forward. So far from there being a monotonous uniformity in these internal organs, the differences are such as no student of these little parasites can afford to neglect. The ultimate systematic value of such characters can only be estimated after many more dissections; but whether it be great or small, the considerable difference in the form of the vesicula seminalis and the ductus ejaculatorius between the two Ov. Philopteri—Philopterus obovatus and *P. caprae*—to take an example, is one which cannot be satisfactorily ignored and which conveniently falls within the province of the systematic writer to record.

**METHODS.**

All chitinous parts were studied after hot caustic potash had cleared away the soft parts. For an examination of the soft parts the following methods are recommended:—

* Part I. appeared in the F.Z.S. 1914, p. 263.
† Published by permission of the Trustees and communicated by the Secretary.
(On account of the illness of Mr. Cummings, the final proofs of this paper have been corrected, and the magnifications of the figures worked out, by the Rev. James Waterston, B.D., D.Lit., at the Imperial Bureau of Entomology.—Editor.)
ports, fresh material was not available; but it was found that good results may be obtained with well-preserved spirit material if the specimens be plunged for a few minutes in caustic potash, to destroy the connective tissue, and then soaked for twelve hours in glacial acetic acid, transferred to absolute alcohol, dissected in oil of cloves, and mounted in Canada balsam.

For sectioning, the specimens had been fixed in Carnoy's solution (formula No. 4), which proved, however, to be not very satisfactory. For embedding, Askan's methods, detailed in the P.Z.S. for 1914 (p. 986), were followed, the sections being stained in the ordinary way with Ehrlich's Haematoxylin, Eosin, or Orcein. G. E. is much indebted to Dr. C. A. Gunns for assistance in section-cutting.

In none of the figures which follow of the male reproductive system and copulatory apparatus are the muscles shown, and in some the exact position of the entry of the vas deferens into the ductus is not given because, as a rule, in most of the dissections this could only be made out with the greatest difficulty on account of the delicacy of the vas deferens.

Family Philopteridae.

The Owl Philopteridae.

Pinet (3) grouped the Owl Philopteridae together, under the generic name "Strigigale." For convenience, this plan may still be followed. But these Owl parasites cannot very easily be separated off as generally distinct from the Philopteridae of Birds of Prey, with which they show certain affinities. Within themselves they fall into three distinct types, as pointed out by Prof. V. L. Kellogg (4), represented by the following three species:—P. estapotus Nitzsch, P. celebrochys Nitzsch, and P. curvo Nitzsch.

The following four species were included in the collection:—

Philopterus estapotus Nitzsch (5, p. 76).

4 "♂ from the Barn-Owl, Flammea blumen (Linn.).

Dissections were made from male material kindly handed over to me by Mr. Waterton.

Philopterus curvo Nitzsch (6, p. 75).

Several specimens of both sexes, from Rutila montana (Vieill.) (S. Africa) and R. anato (Steph.) (Egypt), P. curvo has been further recorded from B. capensis Smith, B. virginiensis (Gmel.), Axio capripinnis, A. trivittatus (Linn.), and A. galapagoensis (Gmel.).

* The names of families and subfamilies used by scientific names in this paper are used in accordance with Article 23 of the International Rules of Nomenclature (Proc. Zool. Soc. London, 1895, p. 44 (1931)).—G. E. S.
as that figured by Snodgrass (1, pl. xiii, figs. 7, 8, & 9) for Cephalophanus flavicans and Eutrogaster taurus. In P. celerobrachys, on account of the swelling out and rounding of the two separate sacs of which the vesicula is composed, it approaches to the form of the vesicula in P. celerobrachys (text-fig. 2). Note the relatively small size.

Philopterus celerobrachys (text-fig. 2)—In outline the vesicula

Text-figure 2.

Philopterus celerobrachys. Male reproductive system and copulatory apparatus. X 90.


resembles Minerva's helmet. In between the rounded posterior "horn," which sweep backwards and onwards, the ductus enters and swells out at once into an oval form.

Male Copulatory Apparatus of the Owl Philopteri.

Philopterus rostratus (text-fig. 3)—Distinguished by the unusually long parameres in proportion to the basal plate, a feature which separates the species from all other Owl Philopteri so far examined. Basal plate: Rather short, broad; lateral margins strongly chitinised along posterior half. The hind margin juts out medially into a prominence beneath the endosomal plate. Parameres: Elongate rounded rods, graduated to a slender distal end, and slightly curving inwards towards one another. Endosomal plate: Quadrilateral, as level as the basal plate to which it is attached, and about half the length of the parameres. The endosomal plate has a marginal band which

along the lower side deepens considerably in the middle part, where it bends upwards between the parameres and sends backwards across the plate two diverging spines. Each of these runs halfway along the oblique base-line of the articular surface of the paramere. The forked rod (see text-fig. 1) is homologous with similar parts in P. celer, P. celerobrachys, and P. athene (see text-figs. 1-3).
From the Society's Gardens.

The Receptaculum semenii.

Philopterus celerbrachys (text-fig. 4).—Piaget (3, p. 30), in describing this species, says:—"À la face ventrale deux bandes longitudinales sur les côtés de la valves qui est peu visible, et deux taches arquées dos à dos, avec un petit cercle de chitine en avant." As Mjöberg points out (6, p. 256), this "petit cercle de chitine," figured by Piaget in several species, is not a superficial character of the cecolobrach, but a part of the receptaculum semenii strongly chitinized and showing through the integument.

The receptaculum consists of a small or less circular sac of soft, delicate tissue carried by a dark-brown thickly-chitinized calyx at the end of a fine duct leading into the genital chamber.

Text-figure 4.

Philopterus celerbrachys. Receptaculum semenii, X 100.

Mjöberg calls this a "knietsende Chitinäsche," and figures it in Nemes tenuis just as if, indeed, were a flat circular disc on one side of the base of the sac. In P. celerbrachys the calyx is a saucer-shaped piece of chitin with a rim. The duct enters through the centre of its membranous bottom and debouches at the tip of a large chitinous cone, which overtops the side of the calyx and at its base is continuous with the calyx, so that its optical section it looks as if the bottom has been pushed clean through the centre.

In an Owl Philopterus of the celer type, from Ario otus, the calyx differs from that in the preceding in several respects. The outer surface is closely striated in one more or less longitudinal direction, the constriction below the rim is deeper, and the "cone" is parallel-sided at its upper end and as a truncate broad top.

The text-figures should be compared with those of *Holleurus* and *Nesphilopterus* (p. 672). Relatively, the color in the *Philopterus* species is much wider across and shallower, and the chin is of an entirely different consistency, being dark brown, rather thin, but very firm.

