Anoplura from South African Hosts.

BY

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The present paper is based upon the material in the laboratory collection, of which the majority has been collected in the Transvaal by Mr. Powell and myself. The collection also contains a number of species which have been collected in Natal by Mr. Hill, the Veterinary Research Laboratory, Maritzburg, and a few species have been very kindly presented by Mr. E. C. Chubb, Curator of the Durban Museum. To Dr. Breyer I am indebted for kindly placing the whole of the collection of Anoplura (which was collected by Mr. C. J. Swierstra) in the Transvaal Museum at my disposal, and for kindly allowing me to examine skins in the museum for parasites. The Anoplura listed include the majority of the species which are likely to be found on domestic animals and birds. Unfortunately I have only been able to enumerate a small percentage of the species in the collection owing to my not having had access to all the literature on the group and as I have not had time to work up a large quantity of material, which has only recently come to hand. No attempt has been made here to include all the previous records of species which have been found on South African hosts, because our knowledge at present is very limited and any such list would be far from complete, but it is the author's intention to give a host-list of all the known species found on South African mammals and birds at a future date, when the whole collection has been worked up and more material added.

In this paper the recent classification of Harrison * has been followed.

No attempt has been made to give a complete synonymy of all the species listed, and as a rule only well-known specific names, which have recently been sunk as synonyms, have been included.

* Harrison, L. : "The Genera and Species of Mallophaga." Parasitology, Vol. 9, No. 1, 1916.

ORDER ANOPLURA.

Sub-order Siphunculata, Meinert.

Family PEDICULIDAE.

Genus Pediculus, Linné.

Pediculus, Linné, *Syst. Nat.*, p. 610 (1758).

1. *Pediculus humanus*, Linné (1758).

Syns. *P. capitis*, De Geer (1778)
P. cervicalis, Latreille (1803)
P. consobrinus, Piaget (1880)
} Lice found on the head.

P. corporis, De Geer (1778)
P. vestimenti, Nitzsch (1818)
P. tabescentium, Alt (1824)
} Lice found on the body.

This species is very common on man, especially among the native races in South Africa, and Mr. Brain, of the Entomological Division, informs me that they are more numerous amongst the natives in Queenstown than in any other town in the Union.

The lice found on the body have, until recently, been regarded as specifically distinct from those found on the head. The chief differences between them are that the body lice are usually larger, with more hairs on the integument, the thorax broader in proportion to its length, and the lateral borders of the abdomen less festooned, but all these characters vary in different specimens. Especially is this the case with specimens found on different races of man, and Patton and Cragg *, who have studied this louse in India, state that in many instances they have found it impossible to decide whether a given specimen should be regarded as *capitis* or *vestimenti*.

The head lice found on Europeans are much lighter in colour than those found on darker races, and are more common in South Africa than the forms found on the bodies of their hosts.

Genus Phirus, Leach.

Phirus, Leach, in Brewster, Edinburgh Encycl., Vol. ix, p. 77 (1815).
Phirius, Burmeister, Handb. Ent., Vol ii, p. 52 (1835).

1. *Phirus pubis*, Linné (1758).

Syn. *P. inguinalis*, Leach (1815).

This species is also found on man throughout the Union, but is not so common as the foregoing species. As its name implies, it is usually found about the pubic region.

* Patton and Cragg: Medical Entomology, p. 546, 1913.

Genus Pedicinus, Gervais.

Pedicinus, Gervais, Hist. Nat. Ins. Apteres, Vol iii, p. 301 (1847).

1. *Pedicinus* sp.

Several females from a Vervet (*Cercopithecus pygerythrus*), Fairfield, Rustenburg District, Transvaal (W. Powell).

2. *Pedicinus* sp.

Several females from a Chacma Baboon (*Papio porcarius*), Mooi Vlei, Transvaal, 28th July, 1916 (W. Powell).

Family HAEMATOPINIDAE.

Genus Haematopinus, Leach.

Haematopinus, Leach, Zool. Miscell., Vol iii, pp. 64 and 65 (1817).

1. *Haematopinus asini*, Linné (1758).

Syn. *Haematopinus macrocephalus* Burm. (1838).

Common on horses and donkeys throughout the Union.

Fernandes * has recorded it occurring on horses and mules in Mozambique.

It has also been taken from a Burchell Zebra (*Equus burchelli*).

2. *Haematopinus eurysternus*, Nitzsch (1818).

Common on cattle in South Africa. Howard † has recorded it being common on cattle throughout Mozambique.

3. *Haematopinus suis*, Linné (1758).

Syn. *Haematopinus urius*, Nitzsch (1818).

This species is often common on pigs at Onderstepoort. Numerous specimens have also been received from Mr. A. L. Hill, the Veterinary Research Laboratory, Maritzburg, Natal.

Howard has also recorded it having been taken off pigs at Umbelusi.

4. *Haematopinus phachochoeri*, Enderlein (1908).

Syns. *Haematopinus latus*, Neumann (1908).
Haematopinus peristictus, Kellogg & Paine (1911).
Haematopinus phacochoeri, Paine (1912).
Haematopinus incisus, Harms (1912).
Haematopinus phachochoeri, Harms (1912).

One female from a Warthog (*Phacochoerus aethiopicus*), Rustenburg District, Transvaal; also a number of females and males from the same host, Bridgewater, Rustenburg District (W. Powell).

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* Fernandes, J. : "Phthiriase." Boletin de Repartiçao de Agric., Lorenço Marquis, 1914.

† Howard, C. W. : "Insects directly or indirectly injurious to man and animals in Mozambique." Bull. of Ento. Res., Vol. iii, Part ii.

Ferris has recorded this species from *Potamochoerus chaeropotamus*, Ngxwala Hill, Ubombo, Zululand.

It has also been recorded from other parts of Africa from the following hosts:

Phacochoerus aelianus massaicus, *P. aethiopicus*, *Potamochoerus choeropotamus*, and *P. africanus*.

No doubt this species will eventually be found to be common on warthogs and bushpigs throughout the Ethiopean region.

Genus Linognathus, Enderlein.

Trichaulus, Enderlein, Zool. Anzeig., Vol. xxviii, pp. 139, 141 (1904).

Linognathus, Enderlein, Zool. Anzeig., Vol. xxix, p. 194 (1905).

1. *Linognathus vituli*, Linné (1758).

This species is common on cattle, especially calves, in the Transvaal. Fernandes has recorded it from Mozambique.

2. *Linognathus setosus*, Olfers (1816).

Syn. *L. piliferus*, Burmeister (1838).

This louse does not appear to be at all common in the Transvaal. I have only taken one female off a dog at Onderstepoort. Waterston has recorded it having been taken off a dog at Capetown, and it has been recorded from Mozambique by Fernandes.

3. *Linognathus* sp.

Three females taken from a sheep in Natal (A. W. Shilston). There are altogether three species having been found on sheep, namely, *L. africanus*, Kellogg & Paine (*L. stenopsis*, Burm.) taken on sheep in Nigeria; *L. pedalis*, Osborn, found on sheep in North America and Australia; and *L. ovillus*, Neumann, which was described from specimens taken off sheep in Australia.

The specimens in the collection may be *L. ovillus*, Neumann, but as I have not seen Neumann's description I am unable to state whether it is his species or whether it is a new one.

They are closely allied to *L. setosus*, Olfers.

4. *Linognathus stenopsis*, Burmeister (1838).

This species is common on goats in the Transvaal and Natal. Fernandes has recorded it from Mozambique.

5. *Linognathus fahrenholzi*, Paine (1914).

Syn. *L. forficula*, Kellogg and Paine (1911).

