

## FURTHER NOTES ON LILOPTENINAE (Diptera: Hippoboscidae)<sup>1</sup>

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**Abstract:** Contained in this paper are revisions of the *sepiacea* and *depressa* species-groups of *Lipoptena*, descriptive and other notes on species of other groups, and a revised scheme of natural grouping within the subfamily. Palpi (lateral view), hind tarsi (ventral view) and wings are illustrated for the first time for 21, 15 and 4 species, respectively. *L. indicum* (sic) Rao et al. is considered a synonym of *L. pauciseta* Edw. while *L. indica* Maa (nom. praeocc.) is renamed *L. axis*. New species and subspecies described are: *Lipoptena nirvana*, Vietnam, host uncertain; *L. saepes*, Nepal, ex *Axis porcinus*; *L. timida*, Nepal, host uncertain; *L. saltatrix*, India, ex *Hemitragus jemlahicus* and *Naemorhedus goral*; *L. arianae*, Iran, ex *Ovis* sp.; *L. weidneri*, India, host uncertain; *L. depressa pacifica*, California and Brit. Columbia, ex *Odocoileus hemionus*; *Melophagus ovinus himalayae*, Nepal, host uncertain.

The following notes serve as a supplement to my earlier (1965) paper on the subfamily Lipopteninae (=Melophaginae). For the loan of material and other courtesies, I am deeply indebted to Drs P. H. Arnaud Jr. (San Francisco, Calif.), A. P. Kapur (Calcutta), H. E. McClure (Bangkok), M. G. Ramdas Menon (New Delhi), B. V. Peterson (Ottawa), K. R. P. Singh (Poona), A. Stone (Washington, D. C.), R. Traub (Baltimore, Md.), H. Weidner (Hamburg) and R. L. Wenzel (Chicago, Ill.). The camera lucida drawings accompanying the paper were patiently executed by C. T. Lin, P. Y. Hu and S. H. Kuang. The H-number beside each figure indicates the catalogue number of the slide upon which the drawing was based. In the description, averages of setal numbers are in parentheses and for brevity, the term "tergite" is understood to refer to the median tergal plate numbered in accordance with the corresponding abdominal spiracle. In the keys, supplementary characters are also in parentheses.

### ***Lipoptena japonica* Bequaert, 1942**

This species is so far known only from the original description and the unique ♀-type, said to have been taken ex *Capricornis crispus* Temminck in Honshu, Japan (no more details). The authenticity of this record needs verification. The describer of the species believed it to be "very closely related" and "so much so indeed" to *L. couturieri* Séguin which breeds on *Rupicapra rupicapra* Linn. in the Pyrenees. The belief was probably on the bases of the superficial similarity in hairiness of these 2 species and the close affinities of their recorded hosts *Capricornis* and *Rupicapra*. A comparison of the arrangement

1. Partial result of a grant to Bishop Museum from the U. S. National Institutes of Health (AI 01723-11)

of orbital setae, distribution of prosternal setae, robustness and hairiness of legs, relative size of tergite 3 and particularly the sclerotization and setal arrangement of ♀ terminalia clearly shows that *japonica* approaches *cervi* Linn. in affinities. Theodor *et al.* (1964: 64) also pointed out that *japonica* "steht jedoch in anderen Merkmalen [not specified] *L. cervi* sehr nahe." By implication of the host-parasite evolutionary parallelism, I venture to suggest that the true host of *japonica* most probably belongs to Cervidae: Cervinae rather than Bovidae: Caprinae: Rupicaprini. The unique type specimen might even have been originated from a museum skin or zoo animal and from a country other than Japan where the only cervine is *Cervus nippon* Temm., the host of *L. fortisetosa* Maa. In the type, the prosternal lobe is anteriorly rounded and is rather uniformly beset with setae, the median pregenital plates bear 9 long setae, the lateral ones, each 4 (1+3) setae.

**Lipoptena nirvana** Maa, new species      Fig. 62, 91, 98.

**TYPE SERIES.** 1 alate ♂. Holotype (BISHOP 7596). VIETNAM: Holotype, Fyan, 900–1000 m, VII–VIII.1961, N. R. Spencer.

**Habitats.** At present only known from S. Vietnam, submontane. Host unknown, possibly *Cervus (Rusa) unicolor equinus* Cuvier (Assam to Vietnam and S. China, Malaya, Sumatra) or *C. (Panolia) eldi siamensis* Lydekker (Thailand, Vietnam, Hainan).

**Affinities.** Not quite clear, pending the availability of further material. Insofar as the unique alate ♂ is concerned, this species appears to stand very closely to *sigma* Maa (Taiwan ex *C. unicolor swinhoei* Sclater) and differs from the latter in having fewer setae on pleurite 1, longer posterior lobes of sternite 1 and differently shaped genitalia. The next close relative is probably *efovea* Speis. (Ceylon, possibly ex *C. unicolor unicolor* Kerr) which is, however, more richly setose on pleurite 1 and has much narrower and less richly setose tergites 4 and 5 (genitalia not compared). The name *nirvana* (Sanskrit, the state of perfect blessedness in Buddhism achieved by extinction of all desires and passions) is suggested for the war-stricken Buddhist country Vietnam.

**Description.** Body moderately dark. Length (head + thorax) 2.1 mm. Head strongly narrowed behind eyes. Eye fairly large, laterally not reaching margin of head. Inner orbit less than 1/2 as wide as eye, with 1 vertical and 2 orbitals. Postvertex *ca* 2/5 as long as wide, hardly raised; ocellar triangle scarcely longer than wide; mediovertex longer than wide. Palpus (fig. 62) longer than antennal pit, in lateral view *ca* 2.7× as long as wide. Pronotum ribbon-like, both anterior and posterior margins gently curved at middle. Median notal and transverse mesonotal sutures ending at same level, not reaching scutellum; longitudinal intrascutal groove distinct. Mesonotal chaetotaxy: 3 humerals, 5–6 acrostichals, 5–6 laterocentrals, 4 postalars, 2 prescutellars, 8 scutellars (in 4 pairs); outermost scutellars *ca* 1/3 as long as innermost ones. Prosternal lobe wider than long, anteriorly narrowly rounded, anterior 1/2 with 11–13 spines (in 3 rows) plus 1 pale bristle; mesosternum evenly spinose, spines of hindmost row stouter and slightly longer than those of anterior rows and mixed with 1 long bristle on each side; metabasisternum with 4 spine-rows, spines of inner 1/2 of hindmost row 2× as long as those of outer 1/2 where they are about as stout as on mesosternum, spines of anterior rows finer and shorter than on mesosternum. Wing (fig. 98) 4.1 mm long, similar to that of *cervi* Linn. but C with only 10± setulae (in *cervi*, with 20± setulae) between apices of R<sub>1</sub> and R<sub>4+5</sub> and interior angle formed by R<sub>4+5</sub> and *rm* much smaller. Legs rather similarly setose as in *pauciseta* Edw.; femora 1 and 2 each with 3 long bristles arranged in single series along dorsomedian line; tibia 2 with 1 major and 1 minor apical spur, major one more than 2× as long as minor; tibia 3 with 4 spurs plus 1 seta at extreme apex, with 2 stout spines plus 1 shorter spine on anteroventral margin; tarsomeres 4 and