**The Philopterus of Birds of Prey.**

Future research may bring the Philopteri of the Owls and the Birds of Prey into closer relationship—a result which, according to modern views on the classification of birds, would lend no support to the theory that the phylogeny of total obligate parasites like Anoplura and Mallophaga will assist in the unravelling of the phylogeny of their hosts, as ornithologists present a solid front against the old position of the Owls among the Birds of Prey. Between the two groups there is a strong likeness, for example, in the male copulatory apparatus.

**Philopterus platystomus** Nitzsch (5, p. 60).

Females and larvae from *Bubo erythrorhynchos* (King) (Argentina).

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**From the Society's Garden.**

*Philopterus fuscus* Giebel (5, p. 68).

1 & 2 from *Ampelisculus* (Linnaen).---

*Philopterus asturinus* Mjöberg (6, p. 112).

Males and females rather plentifully from the Goshawk (*Asio polanczus* (Linnaen)).

This species comes close to Denny's type-specimens of *P. nius* from *Accipiter nius* (Linnaen), which Piaget—1 do not know with how much reason—synonymises with *P. powellii* (Powell).---

Text-figure 6.

**Philopterus asturinus.** Male reproductive system and copulatory apparatus. X 70.


Male Reproductive System and Copulatory Apparatus (text-fig. 5).

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Text-figure 5.

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**Philopterus asturinus.** Male reproductive system and copulatory apparatus. X 70.


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Male Reproductive System and Copulatory Apparatus (text-fig. 5).

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Text-figure 5.
local plate, is a short stout penial-like tube formed of two distinct longitudinal halves. Each half is densely chitinised and dark brown in colour, and at the base spread out towards the base of the paranome. This tube is perhaps homologous with the transverse piece of P. coleoptera and other Ovum Philopteri (see text-figs. 1 & 2). The endosomal plate corresponding with the same piece in the Ovum Philopteri rests over the mesosome and bridges across from the base of one paranome to the other. The ductus ejaculatorius runs under the bridge. The endosomal plate may either consist of two pieces superimposed upon one another—viz., the deeply folded maxillary in the text-figure and the plate above this stretching across from paranome to paranome; or these parts may only be sculpturing or lobe thickenings in the same plate of chitin.

Miscellaneous Case (text-fig. 6).—This belongs to the common bovine-case type figured by Scudder (1 pl. xi. fig. 11). But the crop is longer and narrower, and in the ventriculus immediately behind the two anterior ones is a deep constriction, below which the ventriculus is broad and spacious.

The Philopteri of Ducks, Geese, and Swans.

This interesting group of Malloplastra was first seriously tackled by Giebel in the ‘Insecta Equina,’ 1874 (4, pp. 113-116), in which eight distinct species are described, including the typical Philopterus intestinum. Denny (8, pp. 95 & 96) described two other species—P. eugii from Cygnus (virgins), and P. cygnorum from Eucrosseris clara (Linn.) (Clamases cynornis). By reference to Denny’s collection, new in the British Museum, his “B. phallicus” proves to be in Agapizipora parasites, probably P. phallicus, a straggler perhaps upon the Golden-eye Duck; or Denny may have misread or confused his label, mistaking “Golden Eagle” for “Golden Eagle.” Giebel remarks, in the form figured and described by Denny under the name “B. intestinum,” that “seine Abbildung geht so unladehlich Differenzen auf, dass man gernche Zweifel an der Identität sich eben konnen.” I have examined Denny’s specimen, and find, as Giebel supposed, that Denny did not have P. intestinum before him. His specimens belong to the form which, until the types of Giebel and Nitschke can be re-examined, I propose to identify with Giebel’s P. fervinens. Fingel (3, pp. 116) was imperfectly acquainted with these Duck parasites. He describes and figures true P. intestinum, I think correctly, although the sketch of the terminal segments of the abdomen of the male (pl. x. fig. 1 e) appears to show the remarkable structure on the endosomal plate described below and called the esophageal, which is present in P. fervinens but absent in P. intestinum. Fingel did not know any of Giebel’s species, and subsequent authors have labelled all Philopteroides from Geese and Ducks P. intestinum.

Through the generosity of Mr. Waterston I have been able to prepare, dissect, and mount a considerable number of Philopteri of this group from a variety of hosts, the following distinct species emerging as a result—Philopterus eugii D. (on Swans), P. brunnicephalum G. (on Geese), P. intestinum N. (on different species of Ducks), P. fervinens G. (on Ducks), P. nitschkei G. (on Sitta nova Linn.), and a species taken on the Poched, which I cannot name satisfactorily and must therefore regard as new.

The whole group, for which the new genus Anasurus is proposed, is remarkably compact one, and the species comprised in it are all closely related and sometimes with difficulty differentiated one from another; so that Giebel’s specific diagnoses are of little assistance, even for the purposes of identification. Further, as struggling occurs so frequently from Duck to Duck, it is unsafe to rely for help upon the host’s name.

The above identifications, therefore, must be accepted with reserve. Rather than give new names, it has appeared better to perpetuate the old where that was possible, at the same time figurine the parts important for the differentiation of the species. In the future, should the types of Giebel and of Nitschke become accessible, these decisions can be revised if necessary.

Anasurus, gen. nov.

Head distinguished by the characteristic slant of the clypeus, by the presence of two small pap-like spines dorsally (one on each side of the posterior apex of the sphenial plate*), by the unusually short antennae, and the modified lyriform organ. Abdomen characterised by the form of the lateral tergites, which in segment I meet each other in the middle line. In subsequent sections, except the last, the tergites leave an unjoined median field. In the male copulatory apparatus, the fusion of the parameres distally with the pseudopenis, the form of the latter, the endosomal plate, and so on are also good generic characters. Finally, the form of the exstrosternum and the extremely short ductus must be included.

Small set quadrates, infesting Swans, Geese, and Ducks. A genus indicating in the male genitalia certain Lipuriperal affinities, and in the mouth-parts obvious affinities with the genus Philopteroides, nov.

Genotype: Anasurus intestinum Nitschke.

The six species distinguished up to the present (no doubt others remain to be elucidated) fall into two groups, according as the esophageal—a remarkable structure shaped like a three-prong—is present or absent on the endosomal plate of the male. A. Those with the “three-prong” are A. fervinens and A. eugii. B. Those without it are A. eugii, A. intestinum, A. brunnicephalum, and A. difficilis, sp. n.

* The whole of the dorsal chaetotaxy of the head is a generic character.
In the same genus should be included *Dioecodes brunneopyga Mjöberg* (p. 130) on *Aneis levicoris*, which I do not know. *A. difficilis*, sp. n., closely resembles *A. ferrugineus* in form, with the one considerable difference that the "pin-opener" is absent.

Text-figure 7.

A. *Aneis ferrugineus*, d. × 80.
A. *Aneis difficilis*, d. × 80.

Text-figure 8.

A. *Aneis difficilis*, d.
A. *A. brunneopyga*, d. × 80.

Text-figure 9.

