



STUDIES ON SUCKING LICE OF AFRICAN MAMMALS.
PART I—REVISION OF CERTAIN DOUBTFUL *LINOGNATHUS*
SPECIES.

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Some species of Anoplura, within the genus *Linognathus* Enderlein, have been recorded from animal hosts of such taxonomic diversity that it is inconceivable that they could possibly belong to one and the same species of which they are supposed to form different varieties. The present classification becomes even less tenable when the geographical distribution of the mammalian hosts are taken into consideration, since some of the animals occur in parts of the African continent which are far apart and well isolated.

For this reason, the taxonomy of those forms, which at present are included in the two species of *Linognathus tibialis* (Piaget) and of *L. gnu* Bedford, must be regarded as most unsatisfactory and in need of investigation. Thorough examination of all material so far available led to the conclusion that these forms, formerly considered as varieties or synonyms, actually represent closely related yet distinct species. The new findings necessitate redescriptions of the species involved, these are given in this paper. Furthermore, a new louse from the South African springbuck, as well as the male of the *Linognathus* species from the giraffe have been found lately and are described for the first time.

THE VARIETIES OF *LINOGNATHUS TIBIALIS* (PIAGET).

Several *Linognathus* specimens were collected by Piaget (1880) from different African antelopes at the Zoological Garden, Rotterdam; these he identified as a single species with two varieties on account of their striking similarity and gave the following names:—

1. *tibialis* from "*Antilope maori*";
2. *tibialis* var. *appendiculatus* from *Gazella subgutturosa* Gldenstdt;
3. *tibialis* var. *antennatus* from *Alcelaphus caama* (G. Cuvier).

A fourth variety was later added to this group by Waterston (1914), who described a new parasite from the springbuck as

4. *tibialis* var. *euchore* from *Antidorcas marsupialis* Zimmermann.

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Bedford (1918, 1926) then recorded *L. tibialis* and its variety *euchore* from the South African antelopes *Raphicerus campestris* (Steenbuck), *Aepyceros melampus* (Impala), and *Antidorcas marsupialis* (Springbuck). A few years later Ferris (1932a) made a study of the group and stated that the examination of the type material revealed absolutely no basis for the supposed varieties, and that in his opinion these varieties were purely synonyms of *L. tibialis*. In his new book on sucking lice (1951a), however, he commented that the specimens collected off the steenbuck and certain of those off the springbuck raised some doubt as to their identification. He considers them as being extremely close to *tibialis* but somewhat different.

Van K ler (1954) conducted a survey of the animal hosts of the *tibialis* varieties and directed attention to the obvious improbability that different antelopes occurring in well separated geographical regions should harbour identical parasites. He also recorded another representative of the *tibialis* group from the Dorcas gazelle; this constitutes a valuable link in the solution of the present taxonomic question. In the meantime the authors (1955) have established the identity of the above mentioned Anoplura from steenbuck and springbuck as distinct species which received the names of *L. raphiceri* and *L. antidorcitis*. Careful re-examination of the other forms within the *tibialis* group revealed a number of constant characters in both sexes, which are only small in some cases but nevertheless made it imperative to consider the so-called varieties as separate entities and split the existing group into four good species, here listed as *L. tibialis* (Piaget), *L. appendiculatus* (Piaget), *L. antennatus* (Piaget) and *L. euchore* Waterston.

1. *Linognathus tibialis* (Piaget).

Record: Females and males collected off "Antilope maori" at the Zoological Garden, Rotterdam. According to Hopkins (1949) the host is *Gazella dama mhorr* (Bennet) which occurs in Southern Morocco. Types at the British Museum, London.

Female (Fig. 1): Length 1.9 to 2.11 mm.

Head very slender (0.51 × 0.25 mm.), pre-antennal part acutely parabolic. Lateral margins of post-antennal region undulating and convergent (Fig. 2). Mouth parts extend well into the thorax. Length of antennae 0.285 mm.