5 of leg 3 closely similar to that of *saepes*, each with 2 plantar spines; anterior pulvilli of all legs *ca* 1/2 as long as corresponding posterior pulvilli; anterior claws of all legs longer than posterior ones. ♂ abdomen: Pleurite 1 reniform, transverse, with  $9\pm$  bristles on posterior and outer margins, and 12-13 small setae largely arranged near posterior margin. Pleurite 2 and tergite 3 (?). Tergites 4 and 5 very wide, each with single row of  $18\pm$  setae; tergite 6+7 large, bearing 3 setae on each side. Sternite 1 posteriorly curved nearly semicircularly, its outer margin straight at basal 3/5, gently curved at apical 2/5, posterior lobes short, hardly divergent, apically acute. Genitalia (fig. 91) rather similar to that of *sigma* Maa but aedeagus not hook-like at extreme apex, paramere broader and slightly upcurved near apex, and postgenital plate less richly setose. ♀ unknown.

### *Lipoptena sigma* Maa, 1965

The mesonotal chaetotaxy of the alate ♂ mentioned in the original description: 3 humerals, 8 acrostichals, 5 laterocentrals, 4 postalars, 3 prescutellars, 8 scutellars. Its palpus, wing and ♂ genitalia were not critically compared.

### *Lipoptena saepes* Maa, new species      Fig. 1, 3, 4, 61, 77.

TYPE SERIES. 7♀♀. Holotype ♀ (BISHOP 7597) and 3 paratypes (BISHOP), 2 paratypes (CNHM), 1 (USNM). NEPAL: 4♀♀ incl. holotype, Reu-Rapti R., Chitwan Distr., ex *Axis porcinus* (SE 1510), 30.X.1964, Migr. Anim. Path. Surv. 3♀♀ (CNHM), Reu Valley, Birganji, 300 m, ex *A. porcinus* (# 325), 12.III.1964, R. Fleming.

*Habitats.* At present only known from Nepal; its range is probably in coincidence with that of its breeding host *Axis (Hyelaphus) porcinus* Zimm. which spreads widely in the

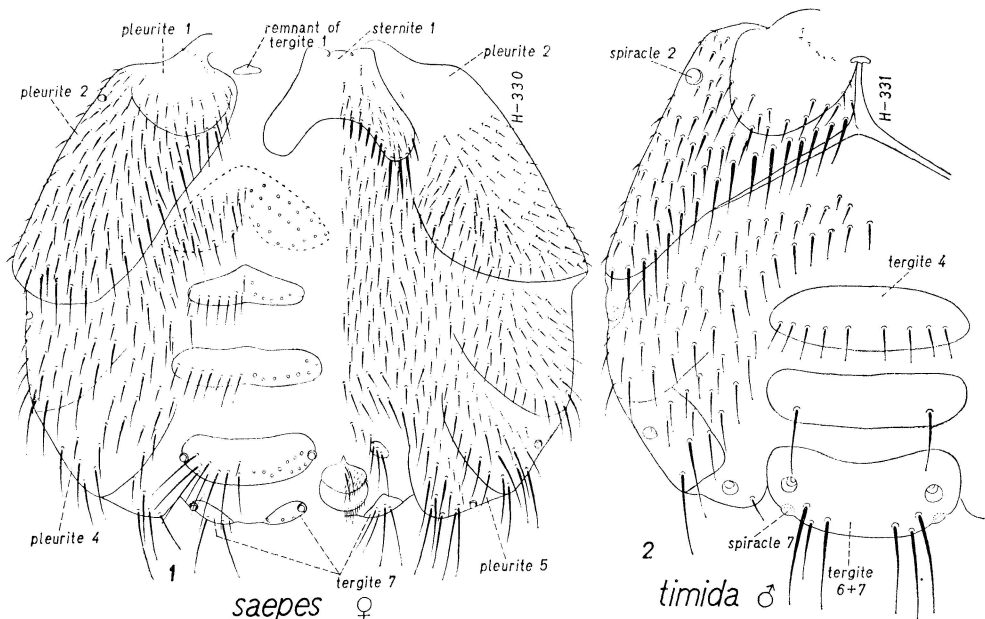


Fig. 1-2. *Lipoptena*, abdomens. 1, *saepes* Maa, ♀, dorsal and ventral views; 2, *timida* Maa, ♂, dorsal view.

southern Himalayas, extends eastward to Thailand and Vietnam, but is not found in Peninsular India.

*Affinities.* Intermediate between the *Cervi* and *Pauciseta* subgroups. The chaetotaxy is closely similar to that in the former subgroup but the ♀ terminalia, approaches that in the latter subgroup. Superficially *saepes* looks very like *cervi*, but the former species can be distinguished by the much shorter palpus, comparatively finer setae-spines, and particularly the differently shaped ♀ terminalia. From *axis* which breeds on the same genus of hosts, *saepes* can be recognized by (a) much larger size, (b) richer chaetotaxy, particularly with the number of laterocentrals, acrostichals and of dorsal femoral bristles (in *axis*, only 3 such bristles each on femora 1-2), (c) ♀ terminalia, and (d) in fully matured specimens, less extensive dark marking representing tergite 3. The specific name *saepes* (Latin, a hedge, a fence) refers to the most outstanding character of the species, i. e., the anterior setal fence of ♀ urogenital area.