Four specimens, all females, taken on a Mountain Reedbuck (*Cervicapra fulvorufula*) at Mfongosi, Zululand (collected by Mr. Jones and presented by Mr. Chubb, Curator of the Durban Museum).

6. *Linognathus ungulata*, Piaget (1885).

Two females from a Red Duiker (*Cephalopus natalensis*), Mfongosi, Zululand (collected by Mr. Jones and presented by Mr. Chubb).

7. *Linognathus caviae-capensis*, Pallas (1767).

Several females from a Cape Hyrax (*Procavia capensis*), Rooi Krans, Rustenburg District, Transvaal (W. Powell).

Genus Scipio, Cummings.

Scipio, Cummings, Bull. Ento. Res., Vol. iii, p. 393 (1913).

1. *Scipio aulacodi*, Neumann (1911).

Several females taken from a Cane-Rat (*Thryonomys aulacodus*) in the Rustenburg District, Transvaal (W. Powell).

This species has been found on the same host in Dahomey and North-East Rhodesia; also from a *Thryonomys* sp. at Mfongosi, Zululand.

2. *Scipio breviceps*, Ferris (1916).

Four females taken from the same individual as the preceding species.

This species was described from specimens taken off a *Thryonomys* sp. at Mfongosi, Zululand.

Genus Hybophthirus, Enderlein.

Hybophthirus, Enderlein, Denksch. der Medig.-Naturw. Gesells (1909).

1. *Hybophthirus notophallus*, Neumann (1909).

Numerous specimens, mostly females, taken from an Ant-bear (*Orycteropus capensis*) in the Zoo, Pretoria, 24th March, 1914 (C. J. Swierstra).

Genus Polyplax, Enderlein.

Polyplax, Enderlein, Zool. Anzeig., Vol. xxviii, pp. 139, 142, and 223 (1904).

1. *Polyplax spinulosa*, Burmeister (1839).

A number of females, males, and immature forms of this species have been taken from two or three species of rats at Onderstepoort. The collection also contains several ♀♀, ♂♂, and immature specimens taken off *Mus decumanus* at Maritzburg, Natal (A. L. Hill).

2. *Polyplax otomydis*, Cummings (1912).

This species is extremely common on the Water-rat (*Otomys irroratus*) at Onderstepoort. The collection also contains specimens taken off the same host at Jericho, Transvaal, and Mfongosi, Zululand.

Waterston has recorded it from *Otomys brantsi luteolus*, from skins in the South African Museum, Capetown.

It was described by Cummings taken from *Otomys irroratus tropicus* in British East Africa.

3. *Polyplax waterstoni*, nov. sp. (Plate I, figs. 1, 2, 4, and 5.)

A number of males and females from several rats (two species) at Onderstepoort.

Female: Length 1.46 mm., head .2 mm., thorax .13 mm., abdomen 1.13 mm., width of abdomen .48 mm.

Head: Almost as broad as long. Immediately behind the antennae the head widens abruptly and then becomes slightly narrower again. Behind the temporal margins the posterior margin turns

abruptly inwards and then becomes convex. One conspicuous hair on each side near the base of the antennae, and three backward projecting hairs at the posterior angles, the first of which is the shortest, the second about twice as long, and the third reaching to the thoracic stigma. On the ventral surface there is one longish hair on each side near the base of the antenna, and two short hairs on each side in a line with the anterior margins of the antennae.

Antennae: Five-jointed; the first joint slightly broader than long; the second nearly as long as the first, but much narrower, narrower at the base than at the apex; the third, fourth, and fifth joints small—about the same size. Sense-organ present on the fifth.

Thorax: Short, lateral margins convex, the anterior margin with a V-shaped notch, which extends as a narrow median furrow to the posterior border of the mesothorax. On the posterior margin of the mesothorax there are six hairs; the outer pair are short and situated near the lateral border; the second pair are twice as long as the first pair, and the third pair are long and extend to the abdomen. Sternal plate as in Plate 1, fig. 5.

Legs: The first pair are small with very small claws; second pair larger, claws also larger; third pair large with stout claws.

Abdomen: Elongate, broadest about the middle, rounded behind. On the dorsal surface segment i short with two hairs; segment ii with two rows of hairs, the first of two, the second of six; segment iii with one sclerite and one row of six hairs; segments iv to vii each with two sclerites and two rows of six to eight hairs. Segments viii and ix each with one sclerite and one row of six hairs. On the ventral surface segment i indistinct; segments ii to vii each with two sclerites and two rows of four to eight hairs; segment viii with one sclerite. Gonopods with three hairs, two long and one short.

Pleurae: Triangular with two long teeth on the posterior lateral margins and two short bristles; the teeth of the dorsal angle being the longer.

Pleurae of segment vii with a single tooth and two longish bristles; pleurae of segment viii without a tooth and two long bristles.

Male: Length 1.02 mm.; head .18 mm.; thorax .13 mm.; abdomen .71 mm.; width of abdomen .36 mm. Head, thorax, legs, and pleurae like those of the female. Third joint of antennae projected outwardly to a point. Posterior margin of mesothorax with only four hairs, two long and two short.

On the dorsal surface the abdominal segments have only one sclerite each. On the ventral surface segments ii and iii each have two sclerites, the remainder with one each. Distribution of hairs on the dorsal and ventral surfaces as in the female, except segment viii, which has four hairs on the dorsal surface and two median short spines on the venter.

Genitalia conspicuous. See Plate I, fig. 4.

I have much pleasure in naming the species after the Rev. James Waterston, B.D., B.Sc., of the Imperial Bureau of Entomology, to whom I am indebted for much kind assistance.

4. *P. arvicathus*, nov. sp.

Three females taken from the Striped Mouse (*Arvicanthus pumilio*) at Onderstepoort.

Female: Length 1.14 mm.; head .13 mm.; thorax .13 mm; abdomen .78 mm.

Head: As broad as long; in shape it resembles that of *P. waterstoni*. On the dorsal surface in front of the antennae there is a transverse row of four hairs. Behind the antennae there is an inconspicuous transverse suture with six hairs. One minute hair at the margin of the temples and three backward projecting hairs near the posterior angles, the first and second short (about equal), the third long and extending to the thoracic stigma; also two minute hairs on the occiput. On the ventral surface four hairs in a line with the anterior margins of the antennae; two minute hairs immediately in front of these and two longer ones behind. Antennae five-jointed, the first joint broader than long; the second very nearly as long as the first, but narrower, about the same width at the base as at the apex; the third and fourth small, about the same size; the fifth short, with a sense organ.

Thorax: Short, lateral margins convex. The anterior margin concave. On the posterior margin of the mesothorax there are two long hairs which reach the abdomen; behind these there are two short hairs. Sternal plate as in Plate I, fig. 6.

Legs: First pair small with fairly long slender claws; second pair larger, claws also larger; third pair large with stout claws.

Abdomen: Elongate, broadest about the middle. On the dorsal surface: segment i short with two hairs; segment ii with two rows of hairs, the first of two the second of four; segment iii with one sclerite and eight hairs; segments iv to vii each with two sclerites and two rows of eight to ten hairs; segments viii and ix each with one sclerite and one row of six hairs on the former segment, and two median ones on the latter. On the ventral surface segment i indistinct; segments ii to vii each with two sclerites and two rows of four to ten hairs; segment viii with one sclerite. *Gonopods* with three hairs, one long and two short.

Pleurae as in Plate I, fig. 3.

Genus Hoplopleura, Enderlein.

Hoplopleura, Enderlein, Zool. Anzeig., Vol. xxviii, p. 221 (1904).

1. *Hoplopleura intermedia*, Kellogg and Ferris (1915).