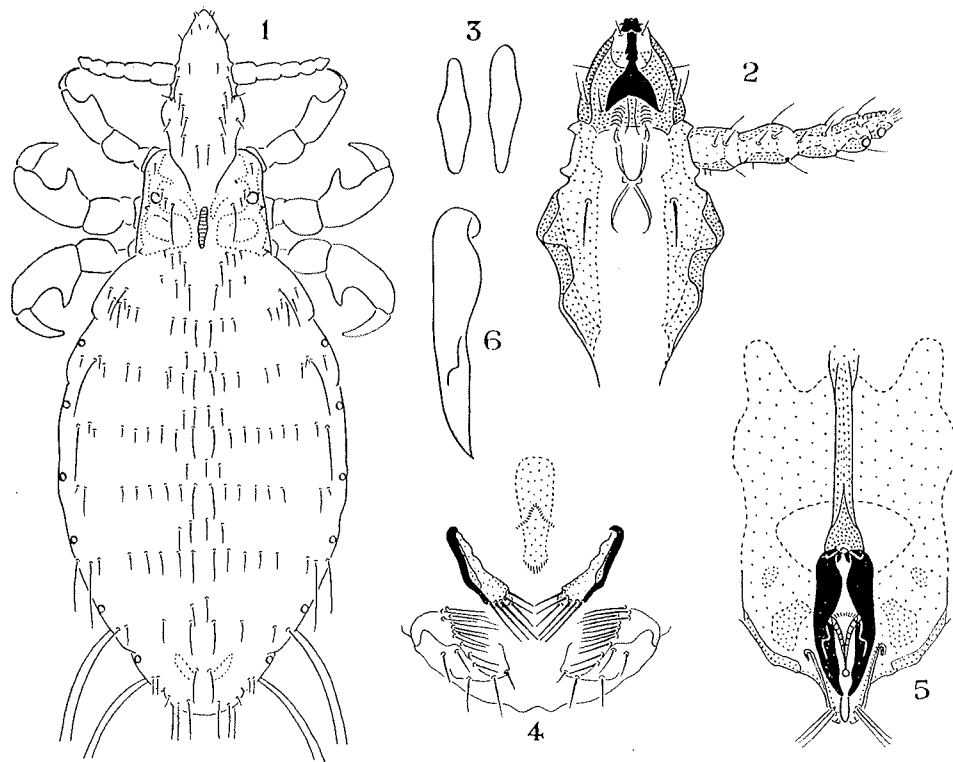
Thorax narrow and considerably shorter than head. Sternal plate small and slender, like a narrow trapezoid with rounded corners (Fig. 3). Second and third pairs of claws comparatively short (0.22 mm.), smaller than in the other three species.

Abdomen slender oval. Spiracles small, between 18.5 and 21.5 μ in diameter. Bristles on the dorsum rather short and thin, arranged in well defined rows. There is a break between the rows at the middle and the bristles at the lateral margin. The middle rows consist of 12 to 14 setae on segment 4, 12 setae on segment 5, and 9 to 10 setae on segment 6. Segments 2 to 4 bear a single long setae on either side, segments 6 to 8 have a pair of very long setae in those places.

Genitalia (Fig. 4). Gonopods small and slender, posterior end rounded with about 5 to 6 setae of more or less equal length. Sclerotic band only along the outer margin. Medium genital plate very small (132 × 39 μ) and spatulate in shape.

Male—Length about 1.6 mm. (Fig. 5).

Genital plate small ($345 \times 210\mu$), basal plate short and narrow ($210 \times 15\mu$). Parameres (Fig. 6), 145μ in length, straight and slender, rounded proximally, with a smooth round expansion at the proximal part of the inner margin. Dorsal sclerotisations on segment 9 rather small and rounded, not covering the parameres.

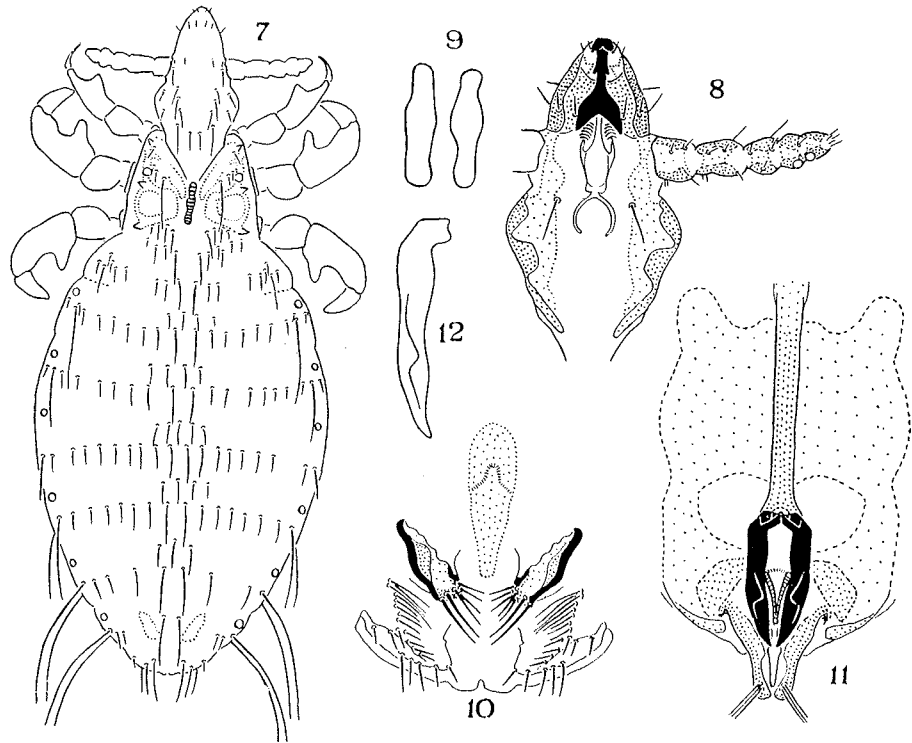


Linognathus tibialis (Piaget), (Fig. 1-6):—

- Fig. 1. Dorsal aspect of female;
- Fig. 2. Ventral aspect of head;
- Fig. 3. Sternal plates;
- Fig. 4. Genitalia of female;
- Fig. 5. Genitalia of male;
- Fig. 6. Paramere.

2. *Linognathus appendiculatus* (Piaget).