A. *Aneis difficilis*, d. × 80.

*Head-measurements (millimetre scale) of Males of Aneis species.*

<table>
<thead>
<tr>
<th></th>
<th>A. ferrugineus</th>
<th>A. obtusa</th>
<th>A. exiguis</th>
<th>A. brunneopyga</th>
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In addition to the differences in the form of the head, in the cephalic index, and in the male copulatory apparatus, small specific characters may also be seen in the colour (rather variable, however), in the shape of the abdomen, and the genital mark in the male.

The Society's Collection contained two or three specimens of the typical *A. obtusa*.

*Anaxeneus intermedius* Nîlhich. *From Aneis gallericolata* (Linm.).

The *Mouth-parts* (Text-fig. 10.)

*Mandibles.*—In *A. exiguis* and *A. intermedius*, and probably throughout the genus, the narrow basal process of the left and the quadrangular process at the base of the right mandible are absent, the shape of the mandibles being accordingly different.
These processes occur and have been described in many species of Mallophaga, both Amblycera and Ischnocera (see Part I. and some of Kellogg’s cases. Proc. Cal. Acad. Sci. vol. vi., 1894). I find them absent not only in Anastenecus, but in the genus Hololeucus, nov. (see p. 664) and in Belopon termina—probably absent in other Boquiphe as well.

The lyriform organ and “gland” are modified throughout the genus, and resemble those of Hololeucus figured on p. 676. The text-figure shows their typical form.

A. stercoreus.—Both mandibles are very similar, the right differing from the left in the appearance of the apices of its two branches. In the right there is a minute protuberance subapically on the ventral branch and another lower down on the cutting-edge. There are a few transverse ridges distally on the dorsal surface of the dorsal branch and a V-shaped groove, the lower margin of which curves inwards and then downwards, showing a notch in its margin just before the latter slopes inwards in a straight line. Luhum: This has clearly demarcated lateral margins, formed of stronger chitin than the immediately surrounding area. “Paraglossa” short, with long terminal spines. Inner pair of lobes well defined. *Lepomyx appendiculata:* The two sprawling posterior cornu of the lyriform organ run in a dorsal direction, one on each side of the pharynx. The anterior cornu are two short broad processes, rounded in front. The lyriform organ is small and thinly chitinised, invisible without dissection. The basal piece (or “gland”) are small, circular areas, each framed in a chitinous plate which goes forward to the labial margin as anterior hypopharynx. Posteriorly are attached the usual narrow tendons, one to each “gland.” “Ducta” or chitinous chords apparently absent.

A. egypti.—In the form of the mandibles, lyriform organ, basal pieces, anterior hypopharynx, and in the absence of ducts, this species agrees closely with the preceding, and I am unable to find any obvious differences. The mandibles are perhaps more powerful.

**Text-figure 11.**

![Text-figure 11](image)

Male copulatory apparatus of the genus Anastenecus. × 100.

1. A. ferugineus. 2. A. egypti. 3. A. obtusus.


The small setae cannot be shown.

**The Male Copulatory Apparatus in the Genus Anastenecus.**

(Text-figs. 11 & 12.)

**Group A. Those with the effector.**

A. ferugineus.—Basal plate: Longer than broad with a rather deep and broad V-shaped white mark debouching on the anterior margin, looking like a split, the result of an accident in dissection;
it is present in all the species except A. cygni. The plate and parameres are fused to one piece, there being no articulation and no trace even of a suture. Parameres: Dorsally those appendages bend in to meet one another and embrace the median pseudopenis, which is probably endoceral. The parameres are fused with the base of the pseudopenis, but not with one another, the tips being quite discrete. Parameres and pseudopenis lie dorsally and curve upwards at the end. Below, in the mesosomal space, is the sac—an interesting structure, slightly expandable (in copulation), and curving dorsally at its distal end a great number of minute finger-shaped papillae. Behind these are seen numbers of minute circular spines. On its ventral surface in the hypopyral area is a remarkable retinacular apparatus, consisting of a semicircular row (with the spines pointing backwards) of ten elongate power teeth, those in the middle as long as the pseudopenis: it is uncertain whether this comb of teeth can be moved forward or not. Below the sac is the endoceral plate, which, like the parameres, is continuous with the basal plate. Fixed upon the posterior margin dorsally is the densely chitined effector. It is a little, more or less real piece of dark-brown shiny chitinous, running out into two limbs behind—a dorsal and a ventral, the one immediately above the other. The ventral limb is blunt at its tip, the dorsal more acute, the two together recalling a twin-screw without the handle.

A. obtusa.—Very similar to the apparatus of the preceding species, so that it is sufficient to signal the differences. The basal plate is different in shape in the neighborhood of the effector: the teeth of the retinacular comb are shorter and more numerous, being fifteen or sixteen or more in number; and, lastly, the effector has a different shape, being distinguished by the narrower and more elongate dorsal limb, which is set in the ventral process of pyriform outline as in a sort of pedicel.

Group B. Those without the effector. Correlated with its complete absence, is the complete absence of the retinacular comb.

A. cygni.—Basal plate: Short and broad, posterior V-shaped mark absent. Parameres: Bread at the base, at the apex blunt and fused closely with the pseudopenis, which is quite short. Two minute white circles on the posterior margin of the endoceral plate—probably the relatively large areoli of minute sensory hairs.

A. interula. Basal plate: Short and broad; the V-shaped mark present. Parameres: Longer than the basal plate, and enclosing a space of different shape from that of A. brunneicincta, with which it must be compared.

A. brunneicincta.—In this species the apparatus, very similar to

the preceding, is nevertheless characterized by the possession of an elongate, thin, chitinous spint lying dorsally on the sac and projecting a little beyond it. This probably is the penis, and is particularly easy to see in some specimens from Somateria melanocorys.*

A. difficilis, sp. n.—The penis-spint is present. The apparatus appears to me to be quite indistinguishable from the preceding.

Text-figure 12.

Anatenuca interula. Male reproductive system and exosporatory apparatus. X 180.


See text below.

Male Reproductive System in Anathenuca. (Text-fig 12.)

This was examined in A. interula and A. brunneicincta and found to be the same. It is noteworthy for the extremely

* It may exist in other species and yet escape detection, if the chitin be hyaline and transparent.
short ejaculatory duct, the large testes and the curious locular character of the vesicula seminalis, which, as usual, consists of a right and a left ventricle fused into an ovary of the shape seen in the text-figure.

The Philopinæ of Storks and Ibises.

Two new genera are diagnosed below—the one represented by Philopinus trioculæ N. and found upon the Cicinnus, and the other represented by P. planataris D. and found upon the Halicae. These two genera stand fairly close to one another, $\text{N. bicuius}$, gen. nov., contains the species designated "Biazi" by Piaget and characterized by the large double signature; Neophilopinus, gen. nov., contains the forms which Piaget collected under the heading "Setia," and is characterized by the fusion of the double signature into one plate. Other well-defined characters are recounted under the respective diagnoses of these two genera.