Numerous males and females from rats (two undetermined species) taken at Onderstepoort. This species was described from specimens taken on *Mus coucha* at Mfongosi, Zululand. The collection also contains several specimens, which Ferris * takes to be immature forms of this species.

Genus Haemodipsus, Enderlein.

Haemodipsus, Enderlein, Zool. Anzeig., Vol. 28, pp. 139, 143 (1904).

1. *Haemodipsus ventricosus*, Denny (1842).

Several females, males, and immature forms collected from domestic rabbits at Onderstepoort.

* G. F. Ferris: "Mallophaga and Anoplura from South Africa." Annals of the Durban Museum, Vol. I, Part 3, pp. 243–245, fig. 27, 1916.

Sub-order Mallophaga.

Family BOOPIDAE, Mjöburg.

Genus Heterodoxus, Le Souef and Bullen.

Heterodoxus, Le Souef and Bullen, Vict. Naturalist, Vol. xviii, p. 159 (1902).

1. *Heterodoxus longitarsus*, Piaget (1880).

The collection contains numerous males and females taken from dogs at Onderstepoort, 22nd May, 1915 (G.A.H.B.); Mooi Vlei, Transvaal, 30th August, 1916 (W. Powell); and at Maritzburg, Natal (A. L. Hill).

It has also been found on dogs in other parts of Africa, America, Malay Peninsula, Japan, and Formosa, and is common on kangaroos and wallabies in Australia.

Family GYROPIDAE, Burmeister.

Genus Gyropus, Nitzsch.

Gyropus, Nitzsch, Germar's Magazine, iii, p. 303 (1818).

1. *Gyropus ovalis*, Nitzsch (1838).

This species is very common on Guinea-pigs (*Cavia cobaya*) at Onderstepoort.

Genus Gliricola, Mjöberg.

Gliricola, Mjöberg, Arkiv. f. Zoologi, vi, p. 18 (1910).

1. *Gliricola porcelli*, Linné (1758).

Syn. *Gliricola gracilis*, Nitzsch (1838).

The collection contains numerous males and females taken off guinea-pigs at Onderstepoort.

Family MENOPONIDAE, Mjöberg.

Genus Menopon, Nitzsch.

Menopon, Nitzsch, Germar's Magazine, iii, p. 299 (1818).

1 *Menopon antennatum*, Kellogg and Paine (1911).

Several females and males taken off the Crowned Guinea-fowl (*Numida coronata*, Gray) at Bridgewater, Transvaal, 18th June, 1917, (W. Powell), also several females and males taken from a guinea-fowl at Maritzburg, Natal (A. L. Hill).

This species was described from specimens taken off *Numida mitrata* by H. H. King at Azzar, near Boe, Egyptian Sudan.

2. *Menopon madagascariense*, Mjöberg.

Several females and males collected from a Hammerhead (*Scopus umbetta*, Gmel.) in the Rustenburg District, Transvaal, and at Maritzburg, Natal (A. L. Hill). They differ from Mjöberg's description of his types, which were taken from the same host in Madagascar, by the presence of six hairs on the occipital margin of the head, and also by their having ten hairs instead of only six on the posterior margin of the prothorax. At each end of the transverse line there is a small spine.

3. *Menopon* (*Menacanthus*) *stamineum*, Nitzsch (1874).

Syn. *M.* (*M.*) *biseriatum*, Piaget (1880).

This species is extremely common on domestic fowls and turkeys at Onderstepoort, and on fowls at Maritzburg, Natal.

4. *Menopon* (*Menacanthus*) *numidae*, Giebel (1874).

The collection contains two ♀♀ taken off the Crowned Guinea-fowl (*Numida coronata*, Gray) at Elandsfontein, Transvaal, 11th April, 1916 (W. Powell). I have also taken it off domestic fowls at Onderstepoort on more than one occasion.

6. *Menopon* (*Menacanthus*) *giganteum*, Denny (1842).

Syn. *M.* (*M.*) *latum*, Piaget (1880).

One ♀ taken off a domestic pigeon at Onderstepoort, 2nd May, 1914 (G.A.H.B.), and one ♀ from a Cape Turtle-dove (*Turtur capicola*, Sund.), Brock Spruit, Transvaal, 2nd April, 1916 (W. Powell).

7. *Menopon* (*Menacanthus*) *spinosum*, *Piaget* (1880).

One female collected from a Red-shouldered Glossy Starling (*Lamprocolius phoenicopterus*, Swains) at Jericho, Transvaal (W. Powell). Mr. Hill has also taken a female from a Blackcap Bulbul (*Pycnonotus barbatus layardi*) at Maritzburg.

Genus Colpocephalum, Nitzsch.

Colpocephalum, Nitzsch, Germar's Magazine, iii, p. 298 (1818).

1. *Colpocephalum turbinatum*, Denny (1842).

Syn. *C. longicaudatum*, Nitzsch (1866).

Several females and males taken off a domestic pigeon at Maritzburg (A. L. Hill).

2. *Colpocephalum pygidiale*, Mjöberg (1910).

Several females and males of this distinct species taken from a Sacred Ibis (*Ibis religiosa*) in the Rustenburg District, Transvaal, 17th June, 1917 (W. Powell).

3. *Colpocephalum scopinum*, Mjöberg (1910).

Three ♀♀ and three ♂♂ taken from a Hammerhead (*Scopus umbretta*, Gmel.) at Maritzburg, Natal (A. L. Hill).

This species was described from specimens taken off the same host at Madagascar.

4. *Colpocephalum subpenicillatum*, Piaget (1885).

One ♂ from a Hadadah Ibis (*Hagedaschia hagedasch*, Lath) at Mfongosi, Zululand (collected by Mr. Jones and presented by Mr. Chubb).

5. *Colpocephalum harrisoni*, nov. sp.* (Plate II, fig. 7.)

Female: Length 3.226 mm.; width .85 mm.; ground-colour light yellowish brown. *Head*: Length .5 mm.; width .56 mm.; forehead conical, much narrower than hind head, with five short and one longish hair on each side of the median line, and five long hairs in front of the ocular emargination. Palpi long, last two segments projecting beyond the head. Antennae long, third joint with the basal half very narrow, and then gradually widening out towards the apex; fourth joint elongated-oval. Eye prominent, almost, if not quite, divided. The ocular emargination very pronounced; ocular fringe well developed; temples projecting, slightly angular in front, rounded behind, with six long hairs; occipital margin concave with four bristles; in front of the occipital margin there are two large black blotches which are connected together by a dark transverse band; ocular blotches also large and black. On the dorsal surface of the head there are two short admedian hairs in front of the blotches and three longer ones behind each blotch. Mandibles dark brown.

Prothorax: Short, narrower than the head; lateral angles produced with a short spine in each angle and two longer ones behind; just inside each lateral angle, at each end of the transverse line, there is a short hair; on the posterior margin there are four long lateral bristles and two short admedian hairs.

Mesothorax: Distinct, separated from the metathorax by an uncoloured band; slightly narrower in front than behind, with six short hairs on the posterior margin.

Metathorax: Wider than mesothorax, with several spines and hairs on the lateral margins.

Legs: Long and slender, with dark marginal bands on femora and tibiae; hind femur with a dense patch of small hairs on the ventral surface.