Records: Females and males taken off *Gazella subgutturosa* Gldenstadt at the Zoological Garden, Rotterdam (types at the British Museum, London), and off *Gazella dorcas* L. at the Zoological garden, Berlin, from an animal recently imported from Palestine, coll. J. Holtz, Dec. 1952 (Zool. Mus. Berlin), tentatively described as *L. tibialis* (Piaget) by von Kler (1954). Specimens (2 females) at the Hamburg Museum collected off *Gazella subgutturosa* in 1941 have been destroyed during the last war.



Linognathus appendiculatus (Piaget), (Fig. 7-12):—

- Fig. 7 Dorsal aspect of female;
- Fig. 8. Ventral aspect of head;
- Fig. 9. Sternal plates;
- Fig. 10. Genitalia of female;
- Fig. 11. Genitalia of male;
- Fig. 12. Paramere.

Female (Fig. 7)—Length 1·6 to 1·9 mm.

Head slender, but not quite as narrow as in *tibialis* ($0\cdot50 \times 0\cdot27$ mm.). Lateral margin of postantennal region rather straight and convergent (Fig. 8). Mouth parts extend to the posterior margin of the thorax. Length of antennae 0·27 mm.

Thorax narrow, shorter than head. Sternal plate small, with both extremities rounded and inflated at the middle (Fig. 9). Second and third pair of claws slightly larger than in *tibialis* (0·24 mm.).

Abdomen slender oval. Spiracles large ($24\cdot5$ to $28\cdot0\mu$). Bristles generally longer than in *tibialis*, mainly at the middle and along the margins. The setae normally are arranged in continuous rows, which consist of 15 to 16 setae on segment 4, 12 to 16 setae on segment 5, and 12 to 14 setae on segment 6. Lateral bristle on either side of segment 3 longer than in *tibialis*.

Genitalia (Fig. 10). Gonopods small but broader than in *tibialis*. Posterior ends rounded, bearing 5 to 7 bristles of different length. The two distal bristles are usually very strong and long. Sclerotic band along the distal margin well curved with a wide mesal extension. A very short sclerotic band is found at the base of the proximal margin. Median genital plate shaped like a spatula, but considerably larger than in *tibialis* ($163 \times 52\mu$).

Male. Length about 1·5 mm. (Fig. 11).

Genital plate larger than in *tibialis* ($383 \times 270\mu$), basal plate also longer and broader ($270 \times 20\mu$). Parameres (Fig. 12), 148μ in length, without an expansion at the inner margin; proximal portion rather angular. Dosal sclerotisations on segment 9 large, covering the parameres from both sides.

3. *Linognathus antennatus* (Piaget).

Record: Females and males taken off *Alcelaphus caama* (G. Cuvier), Cape or Red Hartebeest, at the Zoological Garden, Rotterdam. Types at the British Museum, London.

Female (Fig. 13)—Length 2 mm. and over.

Head shaped as in *appendiculatus* (Fig. 14) but preantennal portion acutely pointed. Pharyngeal funnel more slender. Mouth parts reach the posterior margin of the thorax. Antennae narrower and longer, measuring 0·31 mm.

Thorax short and narrow. Sternal plate long and slender with almost straight sides (Fig. 15). Second and third pair of claws slightly larger than in *tibialis* and *appendiculatus* (0·255 mm.).

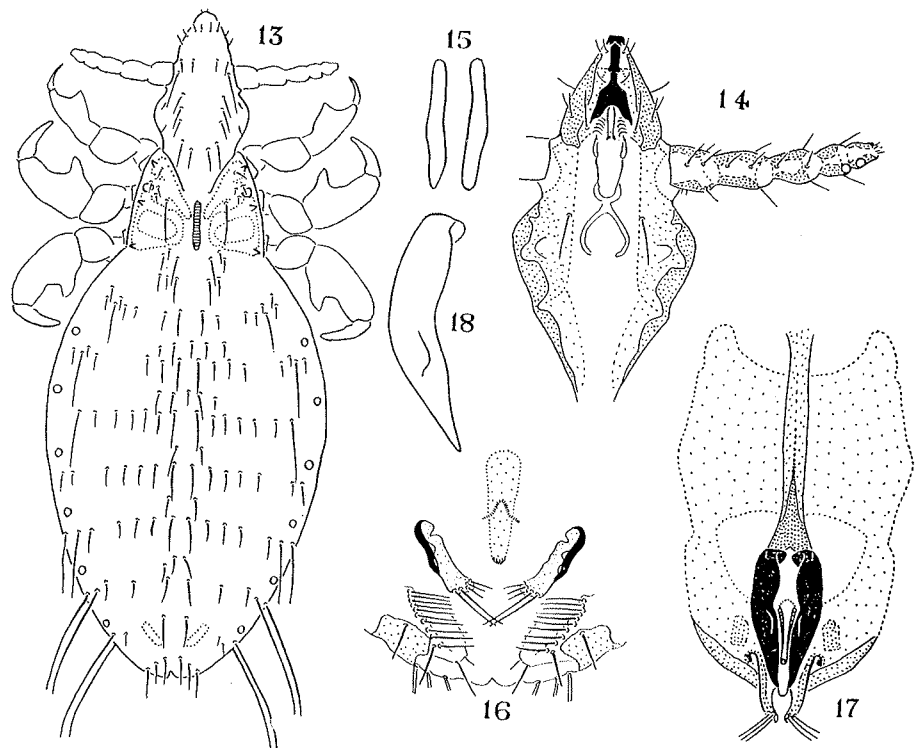
Abdomen slender oval. Spiracles larger than in *tibialis* but smaller than in *appendiculatus*, measuring between $21\cdot5$ and $24\cdot5\mu$. Structure and pattern of bristles very similar to *tibialis*; however, the rows on each segment consist of fewer setae. There are 10 to 12 setae on segment 4, 10 on segment 5, and 8 to 10 on segment 6.