Neophilopinus, gen. nov.

Head, especially in the female, relatively small; on the dorsal surface of the pre-antennal area, a transverse suture marks the posterior margin of the signature. In the new genus $\text{N. bicuius}$ each element of the double signature ends behind in an acute angle. In the present genus two acute angles are present posteriorly, suggesting fusion of an originally double plate. Each of these posterior angles is situated more laterally than in $\text{N. bicuius}$, and the plate on each side extends further, so as to enclose the elyptal band so prominent in $\text{N. bicuius}$. By focusing down, the elyptal band is seen crossing the suture and thus uniting the elyptal region with the skull (as in other Philopinæ). Thorax longer than broad, with a strong, transverse, acutangular bar running in from each side between the first and second pairs of legs and giving attachment to the former. Clavicles present. Abdomen with two transverse rows of silky hairs on the tergum of each segment. Two tergites on each segment situated laterally and leaving a bare median field except in the terminal segment, where they meet across the middle. The male copulatory apparatus is also fairly characteristic, and may probably prove diagnostic for the whole genus.

Genotype: $\text{N. bicuius}$ Nitzsch (S. p. 96).

Parasites of the Cicinnus.

The following good species can with certainty be referred to this genus: $\text{N. bicuius}$. $\text{N. indicus}$ F., $\text{N. incompletes}$ N., $\text{N. angustatus}$ F., and $\text{N. episeta}$ Kullogg.

Neophilopinus incompletes Nitzsch (S. p. 97).

This is the only member of the new genus included in the collection. It was represented by many specimens from Eucrossa squamata (Rath.);

Giesel described a Neophilopinus from this same host, calling it $\text{N. incompletes}$. But to this species, so far as it is possible to understand it from Giesel's description, the present specimens do not belong.

Male Reproductive System (text-fig. 13).—Testes pyriform as usual. The ductus is short, there being only two bends in it from the mesosome to the vesicula. The vesicula seminalis is elongate, narrow, with a longitudinal median groove indicating the double origin of this organ. The ductus, on leaving it, bends backwards for a little way, and for this portion of its length the duct is a fairly narrow canal. On turning forwards again after the second bend, it expands into a large canal quite

Text-figure 13.

Neophilopinus incompletes. Male reproductive system and copulatory apparatus. X 100.


as broad and long as the vesicula itself, and no doubt functioning as an ejaculatory ampulla, as its walls are well supplied with transverse muscle-fibres, which run in from opposite sides and appear to become plated together in the middle.

Male Copulatory Apparatus (text-fig. 13).—Basal plate: Longer than the parameres, broader behind than in front, posterior margin very convex. Each lateral margin has a broad bend. Between
these lateral bands the median area of the plate is trough-shaped.
Just behind the mesosome lies a small median plate, which sends off a
branch on each side behind into each lateral region of the
basal plate. **Paramsome:** Quite evenly rounded rods, tapering
somewhat towards the distal end and curving slightly inwards.
**Maxillassae:** Paired into one piece, shaped as in text-fig. 16. Half-
way down on each side, projecting in a forward direction, is

**Text-figure 14.**

![](image)

Neopillogaster tricolor. Male copulatory apparatus. × 140.


A strong bristle set in a well-marked alveolus. These two
bristles mark the end of the endosomal portion of the mesosome;
between it and the distal half or terminal portion a distinct
nurse can be observed. In the dissection of a new species of the
genus collected on *Carphobus spinaculata* (dimsona) the endosomal

or proximal half of the mesosome is large; the two forwardly-
directed spines are present, one on each side at its posterior end;
while the distal or telosomal half, strongly chitinised,
is telescoped up within the endosomal. Similarly with another
new species from *Aldiaana abduni* (Licht.).

**Comparison with the apparatus of Neopillogaster tricolor**
(text-fig. 14).—This apparatus, while resembling the preceding
in its basal plate and paramecrae, differs from each of the three
forms mentioned above in features of the mesosome and in the
presence of a small process or plate at the base of the mesosome
which I regard as an upper endosomal chitinisation. The part
marked Pen, apparently telosomal, is white and more or less
melanomous, and appears to be held by the basal endosomal
portion shaped something like a pair of pincers.

The **Receptacular Seminis of the Female of N. incompleta**
(text-fig. 21 (2), p. 672).—This should be compared with the
**Receptacular Seminis of *Bidiceps* (text-fig. 21 (1 & 2)).** From a minute
opening into the genital cavity, a delicate narrow duct runs up
to a large semicircular sac borne upon a short circular calyx,
buried in colour, with its rounded outer surface longitudinally
striate.

**Mouth-parts of N. tricolor and N. incompleta.**—It is worthy
of record that, while the lyriform organ and basal plate of
*N. incompleta* are normal, in *N. tricolor* the same parts are
greatly modified. The lyriform organ resembles that of *Bidiceps
platenes.* Reference to the isolated modification of the isopoge-
tric apparatus in species of certain genera is referred to in
Part I. of this paper (p. 273), and is again discussed further on,
where the genus *Bidiceps* is discussed.

**Indecis, gen. nov.**

Head with a double signature, consisting of two oblong plates,
each plate usually with a small embossed area on the posterior
end, which runs out into an angle. Cephalic bands very well
marked; behind, they pass beneath each signtural plate and
inward to be attached to the skull. Antennae long, with an
especially long second segment. Abdomen large, broad, with
a lateral tergite on each side of each segment, so as to leave
a clear median area. A single row of hairs across the tergum
of each segment.

Genotype: *Bidiceps platenes* Denny (8, p. 100).

The type of Denny's species is in the British Museum.

The following species can certainly be referred to the new
and *I. hancockia* Mjôb.

The collection of the British Museum contains several un-
described species, including one from that interesting South-
American bird, *Atrapedon scopulorum.*

Neopillogaster and *Bidiceps* appear to be related rather closely.
just beneath the posterior lateral angle. Clavicles present, each running as a narrow rod from halfway down the lateral margin inwards and downwards to project beyond the hind margin into the metathorax as a broad band, which curves down and then forwards again to be inserted into the transverse septacular bar behind the first pair of coxae. The notae of both segments are divided by a median longitudinal suture line. *Abdomen*: Regularly ovate. The terminal tergite forms a deep semicircular band around the genital opening. Ventrally, the genital plate with its chaetotaxy forms an easily recognizable mark (see text-fig. 16).

Text-figure 17.

*Hodiceus ferox.* Head of male.

External form.—*Female.* As in the male, except for the usual sexual differences of the abdomen.