*Description.* Body moderately dark. Length (head + thorax) of ♀ 2.1-2.2 mm. Head strongly narrowed behind eyes. Eye fairly large, laterally almost reaching margin of head. Inner orbit *ca* 1/2 as wide as eye, with 1 vertical and 2-3 orbitals. Postvertex *ca* 1/3 as long as wide, hardly raised; ocellar triangle isogonal; mediovertex longer than wide. Palpus (fig. 61) hardly longer than antennal pit, in lateral view *ca* 2.3× as long as wide. Pronotum (fig. 4) ribbon-like, posterior margin angulate at middle, anterior margin not so. Median notal and transverse mesonotal sutures ending at same level, both not reaching scutellum; longitudinal intrascutal groove distinct. Mesonotal chaetotaxy: 5-6 (5.1) humerals, 5-8 (6.4) acrostichals, 9-14 (11.5) laterocentrals, 8-12 (9.5) postalars plus prescutellars, 6-9 (7.0) mesopleurals, 6 (occasionally 7) scutellars in 3 pairs; outermost scutellars *ca* 1/2 as long as inner ones. Prosternal lobe much shorter than wide, anteriorly narrowly rounded, anterior 1/2 with 5-8 scattered spines; mesosternum almost evenly spinose and, as usual for Old World species of *Lipoptena*, with 1 long bristle at postero-lateral corner; metabasisternum with 3-4 spine-rows, spines of hindmost row much longer, those of other rows about as long as on mesosternum. Wing (?). Legs similarly setose as in *cervi* although in average, setae slightly finer than in latter species; femora 1 and 2 each with 4 long bristles arranged in single series along dorsomedian line; tibia 2 with 1 major and 1 minor apical spur, major one less than 2× as long as minor; tibia 3 with 5 spurs at apex and with 3 very stout long spines on anteroventral margin; tarsomeres 4 and 5 of leg 3 (fig. 77) as in *fortisetosa*, each with 2 plantar spines; anterior pulvilli of all legs *ca* 1/2 as long as corresponding posterior pulvilli; anterior claws of all legs longer than posterior ones. ♀ abdomen (fig. 1): Pleurite 1 reniform, with 2 spine-rows; width of pleurite 1 *ca* 2/5 length along outer margin of pleurite 2; dorsum of pleurite 2 broadly rounded at apex, straight along inner margin. Tergite 3 represented by a densely spinose ∧-shaped darkened area; tergite 4 short, with 12-24 (15.9) spines in 2 rows, its median area often narrowly interrupted; tergite 5 also short, with 9-21 (13.7) spines; tergite 6 longer, with 12-19 (14.6) setae; tergite 7 widely divided into 2 subtriangular pieces, each bearing 5-8 (6.9) setae. Supra-anal plate short, with 2 rows of apical setae. Sternite 1 posteriorly semicircularly curved, its outer margin straight or very weakly curved at basal 2/3, strongly curved at another 1/3, posterior lobes short, divergent. Venter of pleurites 3-5 with 7 (or 6), 4 and 2 rows of setae respectively, setae of anterior rows distinctly shorter, finer than in posterior rows. Pregenital plate (fig. 3) elongate, posteriorly widened and bearing 6-8 setae (in 2 rows) of varied length, anterolaterally flanked by a pair of very small tubercles which bear 2-3, occasionally 4 setae each and are interspaced by an arcuate series of 4-7 (5.6) setae. Setae of remaining area of ventral membrane uniform in length and robustness. Infra-anal plate densely setose near apex, bare at disc; postgenital plate with 3-4 rows of setae which are stronger and more uniform in length than in infra-anal plate. ♂ unknown.

***Lipoptena timida* Maa, new species** Fig. 2, 5-8, 60, 80.

**TYPE SERIES.** 1♂. Holotype (BISHOP 7598). NEPAL: 1♂, Reu-Rapti R., Chitwan Distr., ex *Axis porcinus* (5E 1510), 30.X.1964, Migr. Anim. Path. Surv.

**Habitats.** At present known only from Nepal, probably confined to the Himalayas. The unique ♂ was found in the same vial containing 4♀♀ of *L. saepes* which is apparently a specific parasite of *Axis porcinus*. Hence the host record of *L. timida* as given above might have resulted from contamination.

**Affinities.** At first glance, *timida* was presumed to be either the opposite sex of *saepes* or a stray ♂ of *axis*. But a closer examination of the palpus, chaetotaxy of mesonotum and pleurite 4 (dorsum), plantar spines and genitalia revealed that it is an independent species. As far as the ♂ sex is concerned, the species is obviously closely related to *axis*. The most outstanding characters are the quite short palpus and the poorly developed plantar spines, in allusion of which the name *timida* (Latin, timid, shy) is suggested.

**Description.** Body moderately dark. Length (head + thorax) 1.5 mm. Head strongly narrowed behind eyes. Eye fairly large, laterally not reaching margin of head. Inner orbit 1/2 as wide as eye, with 1 vertical and 2 orbitals. Postvertex *ca* 1/3 as long as wide, hardly raised; ocellar triangle isogonal; mediovertex hardly longer than wide. Palpus (fig. 60) distinctly shorter than antennal pit, in lateral view *ca* 2× as long as wide. Pronotum (fig. 5) ribbon-like, anterior and posterior margins parallel and both gently curved at middle. Median notal suture ending before level of transverse mesonotal suture, far from reaching scutellum; longitudinal intrascutal groove

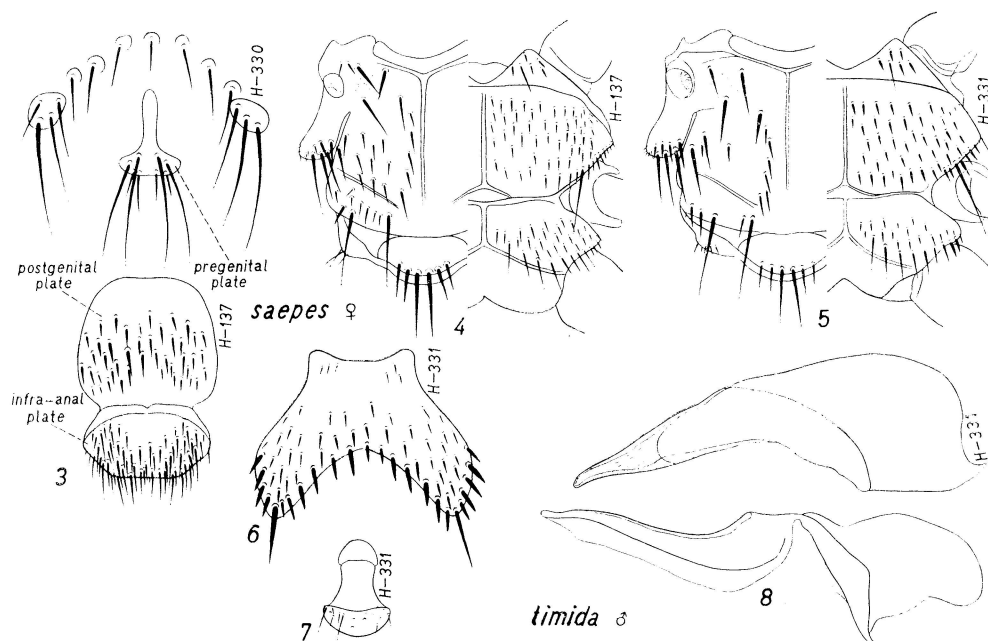


Fig. 3-8. *Lipoptena*, thoraces, sternite 1 and terminaliae. 3, *saepes* Maa, ♀ terminalia, ventral view; 4, *id.*, thorax, dorsal and ventral views; 5, *timida* Maa, ♂, thorax; 6, *id.*, sternite 1; 7, *id.*, postgenital plate; 8, *id.*, genitalia.