Genitalia (Fig. 16). Gonopods very similar to those of *tibialis*. The setae at the posterior end, five in number, are divided into a group of two long and a group of three short bristles. A sclerotic band is only present along the proximal part of the lateral margin. Median genital plate very small ($132 \times 40\mu$).

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Male—Length about 1·2 mm. (Fig. 17).

Genital plate larger than in *tibialis* ($375 \times 255\mu$), basal plate also longer and broader ($240 \times 18\mu$). Parameres (Fig. 18), 151μ in length, are curved like a crescent. Dorsal sclerotisations on segment 9 are rather minute and considerably smaller than in *tibialis*.

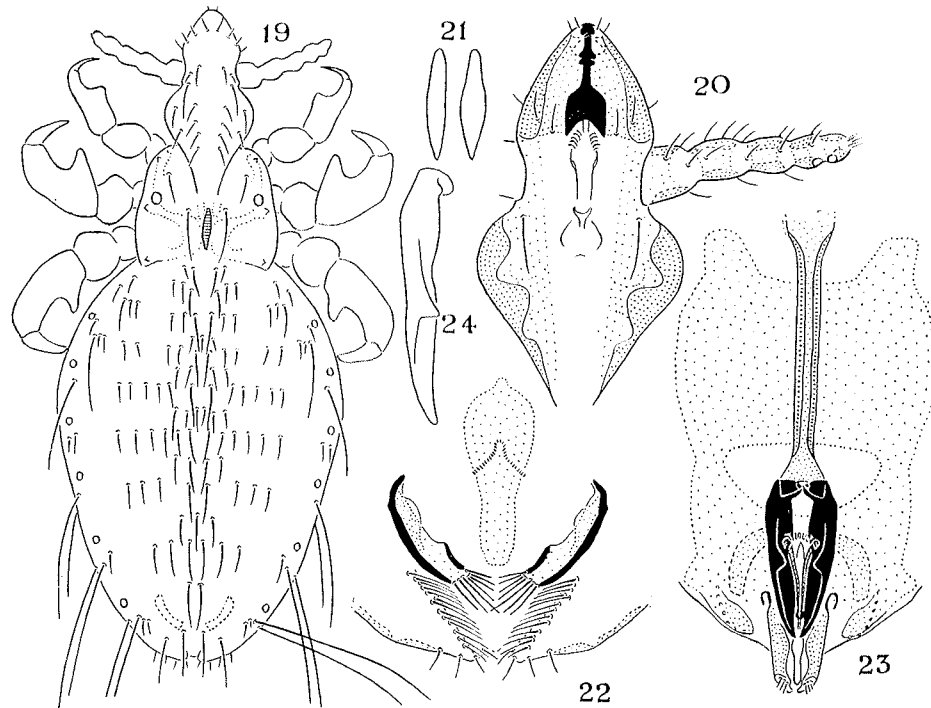


Linognathus antennatus (Piaget), (Fig. 13–18):—

- Fig. 13. Dorsal aspect of female;
- Fig. 14. Ventral aspect of head;
- Fig. 15. Sternal plates;
- Fig. 16. Genitalia of female;
- Fig. 17. Genitalia of male;
- Fig. 18. Paramere.

4. *Linognathus euchore* Waterston.

Records. Females and males taken off a springbuck, *Antidorcas marsupialis* Zimmermann (types at the South African Museum, Cape Town), and off the same host from the Northern Transvaal, collected G. A. H. Bedford, 25.7.1930, (Onderstepoort collection).



Linognathus euchore (Waterston), (Fig. 19-24):—

- Fig. 19. Dorsal aspect of female;
- Fig. 20. Ventral aspect of head;
- Fig. 21. Sternal plates;
- Fig. 22. Genitalia of female;
- Fig. 23. Genitalia of male;
- Fig. 24. Paramere.

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Female (Fig. 19)—Length 1.7 to 1.8 mm.

Head slender and well curved (0.5 × 0.27 mm.). Preantennal region parabolic, lateral margin of postantennal region strongly convex (Fig. 20). Mouth parts very long, extending into the first abdominal segment. Length of antennae 0.27 mm.

Thorax very narrow and considerably shorter than head. Sternal plate small and slender, shaped like a spindle (Fig. 21). Second and third pair of claws rather large (0.26 mm.).

Abdomen oval. Spiracles of the same size as in *antennatus* (21.5 to 24.5 μ in diameter). Structure and pattern of the dorsal bristles very similar to *tibialis* and *antennatus*, showing 10 to 12 setae on segments 4 and 5, and 8 to 9 setae on segment 6. The break between the rows and the marginal setae is even wider than in *antennatus*. Bristles along the margin are very long.