*Chaetotaxy.* For differentiating species, the chaetotaxy in this genus probably will prove of little value, as it is almost identical in the male and female both of this species and of *I. plotelae* except for the usual sexual differences at the end of the abdomen. For example, on the second segment of the antennae there is one elongate bristle and a shorter one beside it; the signalurial plates are bare dorsally; on the ventral surface is a single bristle in the middle of each plate. On the epyseal band at the base there is one bristle dorsally, one projecting laterally, and one on the ventral surface. At the terminal end of the band there are three more bristles similarly arranged. In both sexes of both species, also, there is a bristle on the dorsal surface of the skull just

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behind the posterior acute angle of each signalurial plate, a spine on the corneal surface of each eye, and a spiny hair behind and the same minute spines dotted sparsely over the postantennal dorsal area. The chaetotaxy of the abdomen calls for no special mention.

Text-figure 18.

*Abdomen* of *Hodiceus ferox,* with the central nervous system.

Text-fig. 18: *infra-omphaline ganglion,* *supra-omphaline ganglion,* **1st, 2nd, 3rd thoracic ganglia,* **M.P. stomatogastric nerves.**

*Alimentary Cauter.*—Mr. Waterston has pointed out to me some minute teeth on the chitinose lining of the pharynx in a *Lepidopterion.* Similar pharyngeal teeth in *Lepicera ferox* were figured without comment in 1913 (9, p. 131, text-fig. 24). I now find similar teeth in the pharynx of other genera, including the present species, in which they are very minute and occur in small rows, each tooth directed backwards. The patch of teeth in the anterior oesophagus of the crop is present in its usual extent; and the

*It is likely that the chaetotaxy, at least of the head, just as in *Anocerus,* will prove to contain the same plan throughout the whole genus. If the same in two other species (unsaid) which I have examined, making four in all.
rest of the alimentary tract requires no detailed description, except perhaps a reference to the averted base of each Malpighian tube.

Insecta System (text-fig. 18).—The state of preservation forbade any satisfactory dissection of the nervous system. The brain and main ganglia have been figured by Snodgrass for Karymetopus terces (J. pl. xvi. fig. 7). From this, the central nervous system differs in its general form. The splanchno-neurophageal ganglion is

Text-figure 9.

**Male Reproductive System** (text-fig. 19).—Testes: Relatively much broader and the soy in front less deep. The splanchno-neurophageal is narrower; the first thoracic ganglion is also long and narrow and a little narrower in front than behind. The second or mesothoracic ganglion is roughly triangular in shape the apex pointing forward. The metathoracic is the largest of the three, and more or less circular in shape. Behind, two extraordinarily large stomato-gastric nerves come off and supply the viscera.

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small, the commissure between them weak, so that in dissection the two are commonly separated. *Prostoma nematodes*: This is a long narrow sac, with the usual longitudinal median division. The anterior end is a little truncate, broader than it is behind, where it decreases almost to the base of the issuing ductus. *Eugoniopsis seminata*: absent or only slightly developed.

**Male Reproductive Apparatus** (text-fig. 19).—Basal plate: Lateral margins well chitinised, parallel-sided except for the posterior third of their length, where the plate breaks out. Posterior margin concave. *Parameres*: At the base these are broad, thin, and transparent bands which fold in around the stout densely chitinised endosoma. Distally, the parameres curve in towards one another, so as to embrace the tip of the remarkable penis. Beyond the end of the penis they are produced forwards and become more strongly chitinised and brown in colour. Subapically, on the outside margin of each, there is a small directive hair. *Endosoma*: These remarkable appendages are much shorter than the parameres, strongly chitinised, deep brown in colour, and slightly curved, the convex side of the curve being on the outside of their length. The distal end is enlarged and displays two large ridges, forming distinct cutting-edges, each ridge with a separate apex. Between the distal ends lies the main body of the penis. At the base they articulate with almost the whole articular surface of the posterior lateral angle of the basal plate. *Measurements*: The penis is a large bulky piece of chitin, the form of which is delineated in the text-figure. Behind it lies the curiously-shaped piece labelled X. This is clearly endosomal—whether upper or lower, I am not prepared to say. The outline of the central portion of this piece is shaped something like a bowl on a pedestal. There are two long backwardly projecting spines, one on each of the two outwardly curving corona; and behind, on each lateral angle at the base of the bowl, a short peg-like spine.

<table>
<thead>
<tr>
<th>Measurement (millimetres)</th>
<th>Length</th>
<th>Greatest Breadth</th>
<th>Length of Antenna</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$d$</td>
<td>$e$</td>
<td>$f$</td>
</tr>
<tr>
<td>Head</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pro-Abdomen</td>
<td>$90$</td>
<td>$70$</td>
<td>$12$</td>
</tr>
<tr>
<td>Meta-Abdomen</td>
<td>$90$</td>
<td>$70$</td>
<td>$16$</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total 2845

*Perhaps due to the condition of the tissues.*
It is necessary to revert once more to the subject of the pharyngeal sclerite (or lyroform organ) as within this single genus *Idoborus* may be found species with three genera modified as they occur in scattered instances throughout the Order, at least one species in which the parts are normal in most Mallophaga, and in the species *I. flavus* a valuable intermediate stage.

This isopogonometric apparatus, as Arméniante (10) called it (on the theory that it was a contrivance for measuring the barbules into equal lengths for cutting) *, was supposed by Snodgrass (1) to be absent in some Mallophaga, such as *Lincobothria*, *AnTHRAX*, *Xylazine*, *Physothrips*, *Tristes*, and others. In

* The fact that a similar apparatus is present in the Pseudepis, which do not feed on tritons, does not necessarily dispense Arméniante's theory, as its present function must be a new one, involving the adaptation of all parts. It is certainly difficult to believe that the so-called "glands" (now apparently wholly chitinous) were not once glandular, which they may still be in part.
Spermatozoon in Diptera. (Text-fig. 21.)

Rhabdura platana.—The receptaculum seminis is an irregularly shaped sac at the end of an extremely fine chitinous duct which opens by a small aperture through the chitinous intima of the genital chamber. The duct is finer than in Nephilophaera incompleta and the sac is of a very different shape, being bent back around the top of the duct. Inside the sac may be seen the spermatozoon—hard, thick-walled follicles containing nests of spermatocytes. In some of these no opening could be discovered.

Text-figure 21.


Rhabdura falcon.—The receptaculum resembles that of I. platana and gives the same suggestion of a hydroid on its stalk. Just within the clyl, however, the clyl opens into an atrium, absent in the preceding species. The flask-shaped spermatophores, five in one female and eight in another, lying loose and disposed irregularly, somewhat recall the form of the spermatophore figured by Von Siebold (13) for the Loestid Dictus cinctus, but the mouth is much larger and the neck broader. In each spermatophore in the first specimen was a nest of spermatocytes. In the second they were absent and had probably been discharged.