distinct. Mesonotal chaetotaxy: 3 humerals, 7 acrostichals, 4 laterocentrals, 3 postalars, 2 pre-scutellars, 6-7 mesopleurals, 6 scutellars (in 3 pairs); outermost scutellar less than 1/2 as long as innermost. Prosternal lobe anteriorly narrowly rounded, with 6 spines in 2 rows. Spines of mesosternum in  $5 \pm$  rows, virtually uniform in density, length and robustness, only those on posterolateral margin denser and stouter; metabasisternum with 3-4 rows of spines, those of hindmost row  $ca\ 2\times$  as long as in mesosternum, those of other rows all shorter, finer than in mesosternum. Wing (?). Legs similar to that in *axis*; femora 1 and 2 each with 3 bristles in single series on dorsomedian line; tibia 2 with 1 major and 1 minor apical spurs, major one  $2\times$  as long as minor; tibia 3 with 4 spurs at apex and 3 long heavy spines on anteroventral margin; tarsomeres 4 and 5 of leg 3 (fig. 80) as in *axis* and *pauciseta*, with 2 and 1 plantar spines, respectively; posterior plantar spine on tarsomere 5 replaced by an ordinary seta; anterior pulvilli of all legs  $ca\ 1/2$  as long as corresponding posterior pulvilli; anterior claws of all legs longer than posterior ones. ♂ abdomen (fig. 2): Pleurite 1 reniform, with 2 rows of spines; width of pleurite 1 only 1/2 length of outer margin of pleurite 2; dorsum of pleurite 2 with subacute apex and straight inner posterior margin; pleurites 3 very large, meeting each other at middle, with a pair of large roundish submedian dark markings and with 3-4 rows of setae; dorsum of pleurite 4 distinctly less sclerotized than 3, with 13-16 setae in 3 rows; dorsum of pleurite 5 bare except 2 small setae on posterior margin. Tergite 4, 5 and 6 + 7 large, bearing 9, 2 and 6 setae, respectively. Sternite 1 as in fig. 6. Setae on ventral membrane uneven in length and robustness; venter of pleurites 4 and 5 with 4 and 1 long setae, respectively, near their posterior margins. Genitalia (fig. 7, 8) similar to that in *axis*, but aedeagus very weakly curved in S-shape. ♀ unknown.

***Lipoptena axis*** Maa, nom. nov. pro *L. indica* Maa 1965 non *L. indicum* Rao et al., 1964.

Fig. 59, 79.

**MATERIAL.** NEPAL: 4♂♂, 7♀♀ (CNHM), Simri, Birganji, ex *Axis a. axis* #322, III.1964, R. Fleming. CEYLON: 1♂, 3♀♀ (BMNH), Lahugala Tank, E. Prov., ex *A. a. ceylonensis*, XI.1953, G. C. Beaumont. 1♂ (BMNH), P. Seneviratna, ex *A. a. ceylonensis*. Both lots of the Ceylonese specimens in the Brit. Mus. collection, bear exactly same data as for 2 lots of *L. fovea* Speis. The palpus (fig. 59) and hind tarsus (fig. 79), as here illustrated, are based on a paratype.

***Lipoptena pauciseta*** Edwards, 1919      Fig. 56, 92, 99.

**MATERIAL.** THAILAND: 2♀♀ (CNHM), Sakon Nakhon Prov., Sakon Nakhon Distr., Koekpue, Bansahngkaw 2, ex *Muntiacus muntjak* (B22686), II.1954, R. E. Elbel & Boonsong Lekagul. 1♂, 4♀♀ (CNHM), Loei Prov., Loei Distr., Seio, Sawan Mt, ex *M. muntjak* (B22599), XI.1953, Elbel & Boonsong. VIETNAM: 1 alate ♀, Fyan, 900-1000 m, VII-VIII.1961, N. R. Spencer.

**Synonymy.** The recently published *Lipoptena indicum* (sic) Rao, Hiregaudar & Alwar (1964) is most probably referable here. It was described from material ex fresh carcass of a heavily infested *M. muntjak* in Toslip-Coimbatore Distr., Madras State, India. The type specimens were stated to be in the Zool. Surv. India at Calcutta. But when I visited there in August 1966, none of them could be located. The description and drawings given by those authors are not quite satisfactory for a positive recognition of their species, and the terminology employed by them is somewhat confusing. Pleurite 1 (their "tergite 1") in ♂ was drawn as if leaf-shaped and posterolaterally subacute; pleurite 2 (their

"tergite 2") in both sexes, as if acute at apex; the membranous area between pleurite 2 (their "tergite 3") and tergite 4 (their "sclerite of tergite 3") in both sexes, as if extensively setose. Otherwise, the description and drawings appear to be fitting *pauciseta* fairly well, particularly in the setoseness of venter of ♀ pleurite 5 and the shape of ♀ pregenital plate (their "sclerite of sternite 6"). The said plate was described to have a pair of long setae and was drawn as if very small and roundish; and the ♀ pleurite 5 was shown to be bearing 6 ventral setae. While *L. pauciseta* is widely spread over SW China (Szechwan), Thailand (Chiengmai, Sakon Nakon, Loei), Laos (Phong Saly), Vietnam (Djiring, Fyan) and Sumatra (Sungei Kumbang), and while its breeding host, *Muntiacus muntjak* Zimmermann (and its various subspecies), over Ceylonese, Indian, Indo-Chinese and Malaysian Subregions, the occurrence of this fly ex the same host in India is not surprising. On the other hand, the possibility that *indica* Rao et al. and *indica* Maa were synonymous, though not to be entirely ruled out, seems very unlikely. The pleurite 2 (particularly in ♂) of the former is too long for the latter, the venter of ♀ pleurite 5 too poorly setose, the ♀ pregenital plate too short, and the host preference too different.

*Affinities.* As mentioned in my earlier paper, this and the preceding species are very closely related and differ from each other chiefly with the relative length of pleurite 2 and the details of ♂♀ terminalia. Superficially, *pauciseta* is smaller, paler and has much smaller and paler markings on the dorsum of abdominal segment 3. The wing and ♂ terminalia (fig. 92, 99) are here described for the first time from the unique alate ♀ and ♂ specimens at hand. The apical section of paramere in profile is more slender, the basal part of aedeagus less robust, and the postgenital plate less setose than in *axis*. The wing differs from that of *cervi* chiefly in the relative lengths of veins. The palpus (fig. 56) is longer than in *axis*.

***Lipoptena pteropi* Denny, 1843**      Fig. 71, 76, 97.

**MATERIAL.** MALAYA: 6♂♂, 1♀, Tioman I., off E. coast of Pahang, ex *Tragulus napu* (R 51929), IV.1946. This is the first record for this species ex *T. napu* F. Cuvier (= *javanicus* auctt. nec Osbeck) and from Tioman I. Previously, the species was solely known ex *T. javanicus* Osb. (= *kanchil* Raffles) in Thailand, Vietnam, Malaya, Sumatra, Java, Mergui Arch. and islands nr Strait of Singapore.