Genitalia (Fig. 22). Gonopods long and narrow, posterior end blunt with between 6 and 7 setae of medium length. Sclerotic band along the outer margin curved inwards with a wide chitinised expansion at its proximal part. A second short band is present at the inner margin. Median genital plate large (179 × 71 μ), spatulate, with curved outlines.

Male. Length between 1.5 and 1.6 mm. (Fig. 23).

Genital plate very large (405 × 255 μ), basal plate also rather long (270 × 18 μ). Parameres (Fig. 24) fairly long (160 μ), straight and slender. Spur at the middle of the parameres prominent on a crest-like base. Dorsal sclerotisations on segment 9 large and shaped like a crescent, extending well across the parameres.

LINOGNATHUS SPECIES OF SOUTH AFRICAN WILDEBEEST.

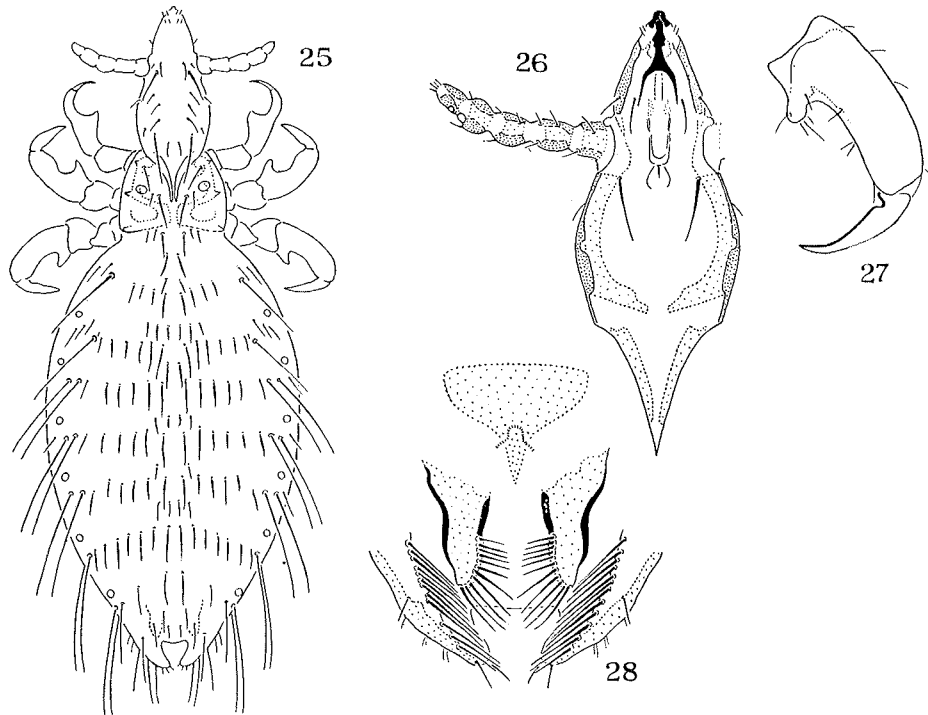
Bedford (1927a) described a *Linognathus* species from two females taken off a *Connochaetes gnu* (Zimmermann), black wildebeest, as *Linognathus gnu*. A single male collected off *Gorgon taurinus* (Burchell), blue wildebeest, was described by him in the same paper (1927b) as a different species and given the name of *Linognathus ferrisi*, which was later changed (1929) into *gorgonus*, as *ferrisi* was pre-occupied. With more material from *Gorgon taurinus* on hand, Bedford (1932) considered the two species as identical, *L. gnu* having priority.

Ferris (1932b, 1951b) with only a male and a female from the blue wildebeest, forwarded to him by Bedford, before him, confirmed the synonymy without having seen the parasites of the black wildebeest. Fahrenholz (1939) considered the two species to be distinct according to the illustrations given by Bedford and by Ferris.

The examination of the material in the Onderstepoort collection shows that Fahrenholz is correct and that the lice off the two wildebeest species are by no means identical and must be regarded as two distinct species. The description and illustrations given by Ferris (1932b) for *L. gnu*, actually refer to *L. gorgonus*. The two species differ in character, as will be seen from the descriptions below.

5. *Linognathus gnu* Bedford.

Record. Two females (types) taken off *Connochaetes gnu* (Zimmermann) at Clocolan, Orange Free State, by G. A. H. Bedford, 18.8.1920. Types in the Onderstepoort collection.



Linognathus gnu Bedford (Fig. 25-28):—

- Fig. 25. Dorsal aspect of female;
- Fig. 26. Ventral aspect of head;
- Fig. 27. Claw of second and third pairs of legs;
- Fig. 28. Genitalia of female.

Female (Fig. 25).—Length 2·60 mm.

Head widest at the temples, which are moderately chitinated, tapering anteriorly with straight margins, (Fig. 26). Preantennal region acutely pointed.

Thorax very small and narrow. Sternal plate not visible. Second and third pairs of legs bearing thin claws which end in a fine point (Fig. 27).