Chobolkovskey (14 and 15) divides the spermatophores in insects into four distinct types—(1) True spermatophores arising from the sexual organs of the male and facilitating the transference of spermatozoa into the female organs. Outside the Insecta this is the typical spermatophore well known by zoologists to occur in Urodeles, Echidnidae, Echidnidae, and elsewhere. Among insects true spermatophores are possessed by Gribis (16), Ephydra, meropsis (17), and others. (2) Spermatozoon or structures which arise in the female sexual organs and serve "as Dosierung des Samens bei der Befruchtung der abzulegenden Eier." To this group belong the flask- and retort-shaped bodies in the receptaculum seminis of many Loestids, where they were first discovered so long ago as 1701 by Caspar Brunell (18), and first accurately described by Carl T. von Siebold in 1845 (13) in Dictus cinctus. To this category belong also the spermatophore-shaped structures discovered by Chobolkovskey in Trichoptera (19) and the "spermatophores" of certain Lepidoptera. (3) Spermatophorin, or masses of gland secretion, serving as a medium for the transference of the spermatozoa from the male to the female, for the maintenance of the spermatozoa during copulation, or for the closing up of the female genital opening. Examples: some Loestid females and the "Sacksehen" of Parapsines. (4) Spermatozoon or bundles of spermatozoa united to form feather-shaped structures, and so on.

The so-called spermatophores of the Mallophaga are spermatophores, and were discovered in Lipurus subpennis by Kraus in 1888 (13), in a valuable and careful memoir which has since been neglected by writers on the Mallophaga as well as by Chobolkovskey, Ballowcy, Blanch, and others engaged in the study of insect-spermatophores. Kraus noticed a number of flask-shaped vessels lying loose in the receptaculum seminis of the female, and as they were too large to permit of their passage up the narrow chitinous duct, Kraus concluded that they arose within the receptaculum, and claimed to have detected the necks of half-formed flasks in a special layer of epidermal cells within the receptaculum.

Chobolkovskey's summary of the reasons for thinking that these interesting spermatophores arise within the female is very suggestive, and it is to be hoped that the problem may be satisfactorily elucidated by an examination of further specimens from the Zoological Gardens, well fixed and carefully preserved.

Rather than be classed under the general term spermatophore, the three new terms introduced by Chobolkovskey should be used in contradistinction to it, spermatozoon being substituted for spermatodermen.

The Philopteris of Nemaides.

Henry Denby, who, with Nitesch and Giebel, shares the honour of laying the foundations of our knowledge of the Mallophaga, describes in his remarkable Monograph of British Lice, published in 1840, two species of Philopterus from the Curlew (Nemaides arguta (Lin.,) 17, P. tropicaria and P. highamiana. In
two limbs two directive hairs in large alveoli. Between lies the penis, a rod with a large wing-like telomere on each side composed of rather transparent delicate chitin.

Text-figure 23.

Indolella testudinaria. Male reproductive system and copulatory apparatus. X 75.


THE REST OF THE PHILOPTERI.

The species of Philopterus in the collection remaining to be considered are five in number:

Philopterus commen N. (5, p. 85).
A single ♀ in company with N. cylindthrurus N. from Passer domesticus (Linn.).

Philopterus semi-comen N. (5, p. 80).
Two ♂ ♀. Host's name not given.
The difficult question of the Corvine Philopteri is discussed by Waterston (21).

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Philopterus lami Denny (8, p. 89).
Five ♀ ♀ from Numenius arquata (Linn.). A straggler from Gulls.
The male copulatory apparatus is figured by Snoilgrass (1, pl. iv, fig. 8).

Philopterus levis N. (5, p. 90).
A single male from Puerulus capella (Vigors).
A common parasite on Starlings, occurring in several different forms; probably a new genus should be established.

Text-figure 24.

Philopterus acanthus. Male copulatory apparatus. X 100.
I am able to describe the male copulatory apparatus from a preparation kindly lent me by Mr. Waterston. This belongs to the same type as that in P. hensoni.

**Male Copulatory Apparatus.**—Dorsal plate: The characteristic feature is its small width in proportion to the dimensions of the parameres and mesosome, which are attached to it. Dorsal transverse band very convex. **Parameres:** Large, powerful rods, with large circular condyles working over the tiny articular surface offered by the posterior lateral angles of the basal plate. Distally they bend in somewhat towards one another. Subapically a minute hair. **Mesosome:** There are two endomeses, a lower and an upper, both being a small deep-bulb plate, each limb of the fork running out behind an articulated tip. The upper endosome has two wings, narrower at the distal end than in P. hensoni, and here solely consisting of the lateral teeth or notch pointing outwards. The meso is a delicate rod with a large bulbous base (hyposome); above lie the "winged" telomeses, which together look like a javelin's head.

A comparison between text-figures 22, 23, & 24 clearly indicates the homologies between the parts in the three species.

**Family Liperidae.**

_Imagorhina asymmetrica_ N. is found on the Ena (Liceamorina nocc-helamundr (Lathi), Liperinae asymetricae P. on two species of Rives (Peronosomum penata (Vic.) and Rives waterworthica ScL), Liperinae quadriramus Linn., and Liperinae americana Leptra latia P. or. R. americana. There can be but little doubt that these four species are related to one another and should be grouped together. Subsequent research and the redescription of Pigoet's _L. latia_ will probably result in the establishment of three new genera placed together in a new subfamily.

Harrison (22) has already suggested that _D. asymmetrica_, _L. asymetricae_, and _L. quadriramus_ should be regarded as congeneric. From the new genus established below to include _L. asymetricae_ and _L. quadriramus_, I have omitted _D. asymmetrica_, as in my opinion it should stand in a genus by itself. It is a curious and significant fact that in three of these species parasitising Struthium birds the margin of the anterior part of the head is from some cause by no means evident asymetrically developed. The asymmetry in the anterior incisions of the head is best developed in _L. quadriramus_, while in the form of this species, as well as in the form of _L. asymmetrica_, the asymmetry is absent even in Stage II. That _D. asymmetrica_, in which the adult asymmetry is most developed, the whole of the preanastomotic region being bent over on itself to form a longitudinal channel, is a derivative of the other two species seems clear from the observation made by Harrison in the shape of the _D. asymmetrica_ possess a asymetrically bilaterally curved and a precisely similar structure to that found in the adults of the other two.

A great deal more collecting and investigation are necessary before any satisfactory conclusions can be drawn upon the relationship of the Milipodinae parasites to their Struthionidae hosts.

**Struthiopodinae, gen. nov.**

Liperoid: antenna sexually dimorphic. Incursions of anterior margin of head placed asymetrically. Left mandible with an enormous basal process almost as large as the mandible itself. In the thorax clavicles present as thin splints running towards and backwards from the antero-lateral angles to join a band which runs vertically downwards to be inserted into the transverse anterolateral bar. Abdomen with finely etched transverse tergites. Two transverse rows of fairly long silty hairs on each tergite. Hairs at the sides numerous and fairly long. Male copulatory apparatus characteristic.