*Affinities.* This is the smallest member (length of head + thorax 0.9–1.2 mm) of the genus and the only hippoboscid parasitic on Tragulidae. It was first assigned to the subgenus *Lipoptenella* Beq. (here termed Depressa group) by Bequaert (1942a) on the basis of the great lengthening of pleurites 2 and hence the crowding of tergal plates to abdominal apex. This assignment was followed by many later workers including myself (1963, 1965). A closer examination of the various structures in comparison with the American species revealed that its similarities to those species are clearly superficial (see p. 222 key, couplet 1) and that instead, it is related to *rusaecola* in many features. Since the chaetotaxy is so simplified, thorax comparatively shorter, pleurite 2 so long, tergal plates so situated and since the host belongs to a different family of mammals, *pteropi* is here placed in a group of its own.

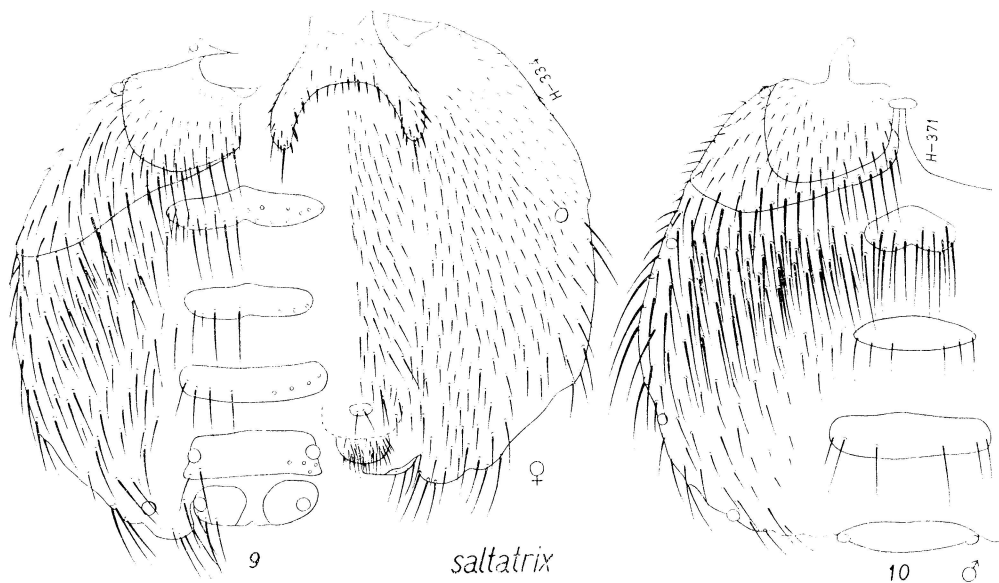


Fig. 9-10. *Lipoptena saltatrix* Maa, ♀ and ♂ abdomens.

***Lipoptena saltatrix* Maa, new species**

Fig. 9, 10, 12, 14, 15, 63, 81.

**TYPE SERIES.** 8♂♂, 10♀♀. Holotype ♀, allotype ♂ and 12 paratypes in Zool. Staatsinstitut u. Zool. Mus. Hamburg, 3 paratypes (BISHOP), 1 (USNM). INDIA: 2♂♂, 6♀♀ incl. holo- and allotypes, Molta, 3000 m, Himalayas, ex *Hemitragus jemlahicus* #439, 18.VI.1956, Dtsch. Indien Exped.; 6♂♂, 4♀♀, *id.*, ex "choral" [*Naemorhedus goral*] #438.

**Habitats.** Probably confined to the Himalayas and breeding on the Himalayan Tahr *H. jemlahicus* H. Smith and the Goral *N. goral* Hardwicke. According to Ellerman et al. (1951), the former host ranges from Pir Pamjal Mts, Kashmir, Punjab, Kumaon, Nepal to Sikkim, whereas the Himalayan subspecies of the latter, from Kashmir, Punjab, Kumaon, Nepal to Sikkim and Tibet (other subspecies of the same, known from extreme SE Siberia, Korea, Manchuria, most parts of China Proper, and Burma). *Hemitragus* and *Naemorhedus* are closely related to each other and both belong to Bovidae: Caprinae: Rupicaprini.

**Affinities.** The ♀ of this species strongly simulates the ♂ of *L. grahami* Beq. which is so far known from SW China (Szechwan) ex an undetermined host. A direct comparison with its type series proved that *saltatrix* is a distinct species and can be distinguished from *grahami* by larger body size, longer palpi, outstandingly long dorsal setae on abdominal segment 3, relatively shorter and smaller pleurites 1 and 2 and difference in details of ♂ genitalia. In size and mesonotal chaetotaxy, *saltatrix* approaches *capreoli* and *chalconelaena*, but the relative size of pleurite 1 as well as tergites 3-5 and the abdominal chaetotaxy are quite different. In size and general abdominal features, the species is also rather similar to *arianae* but its mesonotum and legs are less richly setose, abdominal setae longer and more numerous, and pleurite 2 much longer. The specific name *sal-*