Abdomen: Very long and slender, broadest at segiment iii. Segiment i very short, about the same width as metathorax; segment ii considerably longer and broader. Tergites i to viii with a few hairs on the posterior margins and several short scattered hairs; tergite ix with three or four small hairs in the middle of the posterior margin, two long ones on the posterior angle and another long one just inside the angle. Segments iii and iv with the posterior margins concave. Ground-colour light yellowish brown, pleurae and lateral margins of the third and fourth segments slightly darker; ninth segment with two large square brown markings. Pleurae with several short spines. Pleurae of segments ii to ix, each with a single long hair and one or two short ones on the posterior margin. Sternites ii

* This species belongs to Ferris' new genus *Heleonomus* (*Canadian Entomologist*, p. 305, September, 1916), which includes five species found on Cranes. The collection contains several species of Mallophaga from other Bustards, but there are no species of *Menoponidae* amongst them, and as no species belonging to this family have previously been recorded from bustards, it is quite possible that the host from which the new species was taken was wrongfully recorded, or the specimens may have been stragglers.

and iii with a patch of extremely minute hairs on each side of the middle line. Sternite iv with a dense patch of minute hairs crowded together on each side of the median line. Sternites ii to viii each with a number of fairly small, irregularly arranged hairs and a large, broad median band, which is concave on its posterior margin. Lip of the opening to the genital chamber with numerous fine hairs.

Described from two females taken off a Bustard (*Otis* sp.) in Angola (T. Meyer).

I should not have ventured to describe this species had it not been for Mr. Harrison, after whom I have had much pleasure in naming it.

Genus Myrsidea, Waterston.

Myrsidea, Waterston, Ent. Month. Mag., p. 12 (1915).

1. *Myrsidea rustica*, Nitzsch (1874).

One female taken from a House Martin (*Delichon urbica*) at Brock Spruit, Transvaal, 7th April, 1916 (W. Powell).

Genus Trinoton, Nitzsch.

Trinoton, Nitzsch, Germar's Magazine, iii, p. 300 (1880).

1. *Trinoton anserinum*, Fabr. (1805).

Syns. *T. conspurcatum*, Nitzsch (1838).
T. continuum, Piaget (1880).

Several specimens, both females and males, taken from a Spur-Winged Goose (*Plectropterus gambensis*, Linné).

2. *Trinoton querquedulae*, Linné (1758).

Syns. *T. luridum*, Nitzsch (1838).
T. squalidum, Denny (1842).

Numerous specimens taken from the Red-billed Teal (*Anas erythrorhyncha*, Gm.), the South African Sheldrake (*Casarca cana*, Gm.), the Knob-Billed Duck (*Sarkidiornis melanotus*, Penn), and the South African Pochard (*Nyroca capensis*), in the Rustenburg District, Transvaal.

3. *Trinoton aculeatum*, Piaget (1885).

Numerous specimens taken from White-faced Ducks or Tree Ducks (*Dendrocygna viduata*, Linné), in the Rustenburg District, Transvaal; also several specimens taken from the South African Sheldrake (*Casarca cana*, Gm.), the Knob-billed Duck (*Sarkidiornis melanotus*, Penn.), and the White-backed Duck (*Thalassornis leuconotus*, Eyt.) in the same district. This species was described by Piaget from specimens taken off a *Dendrocygna viduata*, in the Leyden Museum.

Genus Pseudomenopon, Mjöberg.

Pseudomenopon, Mjöberg, Arkiv. f. Zoologi., vi, p. 50 (1910).

The collection contains several specimens taken from Moorhens, a Coot, a Cormorant, and a Snipe. Those taken from the Moorhens, a Coot, and a Cormorant appear to be intermediate forms between Kellogg's *P. insolens* and *P. pacificum*, the former of which was

described as a variety of *P. tridens*, Nitzsch, taken from an Eared Grebe (*Colymbus nigricollis californicus*) in the Bay of Monterey, California, and the latter also as a variety of *P. tridens*, Nitzsch, taken from an American Coot (*Fulica americana*) in the same district. For this reason I do not hesitate to sink *P. insolens* as a synonym of *P. pacificum*, K.

Those from a Snipe are a distinct species, for which I propose the name *P. rostratula*.

1. *Pseudomenopon pacificum*, Kellogg (1896).

Syn. *P. insolens*, Kellogg (1896).

This species differs from *P. tridens*, N., which has been found on Rails and Grebes in Europe, by the presence of six hairs instead of only two or four (according to Giebel, there are only four, and according to Piaget two) on the occipital margin; also by the lateral abdominal bands, which are dark brown instead of being uncoloured.

The following table gives the dimensions of the females of specimens in the collection from the different hosts, also those given by Kellogg:—

Host.	Total Length.	Length of Head.	Width of Head.	Width of Abdomen.
	mm.	mm.	mm.	mm.
1. *Gallinula chloropus*.....	1·89	0·29	0·53	0·7
2. *Gallinula angulata*.....	1·89	0·29	0·53	0·7
3. *Fulica cristata*.....	1·84	0·28	0·5	0·66
4. *Phalacrocorax lucidus*.....	1·78	0·28	0·51	0·68
5. *Fulica americana*.....	1·65	0·28	0·5	0·62
6. *Colymbus nigricollis*.....	2·00	0·31	0·53	0·72

The specimens from (1) *Gallinula chloropus* (Moorhen), (2) *G. angulata* (Lesser Moorhen), (3) *Fulica cristata* (Red-knobbed Coot), and (4) *Phalacrocorax lucidus* (White-breasted Duiker)* were all collected in the Rustenburg District, Transvaal, by Mr. Powell.

(2) *Pseudomenopon rostratula*, nov. sp.

Several females and males taken from *Rostratula capensis* (Painted Snipe) in the Rustenburg District, Transvaal, 22nd May, 1917 (W. Powell). This species closely resembles the other known species of the genus, but can be easily distinguished by the shape of the median lobe on the ventral surface of the head, which tapers to a point, instead of being broad and rounded at the apex. (Plate III, fig. 9.)

Female: Total length 1.71 mm.; length of head .28 mm.; width .5 mm.; width of prothorax .36 mm.; width of metathorax .46 mm.; width of abdomen .61 mm. Colour, pale yellowish-brown.

Head: Temples with four long bristles and some hairs; occiput with a narrow marginal band and six hairs; occipital bands very faint.

* This host was probably wrongly identified, and its true host was a species of *Podicipes*.

Prothorax: Much wider than long, with a short spine at each lateral angle; just beneath the spine there is a longish bristle, and beneath this a shorter one; inside the lateral angle, at each end of the transverse line, there is a short bristle; posterior margin with a row of ten hairs. *Metathorax*: With a row of hairs on the posterior margin.

The *abdomen* resembles that of *P. pacificum*, K., except that the lateral and transverse bands are light yellowish-brown; the lateral bands on the eighth segment and the whole of the ninth segment are, however, slightly darker than the rest of the abdomen.

Male: The male resembles the female, except that the lobes on the ventral surface of the head do not reach the posterior margin. Total length 1.32 mm.; length of head .21 mm.; width .36 mm.; width of prothorax .3 mm.; width of metathorax .35 mm.; width of abdomen .43 mm.

Family LAEMOBOTHRIIDAE, Mjöberg.

Genus Laemobothrion, Nitzsch.

Laemobothrion, Nitzsch, Germar's Magazine, iii, p. 301 (1818).

1. *Laemobothrion kelloggi*, nom. nov.

Syn. *L. africanum*, Kellogg and Ferris (1915), nec Kellogg (1910).

One female taken off a Hadada Ibis (*Hagedaschia hagedasch*) at Mfongosi, Zululand (collected by Mr. Jones and presented by Mr. Chubb).

Family TRICHODECTIDAE, Burmeister.

Genus Trichodectes, Nitzsch.

Trichodectes, Nitzsch, Germar's Magazine, iii, p. 294 (1818).

1. *Trichodectes bovis*, Linné (1758).