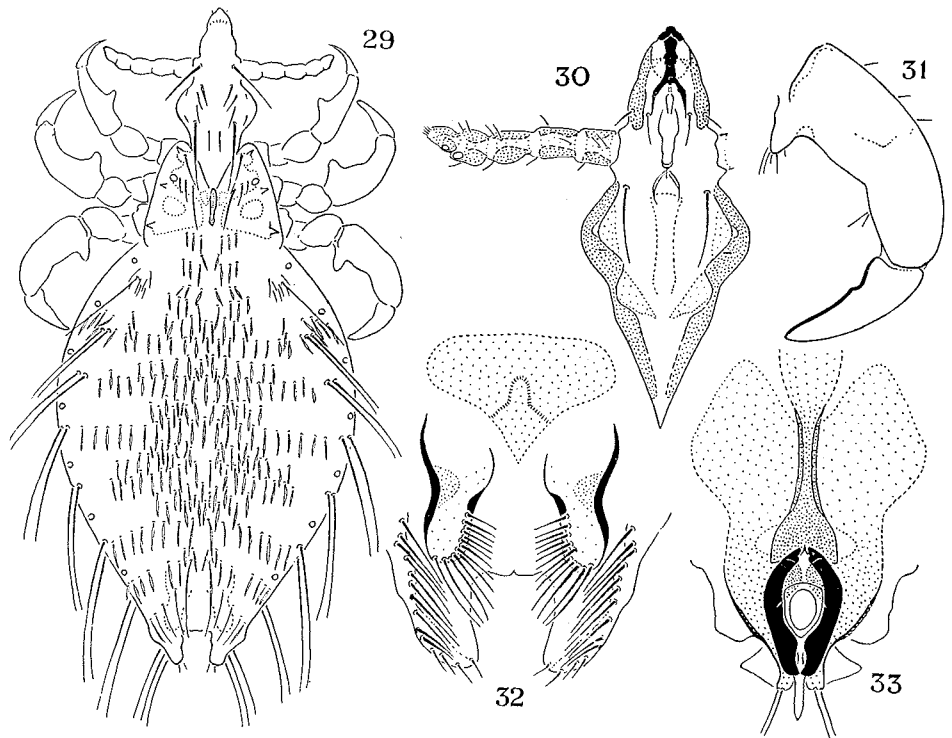
Abdomen slender oval with thin bristles. Each segment on the dorsum is carrying between 17 and 22 setae. Segments 2 and 3 possess a single very long bristle at the margin on either side.

Genitalia (Fig. 28). Gonopods shaped like a scalpel, with distal end rather pointed. Setae along the mesal margin standing in one row. Median genital plate short and broad rather triangular in shape with a thin distal protuberance.

Male still unknown.

6. *Linognathus gorgonus* Bedford.

Records. Two males (including the holotype) taken off *Gorgon taurinus* (Burchell) at the farm Mokka, Zoutpansberg district, Northern Transvaal, by G. A. H. Bedford, 26.7.1924; and a male and a female from the same host at Maasroom, Northern Transvaal, by R. Daly, 13.8.1930. Types in the Onderstepoort collection.



Linognathus gorgonus Bedford (Fig. 29-33):—

- Fig. 29. Dorsal aspect of female;
- Fig. 30. Ventral aspect of head;
- Fig. 31. Claw of second and third pairs of legs;
- Fig. 32. Genitalia of female;
- Fig. 33. Genitalia of male.

Female (Fig. 29)—Length 2.20 mm.

Head long and slender. Preantennal region sharply parabolic, postantennal region strongly convex, lateral margin with a heavily chitinised band (Fig. 30). Bristles longer and stouter than in *L. gnu*.

Thorax short and broad. Small sternal plate present. Second and third pairs of legs bearing strong claws which end in a rather blunt point (Fig. 31).

Abdomen oval with fairly broad, lanceolate setae, more numerous than in *L. gnu*, about 40 per segment. A single long bristle exists on either margin of segment 2, all the other segments possess two marginal bristles.

Genitalia (Fig. 32).—Gonopods spatula-shaped with a round distal end. Setae along the mesal margin arranged in more than one row. Median genital plate short and broad, rather oval in shape with a wide distal protuberance.

Male. Length 1.63—1.78 mm.

Genitalia (Fig. 33). Similar to those of *L. hippotrugi* Ferris. Proximal part of genital plate considerably enlarged. Basal plate of an hour glass shape. Parameres have the shape of a crescent, with a rounded expansion on the mesal margin near the distal end. A second, more transparent and larger lobe exists near the proximal end. Endomeral piece broadly ring-shaped. Pseudopenis very long. Apex of abdomen with two triangular expansions pointing sideways.

LINOGNATHUS SPECIES OF THE GIRAFFE.

Giebel (1874) described a sucking louse taken off a giraffe in captivity under the name *Haematopinus brevicornis*. The whereabouts of the type material is uncertain. Ferris (1932c) gave a redescription of the species which is based on two females in the Piaget collection, the only specimens known at the time.