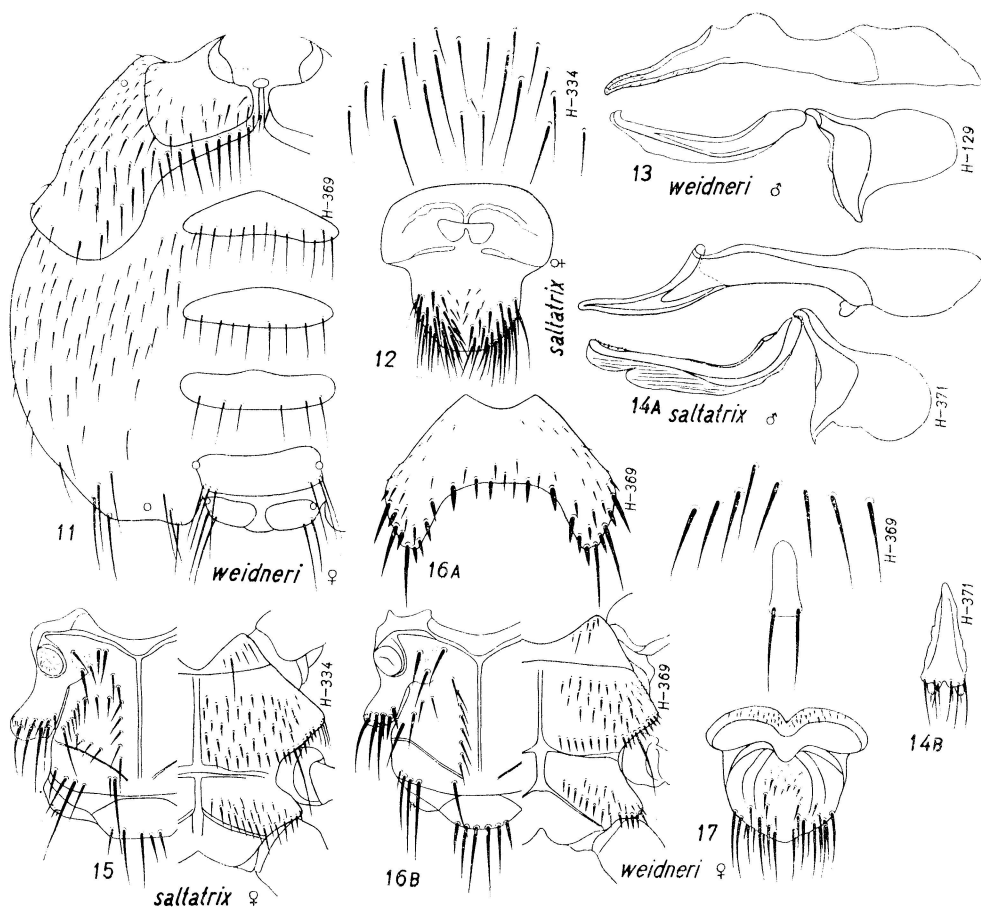


Fig. 11-17. *Lipoptena saltatrix* Maa and *L. weidneri* Maa. 11, ♀ abdomen, dorsal view; 12, ♀ terminalia, ventral view; 13-14A, ♂ genitaliae; 14B, ♂ postgenital plate; 15, ♀ thorax, dorsal and ventral views; 16A, ♀ sternite 1; 16B, ♀ thorax; 17, ♀ terminalia.

*tatrix* (Latin, a dancer) is in allusion to the above mentioned long abdominal setae which together form something like the dancing skirt of the "hula-hula" girls.

**Description.** Body moderately dark. Length (head + thorax) ♂ 2.3-2.5 mm, ♀ 2.2-2.3 mm. Head strongly narrowed behind eyes. Eye rather small, laterally not reaching margin of head. Inner orbit *ca* 2/3 as wide as eye, with 1 vertical and 3 (occasionally 2 or 4) orbitals. Post-vertex *ca* 1/2 as long as wide, moderately raised; ocellar triangle isogonal, occasionally slightly longer than wide; mediovertex much longer than wide. Palpus (fig. 63) distinctly longer than antennal pit, in lateral view 3× as long as wide. Pronotum (fig. 15) not quite ribbon-like, anterior margin hardly curved, posterior margin strongly curved at middle; median scutal and transverse mesonotal sutures ending at same level, both almost reaching scutellum; longitudinal intrascutal groove not definable. Mesonotal chaetotaxy: 5-7 (5.4) humerals, 7-9 (7.9) acrostichals, 9-13 (11.4) laterocentrals (in 2 series), 3-6 (4.6) postalars (about 1/2 of them are small), 2-3 prescutellars (1 large plus 1-2 small), 9-12 mesopleurals, 4-8 (6.2) scutellars (in 2-4 pairs). Prosternal lobe slightly shorter than wide, anteriorly acute, inner margin with 5-8 setae in 2 series;

mesosternum rather uniformly spinose, posterolateral margin densely lined with 1 strong bristle and 8-9 spines; metabasisternum with 3 rows of setae which are more or less finer than spines on mesosternum, setae of hindmost row much longer than in anterior rows. Wing (?). Legs equally stout and similarly setose as in *capreoli*; femora 1 and 2 each with 6 long bristles arranged in single series along median dorsal line; tibia 2 with 1 major and 2 minor apical spur, minor ones *ca* 1/2 as long as major; tibia 3 with 5 spurs and 1 moderately long seta at extreme apex, with 6 strong spines in 2 series on venter; tarsomeres 4 and 5 of leg 3 (fig. 81) with 4 plantar spines each; anterior pulvilli of all legs vestigial, posterior ones fully developed; anterior claws of all legs longer than corresponding posterior claws. ♀ abdomen (fig. 9): Pleurite 1 large, transverse, somewhat reniform, outer margin evenly rounded off into posterior margin, surface covered with 3-4 rows of strong setae, posterior margin with 3-4 moderately long bristles; pleurite 2 moderately long, covered with long strong setae and fringed posteriorly with long bristles, its inner margin gently curved and apex subacute width of pleurite 1 *ca* 3/5 length of outer margin of pleurite 2. Tergites 3-6 large, subequal in width, with 16-26, 6-13, 6-10 and 6-9 setae, respectively; setae on tergites 3-5 and on sublateral membranous interspaces between tergite 3 and pleurite 3 unusually long, not much shorter than in posterior fringe of pleurite 2; setae on interspaces between tergites 4-7 and pleurites 4-5 slightly shorter. Tergite 7 widely divided into a pair of subtriangular pieces each bearing 3-4 setae. Supra-anal plate short. Sternite 1 gently curved along outer margin, its median length subequal to that of posterior lobe, posterior emargination semicircularly curved. Setae on ventral membrane fairly uniform in length and robustness; those on posterior margins of pleurites 4 and 5 distinctly longer. Urogenital area (fig. 12) anteriorly fenced by 12-18 setae in 2 rows; pregenital plate very small, roundish, with 2 setae, occasionally with 1-2 additional minor ones; infra-anal plate anteriorly bare, posteriorly densely setose; postgenital plate with few setulae. ♂ abdomen (fig. 10) similar; pleurite 2 much shorter, posteriorly only slightly surpassing level of pleurite 1; width of pleurite 1 slightly exceeding length of outer margin of pleurite 2; setae on sublateral membranous interspaces between tergites 4-7 and pleurites 4-5 much shorter and finer, thus leaving those at level of tergite 3 quite outstandingly long and conspicuous; tergites 3 and 4 smaller in proportion; setae on tergites 4-5 much shorter and finer; tergites 3, 4, 5 and 6+7 with 11-15, 5-9, 5-6 and 5-7 setae, respectively; tergite 6+7 narrower than and *ca* 1/2 longer than tergite 5, partly enclosing spiracle 6 but far from reaching spiracle 7. Genitalia (fig. 14) as figured.

**Lipoptena arianae** Maa, new species

Fig. 18-21, 24, 26, 27, 70, 83, 100.

**TYPE SERIES.** 12♂♂, 16♀♀. Holotype ♀ (BISHOP 7599), allotype ♂ and 22 paratypes (BISHOP); 4 paratypes (USNM). IRAN: 11♂♂, 14♀♀ incl. holo- and allotypes, 2-6 km SE of Emamghali, 16 km N of Emamghali & 38-52 km N of Quchan, N. Khurasan Prov., ex *Ovis* (GLR 2798, 2816, 2817, 2818), 7-13.X.1962, G. L. Ranck. 1♂, 2♀♀, 2 km W of Bariz, 47 km N of Lar, Fars, Laristan Prov., ex *Ovis* (GLR 3913), 29.III.1963, Ranck.