Syn. *T. scalaris*, Nitzsch (1838).

Numerous females and two males taken from cattle at Onderstepoort (G.A.H.B.).

2. *Trichodectes equi*, Linné (1758).

Syn. *T. parumpilosus*, Piaget (1880).

Numerous females taken from horses and donkeys at Onderstepoort. Mr. Hill has also found this species on a horse at Maritzburg. Fernandes has recorded it from Mozambique.

3. *Trichodectes pilosus*, Giebel (1874).

Syn. *T. equi*, Denny (1842), nec Linné (1758).

I have not been able to find this species in the Transvaal. Fernandes has recorded it having been taken on horses and mules in Mozambique.

4. *Trichodectes caprae*, Gurlt (1843).

Syn. *T. climax*, Nitzsch (1861).

This species is very common on both Boar Goats and Angora Goats in South Africa.

5. *Trichodectes limbatus*, Gervais (1847).

Syn. *T. crassipes*, Rudow (1866).

Several females and males taken from Angora Goats at Onderstepoort (G.A.H.B.) and at Maritzburg, Natal (A. L. Hill).

6. *Trichodectes ovis*, Linné (1758).

Syn. *T. sphaerocephalus*, Olfers (1816).

Several females and males taken from sheep at Post Alma, Waterberg District, Transvaal (Van der Walt), and in the Pietersburg District, Transvaal (O. C. Weeber).

7. *Trichodectes cornutus*, Gervais (1847).

Syn. *T. longiceps*, Rudow (1866).

Two females taken on a Mountain Reedbuck (*Cervicapra fulvorufula*) at Mfongosi, Zululand (collected by Mr. Jones and presented by Mr. Chubb).

8. *Trichodectes caffra*, nov. sp. (Plate III, figs. 10 and 11).

Female: Total length 1.22 mm.; length of head .34 mm.; length of prothorax .08 mm.; length of metathorax .05 mm.; length of abdomen .75 mm.; width of head .36 mm.; width of prothorax .28 mm.; width of metathorax .36 mm.; width of abdomen .6 mm.

Head: Very slightly wider than long. Forehead conical, emarginated at the apex, with sides slightly concave. Antennal bands broad and dark, separated in front by a small clear space. In front of each antenna there is a trabcula-like process. Antennal sinuses rather shallow. On each side of the forehead there are six hairs, two in front, three in the middle, and one above the antennal sinus. Ocular projection prominent, extending beyond the temples. Temples with a narrow dark marginal band, and three short hairs. Occipital margin straight. Occipital bands conspicuous, connected at their bases by a broad band, and meeting the antennal bands just in front of the trabcula-like processes. Antennae rather short and wide; the second segment the longest; third slightly longer than the first, with a sense organ.

Prothorax broader than long, with the posterior margin slightly convex. On each side there is a large conspicuous spiracle.

Metathorax as wide as the head, very short, with three or four short hairs on each side.

Abdomen elliptical, slightly longer than broad, with a median dark band on all the segments, except the first. On the posterior surface of each segment there is a row of a few very minute hairs.

Male: Total length 1.14 mm.; length of head .33 mm.; length of prothorax .08 mm.; length of metathorax .03 mm.; length of abdomen .70 mm.; width of head .35 mm.; width of prothorax .26 mm.; width of metathorax .35 mm.; width of abdomen .53 mm.

The *head* resembles that of the female, except that the antennal sinuses are much wider and deeper. Temples sparsely clothed with small hairs. It is quite possible that the temples in the female are also sparsely clothed with small hairs, but I cannot detect any in the type specimen.

Antennae: First segment long and wide, about as long as the second and third together, with two lines on the dorsal surface near the inner margin; second segment slightly longer than the third, with a small appendage at the base on the inner side; third segment with a sense organ situated in the middle of the segment, and two small spines at the apex.

Thorax and legs as in the female.

Abdomen oval, with median brown bands, and a row of minute hairs on the dorsal surface of each segment.

Genitalia as in Plate III, fig. 11.

Described from one female and one male taken off a Vaal Bush Cat (*Felis caffra*) at Block Spruit, Rustenburg District, Transvaal, 2nd April, 1916 (W. Powell).

9. *Trichodectes genetta*, nov. sp. (Plate IV, figs. 12 and 13).

Male: Total length 1.28 mm.; length of head .36 mm.; length of prothorax .08 mm.; length of metathorax .06 mm.; length of abdomen .78 mm.; width of head .36 mm.; prothorax .25 mm.; metathorax .31 mm.; abdomen .51 mm.

Head as long as wide. Forehead rounded, with four hairs on each side. Antennal band narrow, separated in front by a small clear space. Internal band conspicuous. In front of each antenna there is a trabcula-like process. Antennal sinuses wide and deep. Ocular projections small, with a small hair. Temples rounded, sparsely clothed with a few short hairs. Occipital margin very slightly convex. Occipital bands narrow, connected at their bases by a narrow band, and becoming indistinct towards the middle of the head. On the dorsal surface there is a transverse row of six hairs situated midway between the trabcula-like process and the anterior margin of the head; two more on each side just above the trabcula-like processes; two admedian hairs between the antennae, and two more situated almost in a line with the ocular projections. On the ventral surface there are four hairs on each side, situated just above the trabcula-like processes.

Antennae: First segment long and wide, not so long as the second and third segments together, with five hairs in a longitudinal line on the dorsal surface; second segment as long as the third, with a small appendage at the base on the inner side; third segment with a sense organ, and two small hooks at the apex.

Prothorax broader than long, but not so broad as the head, with the posterior margin very slightly convex. On each side there is a large conspicuous spiracle.

Metathorax short and broad, with four short lateral hairs on the posterior margin.

Abdomen oval, with a narrow, longitudinal band on the dorsal and ventral surface of each segment (in fig. 12 the bands on both the dorsal and ventral surfaces are depicted) and also a transverse row of minute hairs on both the dorsal and ventral surfaces.

Female (slightly immature): *Head* slightly broader than long. Forehead slightly acuminated in front. Antennal bands almost touching in front. Internal bands conspicuous in front, but become indistinct towards the base of the forehead. Antennal sinuses not so broad and deep as in the male. *Antennae* short and broad; first segment almost as broad as long, slightly longer than the second segment; the third segment a little longer than the first. Occipital bands narrow, and not connected at their base by a band, and meeting the antennal bands just above the antennal sinuses. In all other respects the female resembles the male, except that the median abdominal bands are absent, which is usually the case in immature specimens.

Described from two slightly immature females and one male taken off a Small-spotted Genet (*Genetta ludia*) at Jericho, Transvaal, 23rd March, 1916 (W. Powell).

This species appears to be closely related to *T. acuticeps*, Neumann, which was described from three females and three males taken off a genet in Abyssinia, but as Neumann's description is incomplete, and as he does not figure his species it is impossible to draw up an accurate comparison between his *T. acuticeps* and *T. genetta*. *T. genetta*, however, can be easily distinguished from *T. acuticeps* by the first antennal segment of the male, which is shorter than the two succeeding segments together in the former species, and as long as the two succeeding segments together in the latter species.

Family PHILOPTERIDAE, Burmeister.

Genus Goniodes, Nitzsch.

Goniodes, Nitzsch, Germar's Magazine, iii, p. 293 (1818).

1. *Goniodes meleagridis*, Linné (1758).

Syns. *G. stylifer*, Nitzsch (1838).

G. styliferum, Taschenberg (1882).

Males and females taken from a domestic turkey at Pretoria North, Transvaal, 24th April, 1917.

2. *Goniodes numidae*, Mjöberg (1910).