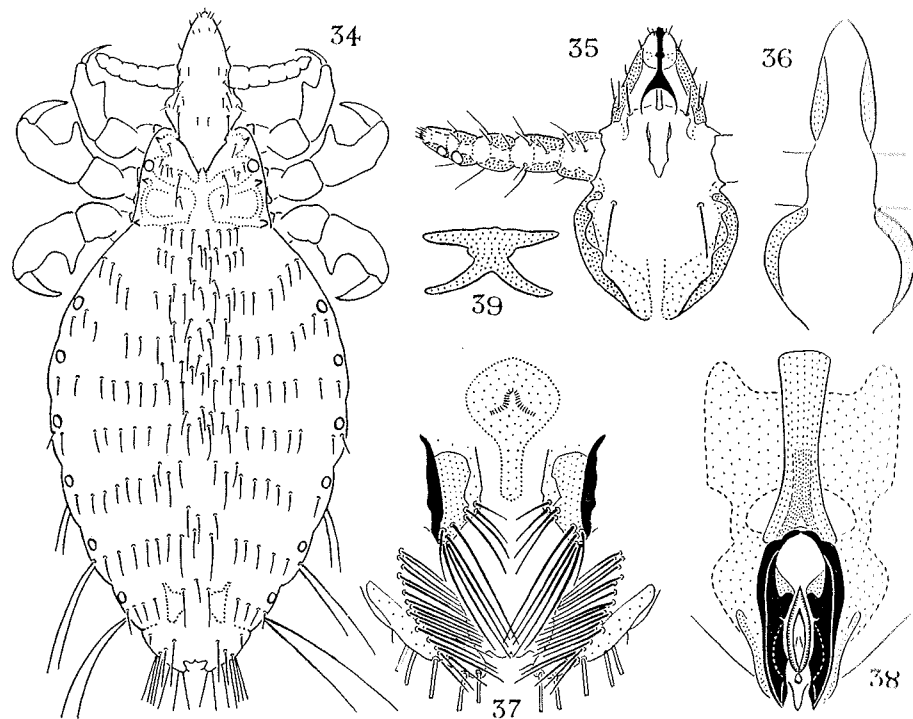
Through the kindness of Dr. S. von Kéler, Zoological Museum, Berlin, the authors have received Anoplura material from a giraffe, identified as *Linognathus breviceps* (Piaget) by Enderlein. By comparing this material with the specimens of the Piaget collection it is seen to be *L. brevicornis* (Giebel). Since these females shew considerable variation of certain characters not mentioned by Ferris (1932c) and since the male has been found, it has been decided to bring the description of the species up to date, basing our description on all the material available.

7. *Linognathus brevicornis* (Giebel).

Records. Two females of the Piaget collection, labelled as "*Haematopinus brevicornis* sur une *Camelopardalis giraffa*". The specimens are at the British Museum, London, and are regarded as paratypes as it is not confirmed whether they belong to the same lot on which Giebel based his original description (Ferris 1951c). Nine females and one male taken off a giraffe, *Giraffa camelopardalis* (L.), at the Zoological Garden, Königsberg, East Prussia, by Dr. R. Müller in November 1931. The specimens are in the collection of the Zoological Museum, Berlin. The male is designated as neotype, and the nine females represent paratypes.

Female (Fig. 34).—Length 1·77 to 2·25 mm.

Head, elongate and acutely pointed, rather constant in length, between 0·50 and 0·54 mm. The width varies considerably, between 0·075 and 0·159 mm. in the preantennal region, and between 0·18 and 0·27 mm. in the postantennal region; resulting in a head that either is triangular in shape (Fig. 35), or very narrow, with nearly parallel lateral margins up to the base of the antennae, followed by an almost circular post-antennal region (Fig. 36). The occipital region is constricted into a “neck”. The sclerotic structures consist of a transverse band in the preantennal region. A second band runs along on either side of the postantennal region, which becomes broader towards the occipital region. The pharyngeal funnel is either very narrow and triangular or shaped like a bell in accordance with the width of the head. Pharynx without brushes. The mouth parts reach the posterior end of the thorax.



Linognathus brevicornis (Giebel), (Fig. 34–39):—

- Fig. 34. Dorsal aspect of female;
- Fig. 35–36. Ventral aspect of head;
- Fig. 37. Genitalia of female;
- Fig. 38. Genitalia of male;
- Fig. 39. Sclerotisation on terminal segment of male.

Thorax shorter than head and fairly wide. Sternal plate absent.

Abdomen elongate oval with shortish setae arranged in the normal pattern. Long marginal setae only on segments 6 to 8. Terminal lobes of medium size bearing a row of long bristles along the posterior margin. Spiracles moderately large, about 43μ in diameter.

Genitalia (Fig. 37). Gonopods small, with apices divergent. Mesal margin with about 10 setae of different length, usually arranged in two clusters. Genital plate strongly spatulate, measuring about $155 \times 100\mu$.

Male. Length 1.52 mm. (Fig. 38).

Genital plate of normal pattern ($330 \times 225\mu$), basal plate short and very wide ($225 \times 60\mu$). Parameres large (180μ long) and fairly broad with rather blunt distal ends and a knob-like expansion on the mesal margin near the proximal third. Endomerical piece forming an elongate ring. Pseudopenis short and thin with long and semi-circular basal arms, projecting only slightly beyond the end of the parameres. An X-shaped sclerotisation (Fig. 39) is lying dorsally across the parameres.