**Habitats.** At present known only from NE and S. Iran (N. Khurasan and Laristan Provs.), ex *Ovis* sp., most probably *O. (Ovis) laristanica* Nasonov or *O. (O.) orientalis* Gmelin. The former species is endemic to Iran, whereas the latter spreads from Asia Minor, Cyprus, Iran, Afghanistan, Baluchistan, Kashmir to Punjab.

**Affinities.** Most closely allied to *L. capreoli* and particularly *chalconelaena* from both of which it differs in the size of ocelli, length of pronotum, robustness of hind tibial spurs and spines, shape of pleurites 1-2 and sternite 1, relative length of palpus, relative size of tergites 3-4, and details of terminalia. The facial and mesonotal chaetotaxy is similar to *chalconelaena*; the aedeagus shorter than in *chalconelaena* and particularly shorter than



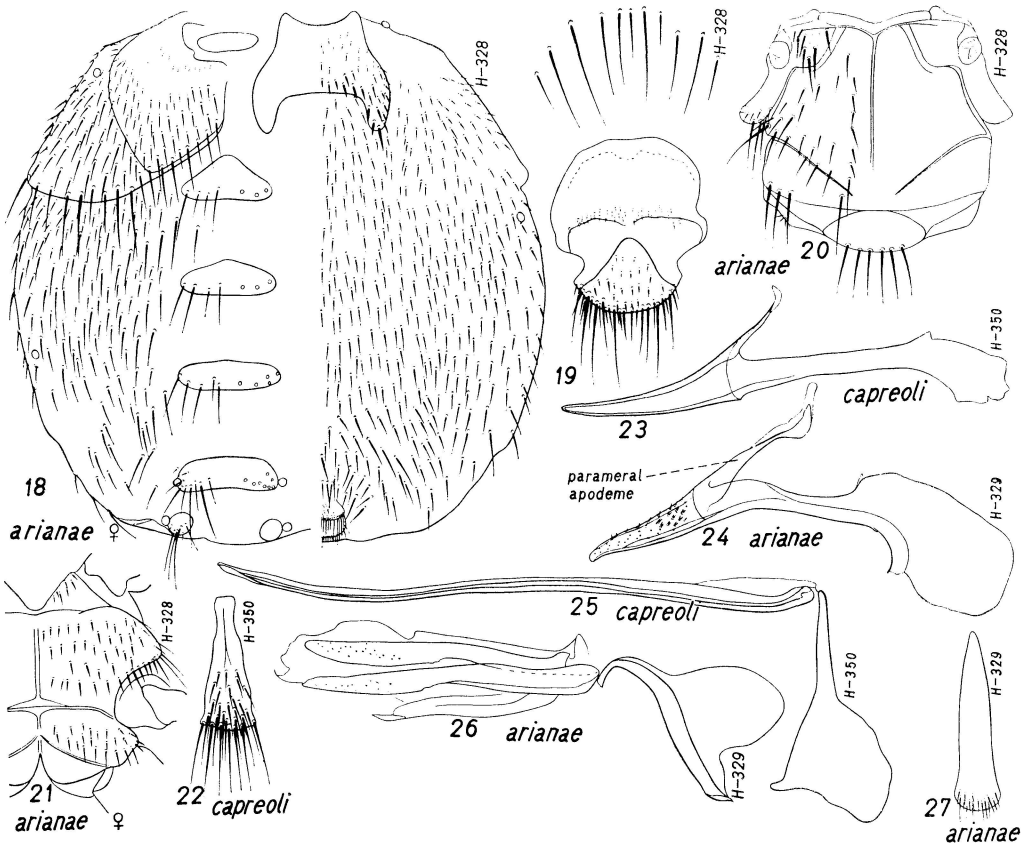


Fig. 18-27. *Lipoptena arianae* Maa and *L. capreoli* Rndn. 18, ♀ abdomen, dorsal and ventral views; 19, ♀ terminalia, ventral view; 20, ♀ thorax, dorsal view; 21, *id.*, ventral view; 22, ♂ postgenital plate; 23-24, parameres; 25-26, aedeagi; 27, ♂ postgenital plate.

in *capreoli*; the paramere more spiny and has much longer basal apodeme than in both species; the ♂ postgenital plate similar to that in *capreoli* but much broader and more setose than in *chalomelaena*; the ♀ urogenital fence of about as many setae as in *chalomelaena*. Thus *ariana* combines several characters of those 2 related species. The name *Ariana*, in ancient usage of Greek and Roman, was applied to the Plateau of Iran and to the southeast part of that country.

**Description.** Body very dark. Length (head + thorax) ♂ 2.3-2.6 mm, ♀ 2.4-2.6 mm. Head strongly narrowed behind eyes. Eye rather small, laterally not reaching margin of head. Inner orbit  $\frac{2}{3}$  as wide as eye, with 1 vertical and 5-10 orbitals (in 2-3 series). Postvertex *ca*  $\frac{1}{2}$  as long as wide, distinctly raised; ocellar triangle isogonal; ocelli rounded, exceedingly small; mediovertex much shorter than wide. Palpus (fig. 70) distinctly longer than antennal pit, in lateral view *ca*  $2.3 \times$  as long as wide, its upper and lower margins both gently curved. Pronotum (fig. 20) ribbon-like, very short, anterior and posterior margins parallel, both subangulate at middle; transverse mesonotal suture almost reaches scutellum, median notal suture does not; longitudinal intrascutal groove not definable. Mesonotal chaetotaxy: 5-8 humerals, 9-12 acrostichals, 42-52