Several females and males taken from a Crowned Guinea-fowl (*Numida coronata*) at Bridgewater, Transvaal (W. Powell). This species appears to be closely related to *G. fimbriatus*, Neumann, which was described from five females and one male taken off an unknown host at Konakry, and from one female, also taken from an unknown host in Mozambique. It can, however, be distinguished by the lateral abdominal bands of the male being separated on their posterior margins.

Genus Goniocotes, Burmeister.

Goniocotes, Burmeister, Handbuch der Entomologie, ii, p. 431 (1838).

1. *Goniocotes gigas*, Taschenberg (1879).

Several specimens taken from domestic fowls at Onderstepoort and Maritzburg, Natal (A. L. Hill); also several females and males taken from a Crowned Guinea-fowl (*Numida coronata*) at Bridgewater, Transvaal, 10th June, 1916 (W. Powell).

2. *Goniocotes bidentatus*, Scopoli (1763).

Syn. *G. compar*, Nitzsch (1838).

Several females and males from domestic pigeons at Onderstepoort, 2nd May, 1914 (G.A.H.B.), and at Maritzburg, Natal (A. L. Hill).

Genus Lipeurus, Nitzsch.

Lipeurus, Nitzsch, Germar's Magazine, iii, p. 292 (1818).

1. *Lipeurus caponis*, Linné (1758).

Syn. *Lipeurus variablis*, Nitzsch (1838).

Several females and males taken from a domestic fowl at Maritzburg, Natal, June, 1917 (A. L. Hill).

2. *Lipeurus heterographus*, Nitzsch (1866).

Very common on fowls in the Transvaal and Natal.

Genus Philopterus, Nitzsch.

Philopterus, Nitzsch, Germar's Magazine, iii, p. 288 (1818).
Docophorus, Nitzsch, Germar's Magazine, iii, p. 289 (1818).

1. *Philopterus dentatus*, Scopoli (1763).*

Syn. *P. icterodes*, Nitzsch (1838).

Several females and males taken off the White-faced Duck (*Dendrocygna viduata*, Linné), the Knob-billed Duck (*Sarkidiornis melanotus*, Penn.),† and White-backed Duck (*Thalassornis leuconotus*, Eyt.) in the Rustenburg District, Transvaal; also two males taken off a domestic duck at Maritzburg, Natal (A. L. Hill).

2. *Philopterus cursor*, Nitzsch (1838).

Numerous specimens from a Spotted Eagle Owl (*Bubo maculosus*, Vieill) at Onderstepoort; also several specimens from a Bush Owl (*Syrnium woodfordi*, Gm.) in the Rustenburg District, Transvaal. Waterston has recorded this species from skins of *Bubo maculosus* and *Bubo capensis*, Gm. (the Cape Eagle Owl) in the South African Museum.

3. *Philopterus cerylinus*, Mjöberg (1910).

Several females and males taken from a Pied Kingfisher (*Ceryle rudis*, Linné) at Mooi Vlei, Transvaal, 26th August, 1916 (W. Powell).

P. cerylinus, Mjöberg, is most probably a synonym of *P. duplicatus*, Piaget, but as I have not been able to examine Piaget's description I am not in a position to state definitely whether it is or not.

* A new genus—*Anatoecus*—has recently been established by Cummings (Proc. Zool. Soc. Lond., p. 653, 1916) for the inception of this and six other species found on ducks, geese, and swans.

† A male from this host proves to be a specimen of *A. ferrugineus*, Giebel.

4. *Philopterus capistratus*, Neumann (1912).

Several females and males taken off a Brown-hooded Kingfisher (*Halcyon albiventris*) at Mooi Vlei, Transvaal, 26th August, 1916 (W. Powell), and from the same host at Maritzburg, Natal (A. L. Hill).

This species was described from two females taken off a *Halcyon semicaeruleus*, Rüpp.

The specimens in the collection differ from Neumann's in the breadth of the head, length of the abdomen, the presence of two admedian hairs in the middle of the first abdominal segment, and also by the presence of four admedian hairs on the ventral surface of the metathorax, and a row of hairs on the ventral surface of the first six abdominal segments.

In the specimens from which Neumann drew up his description there are no hairs on the ventral surface of the metathorax, nor are there any on the ventral surface of the second, third, and sixth abdominal segments. In the specimens in the collection there are two admedian hairs on the ventral surface of the first segment, six on the second, eight on the third, six on the fourth, and four on the fifth and sixth.

On the dorsal surface of the ninth segment there are two brown, lateral, triangular spots.

The male resembles the female, except that the head is as long as broad.

The following is a comparison of the measurements of Neumann's specimens and those in the collection:—

	From *H. semicaeruleus*.		From *H. albiventris*.			
	Female.		Female.		Male.	
	Length.	Breadth.	Length.	Breadth.	Length.	Breadth.
	mm.	mm.	mm.	mm.	mm.	mm.
Head.....	0·53	0·49	0·53	0·55	0·51	0·51
Thorax.....	0·27	0·45	0·28	0·48	0·25	0·46
Abdomen.....	0·96	0·63	1·11	0·68	0·93	0·63
Total.....	1·78	—	1·93	—	1·69	—

I think there can be no doubt that the specimens in the collection are Neumann's species, although there are slight differences, because, judging by his measurements and figure of the ventral surface of a female, one is led to believe that he drew up his description from two immature females.

5. *Philopterus excisus*, Nitzsch (1838).

A single male taken from a House Martin (*Chelidon urbica*) at Jericho, Transvaal, 23rd March, 1916 (W. Powell).

Genus Degeeriella, Neumann.

Degeeriella, Neumann, Bull. Soc. Zool. France, xx, p. 59 (1906).
Nirmus, Nitzsch, Germar's Magazine, iii, p. 291 (1818), nec Hermann (1804).

Ricinus, Enderlein, Deutsche Sudpolar Exped., p 447 (1909), nec De Geer.

1. *Degeeriella fusca*, Nitzsch (1842).

Syns. *D. appendiculata*, Piaget (1880).
D. vittata, Giebel (1874).

The collection contains numerous specimens of this common cosmopolitan species, which has been found on numerous falconiformes, from the African Goshawk (*Astur tachiro*, Daud), Maritzburg (A. L. Hill), the Black-shouldered Kite (*Elanus coeruleus*, Defs), Onderstepoort, 9th March, 1914 (G.A.H.B.), and the Lesser Kestrel (*Cerchneis naumannii*, Fleisch), Maritzburg (A. L. Hill).

2. *Degeeriella umbrina*, Nitzsch (1866).

Several females and males taken off the Hammerhead (*Scopus umbretta*) at Maritzburg (A. L. Hill) and in the Rustenburg District, Transvaal (W. Powell).

3. *Degeeriella hoplopteri*, Mjöberg (1910).

Several females and males taken from a Blacksmith Plover (*Hoplopterus speciosus*) at Bridgewater, Transvaal (W. Powell).

This species was described by Mjöberg from specimens taken off *Hoplopterus spinosus* in the Sudan.

4. *Degeeriella scolopacis*, Denny.

Syn. *D. truncata*, Nitzsch (1866).

One female taken off an Ethiopian Snipe (*Gallinago nigripennis*, Bp.) in the Pretoria District, October, 1897 (C. J. Swierstra).

5. *Degeeriella melanopheys*, Nitzsch (1866).

Syn. *Philopterus upupae*, Denny (1842), nec Schrank (1803). Two females and two males taken off an African Hoopoe (*Upupa africanus*) at Maritzburg, Natal (A. L. Hill).

Genus Acidoproctus, Piaget.

Acidoproctus, Piaget, Tijd. v. Ent., vi, p. 178 (1878).