Note.—This species is related to *L. taurotragus* Bedford collected off the Cape Eland, *Taurotragus oryx oryx* (Pallas).

LINOGNATHUS SPECIES OF THE SPRINGBUCK.

Up to the present three *Linognathus* species have been collected off the springbuck in the Union of South Africa. These are *L. bedfordi* Ferris, *L. euchore* Waterston, and *L. antidorcitis* Fiedler and Stampa. A fourth species was found by one of the authors in the Karoo Area of the Cape Province, which is described hereunder as:

8. *Linognathus armatus* sp. nov.

Record. Females and males taken off a springbuck. *Antidorcas marsupialis marsupialis* (Zimmermann) in the Graaff-Reinet District, Cape Province, by S. Stampa on 15.6.1954. Types in the Onderstepoort collection, paratypes at the British Museum, London, and at the Zoological Museum, Berlin.

Female (Fig. 40). Length between 1.95 and 2.25 mm.

Head robust and well curved with fairly long antennae (0.31 mm.) set forward of the middle. Preantennal region almost parabolic with a heavily chitinised, transverse band; postantennal region with a strongly convex lobe on either side bearing a thick hemispheric chitinisation which ventrally extends a certain distance towards the middle (Fig. 41). Pharyngeal funnel slenderly parabolic. Pharynx with brushes. Mouth parts reach the posterior margin of the thorax.

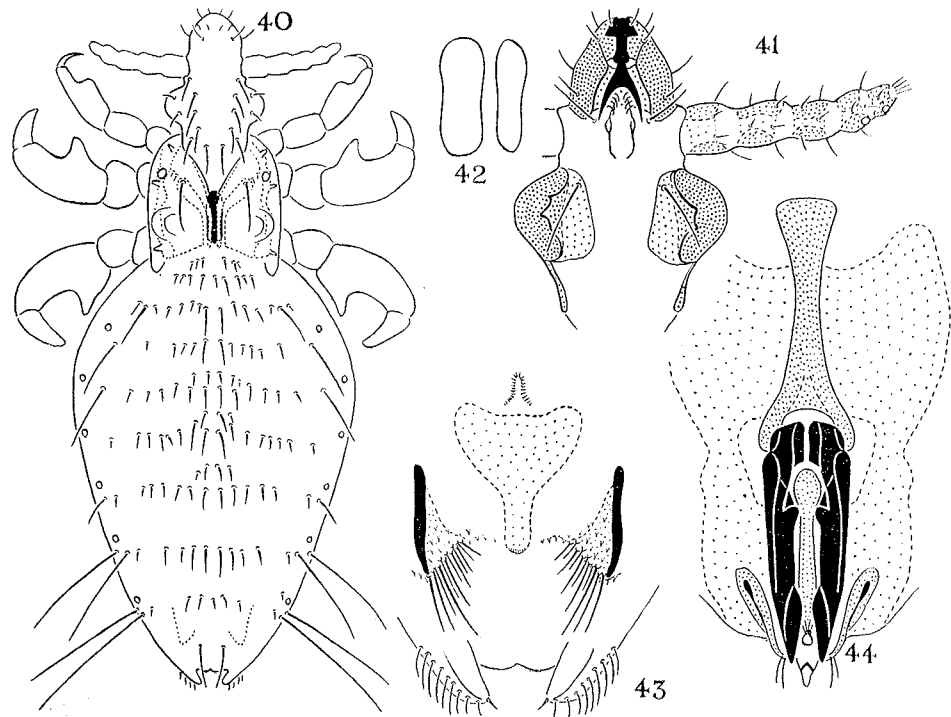
Thorax shorter than head and well chitinised. Propleurites long and narrow, sometimes extending along the middle to the posterior margin of the thorax, as indicated in Fig. 40. Sternal plate larger than in any other *Linognathus* species so far known, 180μ long and up to 60μ wide (Fig. 42). The claws of the second and third pairs of legs are thick and strong.

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Abdomen oviform. Bristles arranged in the normal pattern, but short and thick, except for the single marginal setae in segments 2 to 4, a pair on either side of segments 7 and 8, and a median pair on segment 9. The spiracles are relatively small, 24 to 27 μ in diameter. Terminal lobes of medium size with a row of extremely short setae.

Genitalia (Fig. 43). Gonopods triangular with apices divergent. The mesal margin bears two rows of fairly short bristles varying in length. Genital plate almost shaped like a heart with a long posterior processus.

Male. Length between 1.68 and 1.83 mm. (Fig. 44).



Linognathus armatus sp. nov. (Fig. 40-44):—

Fig. 40. Dorsal aspect of female;

Fig. 41. Ventral aspect of head;

Fig. 42. Sternal plates;

Fig. 43. Genitalia of female;

Fig. 44. Genitalia of male;

Genital plate of normal shape and large. Basal plate almost shaped like an hour glass, posteriorly with a round indentation. Parameres straight and extremely large, of the same length as the genital plate (300μ). Endomerical piece long and spatulate. Pseudopenis short and thick, protruding only slightly.

Note.—The genital features, though clearly different in many characters, have a certain similarity to those of *L. antidorcitis* Fiedler and Stampa, which was collected from the same host in the Northern Transvaal.

ACKNOWLEDGMENT.

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