Genotype: _Struthiopodinae asymetricae_ Pigoet (23, p. 54).

The genus to include _L. quadriramus_ P. (3, p. 398).

**Struthiopodinae asymetricae_ P.**

I collected several specimens of this species personally on a live Rive in the Gardens.

**Male Copulatory Apparatus.**—Dorsal plate: Dorsally tneous-shaped, with a longitudinal median keel. At the posterior end the sides of the trough become steep, and a bridge runs across from side to side in the form of a fairly narrow transverse band, from the middle third of which a parallel-sided plate runs forward between the parameres, ending in a straight transverse margin, to the two transverse rows of fa.
penis. They are slender and wedge-shaped, rather long. The penis is a long, narrow, elongate rod, with a somewhat swollen base, which lies almost buried between the dorsal and the ventral median processes of the basal plate.

Text-figure 25.

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Struthiolipurus angustatus. Male copulatory apparatus. × 110.

BP, basal plate; MK, median keel; TR, transverse back; MP, median piece; Pen, penis; LE, lower columella; P, paramere; UE, upper columella.

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THE REST OF THE LIPURUS.

LIPEURUS SUBSIGNATUS Giebel (5, p. 232).

Several specimens, including a male, from Phasmocephalus variegatus Pulli.

LIPEURUS JUVENILIS Nitzsch (5, p. 240). (Text-fig. 26.)

Males, females, and larvae from Brunia lycopersica (Bechst.).

Male Reproductive System.—This was carefully figured and described by BÖNNER as long ago as 1909 in the "Zeitschrift für wissenschaftliche Zoologie" (12). Testes and vas deferens are normal. The vesicula seminalis is an elongate double-chambered sac, the median partition indicated externally by a longitudinal groove.

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Male Copulatory Apparatus.—Basal plate: Rather long, narrow, of uniform thinness, the lateral margins indistinct, and the colour dull yellow. Mesosome: Attached to the posterior margin of the basal plate is a large, broad, trapezoidal plate—the mesosome. When the apparatus is withdrawn, as shown in the figure, the parameres, slender rods shorter than the mesosome, lie dorally.

Text-figure 26.

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LIPEURUS JUVENILIS. Male copulatory apparatus. × 110.

BP, basal plate; P, paramere; EP, ejaculatory plate; Pen, penis.

and inside the lateral margins of the mesosomal plate. When the apparatus is in action, however, the base of the mesosome swells up and broadens out, carrying the parameres with it, so that the latter come to lie laterally in their normal position. The penis is a perfectly straight elongate tube, with an aperture at its tip and with a forked base.

LIPEURUS HETEROGRAMMICUS N. (5, p. 220).

 Plenty of material of this minute species was sent, collected on Cucurbita chinensis Gray.

complex in structure, consisting of an oval end-sac—the true reservoir seminale—which leads by a narrow neck into a second well-defined portion, for convenience of description called the middle-sac. Further, elongate reservoirs, elegantly flask-shaped,

Text-figure 28.

Lopenus fusciferatus. Male reproductive system and copulatory appendages. X 100.

a. seen from above; b. seen from the side. Totes not shown.


When in use the vesicles and associated parts are much farther forward in the body-cavity in front of the base plate, and the sac when extended in copulation ends over the back of the abdomen.

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lie, one on each side of the middle-sac, and enter by a narrow neck into the narrow section between the end-sac and middle-sac. The ductus spermaticus for a considerable portion of its course on leaving the middle-sac is large and glandular and almost as broad as the middle-sac itself. The narrow canal between the latter and the ductus projects into the lumen of the ductus as a minute cone-shaped protuberance. The broad upper part of the ductus, after two bends, giving the tube an S-shaped form, narrows into a small canal of several coils, which enters lower down into the upper part of the retracted prepupal sac.

Text-figure 29.

Lopenus fusciferatus. 2. Transverse section through the abdomen at the level of the middle-sac of the vesicles. (Diagrammatic.)

R, rectum; T, testis; M, muscula. PC, fat cells; PD, vas deferens; R, reservoir; MS, middle-sac.

Sections of these parts reveal some important points (see text-figs. 29 & 30). Externally the egg-sac is marked by a median longitudinal groove. In cross-section the middle-sac, as in the vesicles seminale of other insects, is seen to be double, consisting of two distinct tubes closely applied one to the other. Similarly, the middle-sac is also double. Whereas the end-sac contains sperm, the two "reservoirs", the middle-sac, and the two minute vesicles, one on each side at the lower end of the latter, contain a conglobule white secretion, which possibly plays the part of spermatophragm, serving for the maintenance of the spermatophores during copulation.

The walls of the end-sac are fairly thin. Those of the middle-
The apparatus when retracted.—During retraction the sac is continuously invaginated until the distal end with its denticles comes to lie farthest forward within the abdome cavity a little anterior to the fore end of the basal plate. The thin endodermal strip on its lower wall, of course, curls upwards and travels in with the rest, so as to form in the retracted state an enigmatic loop difficult to interpret until an extended sac is examined. In cross-section, therefore, the endodermal strip forms the lower wall of the inner tube (see text-fig. 32). A similar endodermal loop with a similar history was described in Part I., p. 271, for Trichodesma latum. The diagram should make the relation of the parts quite clear.

It should be clearly understood that the parameres are at no place rods or appendages discrete from the sac. At their distal end (text-fig. 33) a membraneous cross between them dorsally and another membrane crosses ventrally. If the parameres become shorter these two membranes would become continuous with one another and with the dorsal wall of the outer tube, and if, finally, they disappeared we should have a simple excretory tube. Sections anywhere across the length of the parameres all show

The parameres are not longer, the cells being of varying lengths and their ends projecting irregularly into the lumen. The walls of the flask-shaped reservoir are very thin, consisting of a clear hyaline external membrane and an inner epithelium of short cells. The walls of the upper portion of the ductus ejaculatorius are very thick, consisting of extremely high cells, the shape of which is not clear in the preparations on account of unsatisfactory fixation. For the same reason the histology of other parts remains obscure.

Text-figure 30.

Lepidurus fragilis. 2. Transverse section through the abdomen, showing the esophagus of the sac lying retracted within the body cavity above the basal plate. (Diagrammatic.)

them to be local thickenings one on each side of a membraneous tube—the outer tube. In text-fig. 32 a section is shown of this outer tube contained within the genital chamber, and the basal plate and parameres are seen merely as local thickenings in the continuous wall of the sac.

Text-figure 32.

*Lipurus forsteri*, *s. F.* Transverse section through the genital chamber, with the copulatory apparatus retracted. (Diagram.)

B. rectum. M. muscles. PL. cuticular strip on ventral surface of the sac. BP. basal plate between the base of the parameres (P.). GC. genital chamber.

Text-figure 33.

*Lipurus forsteri*, *l.* Longitudinal section through the end of the abdomen. (Diagram.)