1. *Acidoproctus bifasciatus*, Piaget (1878).

Numerous specimens taken off the following ducks in the Rustenburg District, Transvaal:— Red-billed Teal (*Anas erythrorhyncha*, Gm.), South African Sheldrake (*Casarca cana*, Gm.), White-faced Duck (*Dendrocygna viduata*, L.), Knob-billed Duck (*Sarkidiornis melanotus*), and the White-backed Duck (*Thalassornis leuconotus*, Eyt.); also one male from a Spur-winged Goose (*Plectropterus gambensis*, L.) taken in the same district.

2. *Acidoproctus stenopygus*, Nitzsch (1874).

Several females and males taken off a Spur-winged Goose (*Plectropterus gambensis*) in the Rustenburg District, Transvaal (W. Powell).

Genus Esthiopterum, Harrison.

Esthiopterum, Harrison, Parasitology, Vol. viii, pp. 26 and 129 (1916).

1. *Esthiopterum struthionis*, Gervais (1847).*

Syn. *E. quadrimaculatum*, Piaget (1880).

This species is common on Ostriches (*Struthio australis*, Gurn.) at Onderstepoort. Piaget obtained his specimens from a North African Ostrich (*Struthio camelus*) and also from an American Ostrich (*Rhea americana*) in the Zoological Gardens at Rotterdam.

2. *Esthiopterum crassicorne*, Scopoli (1763).

Syn. *E. squalidum*, Nitzsch (1842).

Several females and males taken off a Red-billed Teal (*Anas erythrorynchа*) in the Rustenburg District, Transvaal (W. Powell).

3. *Esthiopterum anseris*, Linné (1758).

Syns. *E. crassicorne*, Alfers (1816).

E. jejunum, Nitzsch (1842).

Several females and males taken off a domestic goose at Maritzburg (A. L. Hill).

4. *Esthiopterum gambensis*, Piaget (1885).

Two females taken off a Spur-winged Goose (*Plectropterus gambensis*, L.) in the Rustenburg District, Transvaal.

5. *Esthiopterum forficulatum*, Nitzsch (1866).

Several females and males taken off *Pelecanus rufescens*, Gm. (Pink-backed Pelican) in the Pretoria Zoo, 16th September, 1914 (C. J. Swierstra). This species was described by Nitzsch taken from *Pelicanus onocrotalus*. Kellogg has recorded it from *P. californicus* and *P. erythrorhynchus* in North America.

6. *Esthiopterum ardeae*, Linné.

Syn. *E. leucopygum*, Nitzsch (1838).

Several females and males taken from a Grey Heron (*Ardea cinerea*, Linné) in the Rustenburg District, Transvaal.

7. *Esthiopterum capitatum*, Piaget (1885).

One female taken from a Hadadah Ibis (*Hagedashia hagedash*) at Mfongosi, Zululand (collected by Mr. Jones and presented by Mr. Chubb).

8. *Esthiopterum columbae*, Linné (1758).

Syn. *E. baculum*, Nitzsch (1866).

This species is very common on domestic pigeons in South Africa. The collection also contains numerous specimens taken from the Laughing Dove (*Turtur senegalensis*, Linné) and the Damara Turtle-Dove (*Turtur capicola damarensis*, Finsch and Hartl) in the Transvaal.

Waterston has recorded it taken from a stuffed Cape Fruit Pigeon (*Vinago delalandi*) in the South African Museum.

* Cummings has recently established the genus *Struthiolipeurus* (Proc. Zool. Soc., p. 679, 1916), for *E. rheae*, Harrison, and *E. struthionis*, Ger,

9. *Esthiopterum sudanicum*, Mjöberg (1910).

Several specimens taken from *Turtur senegalensis* and *Turtur capicola damarensis* in the Transvaal.

This species was described from specimens taken off a Red-eyed Turtle-dove (*Turtur semitorquatus*, Rüpp) in the Sudan. It is not nearly so common as *E. columbae*, which is a cosmopolitan parasite on pigeons.

EXPLANATION OF PLATES.

Fig. 1.—*Polyplax waterstoni*, nov. sp. ♀.

Fig. 2.—Pleural plates of female of *P. waterstoni*, nov. sp.

Fig. 3.—Pleural plates of female of *P. arvicanthus*, nov. sp.

Fig. 4.—♂ genitalia of *P. waterstoni*, nov. sp.

Fig. 5.—Sternal plate of female of *P. waterstoni*, nov. sp.

Fig 6.—Sternal plate of female of *P. arvicanthus*, nov. sp.

Fig. 7.—*Colpocephalum harrisoni*, nov. sp. ♀.

Fig. 8.—Lobes on ventral surface of head of female of *Pseudomenopon pacificum*, Kellogg.

Fig. 9.—Lobes on ventral surface of head of female of *P. rostratula*, nov. sp.

Fig. 10.—*Trichodectes caffra*, nov. sp. ♀.

Fig. 11.—♂ genitalia of *Trichodectes caffra*, nov. sp. (The suture between the two apical abdominal segments has been omitted, and the abdominal bands on the ventral as well as those of the dorsal surface are shown.)

Fig. 12.—*Trichodectes genetta*, nov. sp. ♂.

Fig. 13.—Head of female of *Trichodectes genetta*, nov. sp.

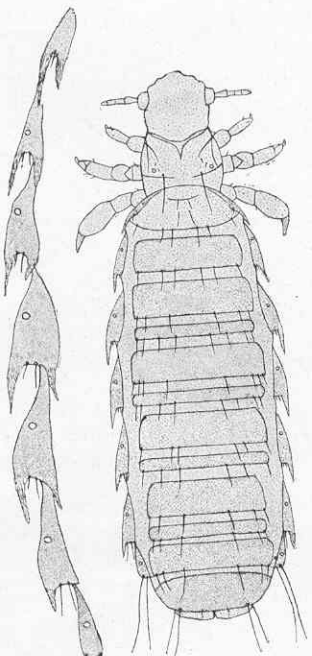


Fig. 1 & 2.

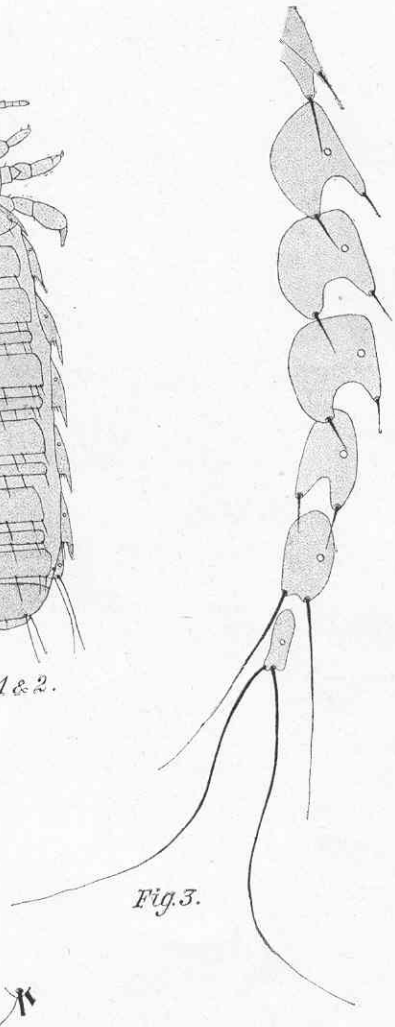
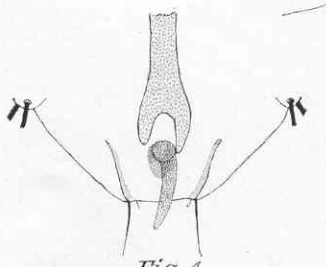


Fig. 3.