Now, if reference be again made to the diagram (text-fig. 33) it is evident that the dorsal sector of the genital chamber ends much sooner than the ventral. Reading the sections forwards establishes beyond doubt the interesting character of the basal plate. The sole remaining ventral part of the genital chamber becomes smaller and smaller until it is no more than a narrow cleft below the basal plate. Next, its lower wall becomes thinned and is approximated to the basal plate, which is for the rest of its course a cleft of cuticle flattened perfectly flat into a plate with only a narrow rift between (text-fig. 31).

The interest in this observation centres in the fact that it explains the nature of the basal plate. At the base (near the parameres) this begins as an ordinary squamous form apodeme on the lower wall of the sac within the genital chamber. It runs back (i.e., in the direction of the basal plate) as an ordinary tubular apodeme formed as an invagination of the ectoderm in the lower part of the genital chamber. This "tube" is compressed into a flat plate and its lumen reduced to a thin rift—continuous with the genital chamber.

Text-figure 34.

*Lipurus forsteri*, *s.* Cross-section through the extruded sac just behind the opening.

D. ductus. M. muscle mass. PL. narrow cuticular strip on ventral surface.

Extension and Retraction.—On the ventral surface of the basal plate there is a series of longitudinal muscles which arise in front from the anterior portion of the basal plate and are inserted behind into the terminal sternite of the abdomen, serving to thicken the plate forward and expose the parameres through the terminal abdominal opening. Text-fig. 28 a shows that the parameres along their dorsal margin curve in somewhat. Underneath this overhanging ledge small muscle-fibres run back along the length of the parameres and are attached to the base of the basal plate, doubtless serving to draw the tip of the fused parameres upwards in a dorsal direction, which is its usual position when in
completion. On each side of the basal plate is a large, bell-shaped muscle arising from an abdominal surrnisome some way forward and plate. These are retinacular muscles, withholding the apparatus of the oesophagus and being brought into the lower end of the basal plate within the body after completion. The continuous invagination small muscles arise from the dorsal surface of the basal plate particularly numerous above the ductus at the distal end of the oesophagus, being inserted just behind the opening (text-fig. 34).

Extinction of the oesophagus is probably caused by blood-pressure upon contraction of the powerful dorso-ventral abdominal muscles segmentally arranged.

The above is not offered as a complete account of the mechanism of this complicated apparatus. The present paper gives in the description much in detail, and may only be filled in only after a great deal more study of the parts.

Text-figure 25.

Leptura nigraeformis, f.—Transverse section through the head behind the antennae. (Diagrammatic.)

CT, chitinous tube for attachment of mandible muscles (M). P, pharynx.

Mouth parts.—Laciniæ: The hyaline sclerite is present merely on a narrow transverse band near the anterior margin, and posteriorly. Apparatus: Lytiform organ without posterior cornea. Anterior cornea are fused and flat, concave on the outer margin, and in length equal to that of the "nucleus" itself; from each further supported basally in a short median longitudinal split. Behind the bifid corneal organ the chitinous flaps of the pharynx are long, but short, median piece, and on each side a longer rectangular strip. The pharynx (text-fig. 24) forms a somewhat hypertrophied consisting of a narrow, The pharynx (see text-fig. 25) is supplied with numerous small muscles.—circular, longitudinal, and transverse. The latter are present, but not fully seen in this form. The pharynx is complex. It consists of a large, swollen, two-chambered sac.

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Test-figure. There are two pairs, one running from the ventral and the other from the dorsal side of the skull.

Genus Proctogaster Mjöberg.

Proctogaster pallidus Nitzsch (5, p. 254).

From time to time a considerable amount of material of this species from Sulcis bennani (Linn.) and from Cape St. James (Sula capensis (Licht.) was sent in.

Text-figure 30.
of somewhat irregular contour and outline. At the anterior end are two small, closely united offshoots from the central chambers, and at the posterior end, where the vesicles join the ducts, are two pairs of accessory holes each attached to the vesicular by a very fine and appreciable neck or constriction. The first pair of holes are quite small and lie posteriorly. The second pair run backwards to the sides of the opening ductus, and are nearly half as long as the vesicles and together almost as broad. The ductus ejaculatorius is broad at the upper end and rather short. About midway towards the coxal aperture apparatus there is a small area in which a pair of small gland are attached.

Nale Cephalic Appendages.—Throughout the Mallophaga, this general structure of the male accessory apparatus is recognizable. In the Mallophaga the strongest condition is found in Pentatomopyges polyactis (see text fig. 36). Mjöberg (8, p. 216, fig. 12), who established the genus, in preparing to describe and figure the apparatus described only the basal plate, parameres, and ductus. The whole long extramural sac, with its complex contractions, is omitted—swept away in dissection possibly in mistake for the rectum or rectal food matter. A rosacea of the sac, Mjöberg states that, although present, it is "jedenicht gut entwickelt." And of the ductus ejaculatorius: "Es sieht in der Freiheit ein in einer Spinne verdrehten Chitinband." But the ductus contains no such spiral band, and so it is difficult to suppose Mjöberg mistook the extramural "preputial sac" for the ductus, there may be here a question of a distinct but unrecognised species.

Penial Plate.—This is long and narrow, with a longitudinal median keel upon its lower surface. The two peculiar processes (P), which probably represent parameres, do not articulate with the basal plate, but are attached to its dorsal surface along the length of the whole "stalk" or unpaired portion. The distal end is band-like and curves outwards. On the inner surface of each are about thirteen denticles like ossicle buds on a stalk, graduated in size from the base to the tip. Below and quite continuous with the basal plate lies an endosperm plate, formed of a rather clear chitin, the upper surface presenting a transverse appearance. In regard to the "preputial sac," the text-figure lays no claim to a representation of this in the natural position. Unfortunately no male specimen was obtained with the sac extruded. Consequently the remarkable sclerites 1, 2, 3, 4 and 5 are shown lying in no very intelligible position. However, the shape of the pieces is seen together with the structure of the large "retenier comb" at the distal end, recalling a similar structure figured for Anostostomus. In Plectomyopus consists a row of about nine elongate bands. Each band at the base has square angles, in fairly broad and parallel-sided for a short distance up before it divides into two, forming a fork with two elongate prongs. All the nine forks are really one continuous piece, the divisions between being filled by a sort of amorphous of thin transparent chitin.

The whole of these pieces, as well as the basal plate and parameres, which in their ensemble Berlitz conveniently collects under the name Peritricha (88), are, it must be remembered, simply chitinous plaques developed upon the outside tube of the apparatus. In Pentatomopyges these are remarkable from their miscellaneous character, whereas in other Mallophaga the mesosomal parts are usually capable of ready classification into the endomeses and telomeses and penis.

Literature.

5. Gebel, C. G.—Insects, n. s., 1874.