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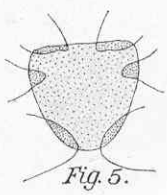

Fig. 5.

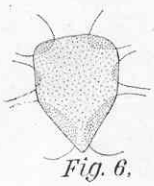

Fig. 6.

PLATE I.

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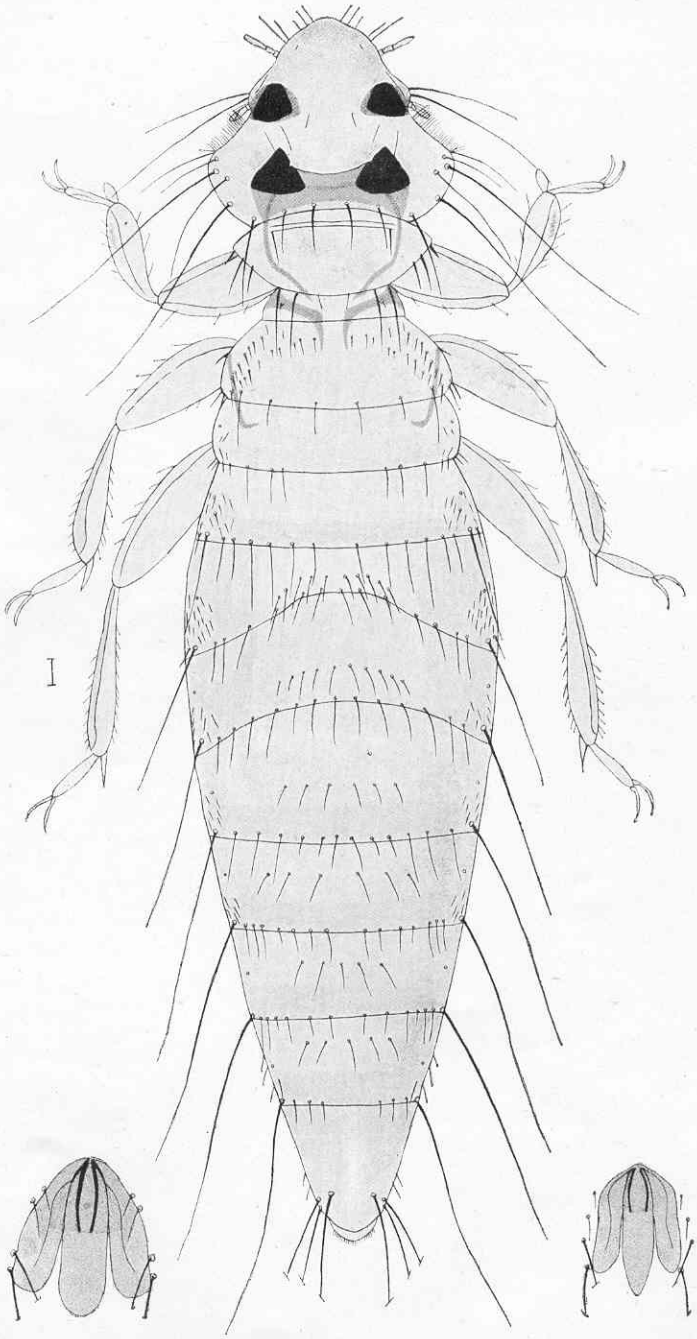

Fig. 8. Fig. 7. Fig. 9.

PLATE II.

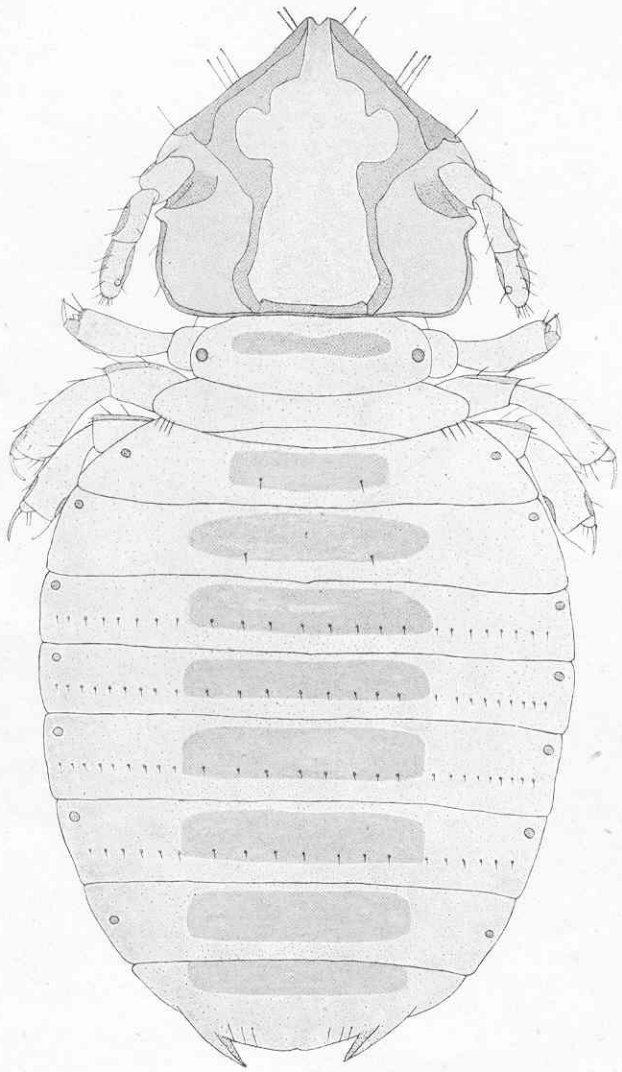

Fig. 10.

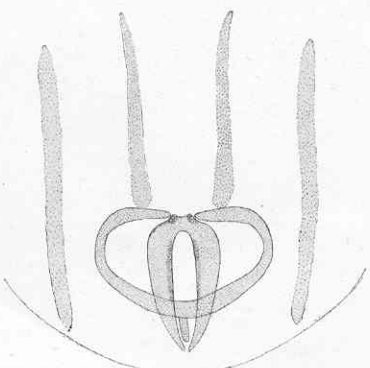

Fig. 11.

PLATE III.

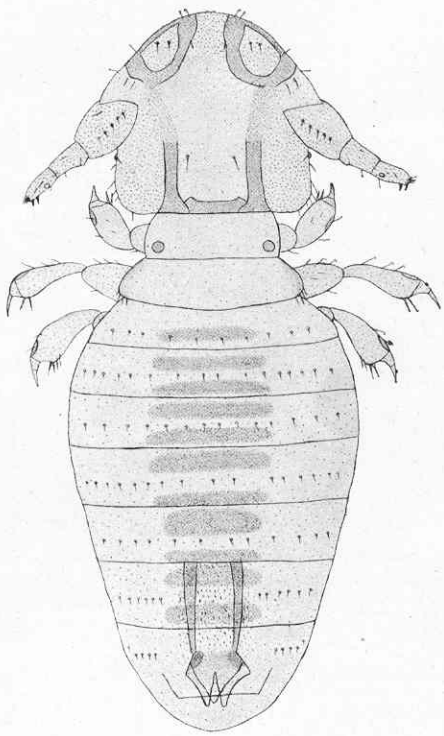

Fig. 12.

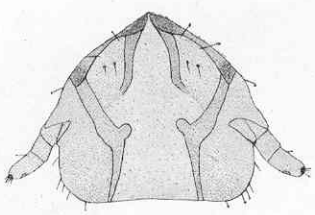

Fig. 13.

PLATE IV.