laterocentrals, 3-5 postalars, 1-2 (usually 1) prescutellars, 9-12 mesopleurals, 6-8 (in 3-4 pairs) scutellars. Prosternal lobe (fig. 21) slightly shorter than wide, anteriorly acute, inner margin covered with 2 series of setae; mesosternum rather uniformly setose, setae of hindmost row distinctly longer, lateral margin with many fine long bristles; metabasisternum with 3 rows of setae, setae of hindmost row also distinctly longer, those of anterior rows finer than in mesosternum. Wing (fig. 100) similar to that of *capreoli* as figured by Theodor et al. (1961: 61, fig. 106b) but apical section of costa (i. e., the section beyond apex of  $R_1$ ) very strongly thickened at midlength and terminating at its junction with  $R_{4+5}$ . Legs as stout as, but more setose than in *capreoli*; femur 1 with 6 long bristles arranged in single series along dorsomedian line, in addition to some others out of alignment; femur 2 dorsally with 12-14 long bristles, about half arranged in a slightly oblique longitudinal series; tibia 2 with 1 major and 1 minor apical spur, major one more than  $2\times$  as long as minor; tibia 3 with 4 quite heavy spurs and 2 rather long bristles at extreme apex, with 2 quite heavy plus 2 finer spines on venter not far from apex; tarsomeres 4 and 5 of leg 3 (fig. 83) with 4 (3 major plus 1 minor) and 1 plantar spines, respectively; anterior pulvilli of all legs *ca*  $1/2$  as long as corresponding posterior pulvilli; anterior claws of all legs longer than posterior ones. ♀ abdomen (fig. 18): Pleurite 1 large, with nearly straight inner, outer and posterior margins, and with 4-5 rows of setae, in addition to posterior fringe of long bristles; pleurite 2 short, in dorsal view narrowly rounded at apex, nearly straight along inner margin; width of pleurite 1 *ca*  $5/7$  length of outer margin of pleurite 2. Tergites 3-6 gradually widened in succession, with 15-23, 19-25, 14-25 and 12-20 setae, respectively; tergite 3 rather variable in size and shape, anterior margin usually produced cephalad at middle, width  $3/4$  to  $5/6$  that of tergite 5; tergite 7 widely divided into pair of small roundish or elliptical pieces each bearing 3-9 setae and some setulae. Supra-anal plate fairly long. Setae on sublateral membranous areas between tergites and pleurites moderately long, noticeably shorter than those fringing posterior margin of pleurite 2. Sternite 1 with median length more than that of its posterior lobe; posterior emargination gently evenly curved; apical  $1/2$  of outer margin distinctly curved. Urogenital area (fig. 19) anteriorly fenced by 35-45 setae which are in 3-4 rows, widely interspaced and varied in length; setae on other areas of ventral membrane fairly uniform in length; lateral marginal setae of pleurites 4 and 5 slightly longer. Infra-anal plate with very short setulae on disc and 2 rows of rather long setae on posterior margin; postgenital plate with few very short setulae. ♂ abdomen similar; dorsal setae much shorter and finer; pleurite 2 posteriorly hardly surpassing level of pleurite 1; tergites 3 and 4 distinctly smaller, former often triangular in outline; tergite 6+7 very slightly longer than tergite 5, bearing 10-17 setae in single series, partly enclosing spiracle 6 but far from reaching spiracle 7. Genitalia (fig. 24, 26, 27) as figured.

***Lipoptena weidneri*** Maa, new species      Fig. 11, 13, 16, 17, 64, 82.

**TYPE SERIES.** 1♂, 4♀♀. Holotype ♀, 2 paratypes in Zool. Staatinstitut u. Zool. Mus. Hamburg, 2 paratypes (BISHOP). INDIA: 1♂♂, 4♀♀, Molta, 3000 m, Himalayas, Tehri-Garhwal Distr., Uttar Pradesh, ex "choral" #438, 18.VI.1956, Dtsch. Indien Exped.

**Habitats.** Probably confined to the Himalayas. The type series was found in the same vial containing 6♂♂, 4♀♀ of *L. saltatrix*. Therefore, it might have been contaminated and might actually have come from a caprine other than choral (*Naemorhedus goral*). See notes under *saltatrix*.

**Affinities.** This is another remote relative of *L. grahami* and differs from that species in having single series of laterocentral setae, much shorter pleurite 2 and entirely differently shaped aedeagus and ♀ pregenital plate. It is also related to *L. saltatrix* but size

smaller, palpus shorter, mediovertex shorter, laterocentral setae in single series, tergites 3-4 larger, setae between tergite 3 and spiracle 3 shorter, aedeagus and ♀ pregenital plate differently shaped, ♀ infra-anal plate more sparsely setose. The species is named in honor of Prof H. Weidner, Abt.-Direktor, Hamburg Zool. Mus.

*Description.* Body moderately dark. Length (head + thorax) 1.9-2.0 mm. Head strongly narrowed behind eyes. Eye rather small, laterally not reaching margin of head. Inner orbit hardly narrower than eye, with 1 vertical and 2, occasionally 3, orbitals. Postvertex  $1/2$  as long as wide, hardly raised; ocellar triangle isogonal; mediovertex as long as wide. Palpus (fig. 64) as long as antennal pit, in lateral view *ca*  $3\times$  as long as wide. Pronotum (fig. 16B) not quite ribbon-like, unusually long at its median section, anterior margin hardly, posterior margin strongly curved at middle; median notal suture ending before level of transverse mesonotal sutures which almost reach scutellum; longitudinal intrascutal groove not definable. Mesonotal chaetotaxy: 3, occasionally 4 humerals; 5-8, generally 7 acrostichals; 3, occasionally 4 humerals; 5-8, generally 7 acrostichals; 3-4 laterocentrals in single series; 3-5 postalars; 1 major plus 0-2 minor prescutellars; 7, occasionally 8 mesopleurals; 6, occasionally 5, scutellars in 3 pairs. Prosternal lobe nearly as long as wide, anteriorly acute, inner margin with 5-8 setae in 2 series; mesosternum with spines of uniform length and robustness, posterolateral margin densely lined with 5-7 spines and 1 strong bristle; metabasisternum with 1-2 rows of rather fine setae, plus posterior fringe of spines which are hardly shorter in average than those on mesosternum. Wing (?). Legs equally stout and similarly setose as in *capreoli*; femora 1 and 2 each with 4 bristles arranged in single series along dorsomedian line; tibia 2 with 1 major spur, 1 minor spur and 1 rather fine seta at extreme apex, with major spur *ca*  $2\times$  as long as minor; tibia 3 with 4 strong spurs and 1 rather fine seta (seta on anterior surface) at extreme apex, with 7-9 (usually 8) heavy spines in 2 longitudinal series on venter; tarsomeres 4 and 5 of legs 3 (fig. 82) with 6 and 5 plantar spines respectively; anterior pulvilli of all legs vestigial, posterior ones fully developed; anterior claws of all legs longer than corresponding posterior claws. ♀ abdomen (fig. 11): Pleurite 1 large, transverse, outer margin slightly curved and much longer than inner margin, posterior margin straight and fringed with  $9\pm$  bristles, surface with 2-3 rows of setae, posterolateral corner subangulate or narrowly rounded; pleurite 2 moderately long, hardly narrowed apicad, apex obliquely truncate; width of pleurite 1 *ca*  $4/7$  length of outer margin of pleurite 2. Tergite 3-6 large, subequal to one another in size and width, with 10-14, 7-8, 4-6 and 5-6 setae, respectively; setae on tergites 3-4 slightly shorter and finer than those fringing pleurite 1; setae on sublateral membranous interspaces between pleurites 3-4 and tergites 3-4 more or less shorter than those on tergites 3-4; interspaces between pleurite 5 and tergites 5-6 bare; pleurites 4-5 posteriorly with long strong setae; tergite 7 widely divided into pair of roundish pieces each bearing 3-4 setae; supra-anal plate fairly long. Sternite 1 (fig. 16A) semicircularly curved along hind margin, basal  $2/3$  of outer margin almost straight thence subangularly curved into another  $1/3$ , median length of posterior lobe subequal to that of sternite itself. Setae on ventral membrane uniform in length and robustness. Urogenital area (fig. 17) anteriorly fenced by 6-8 setae in single series; pregenital plate elongate, with 2 short setae near posterior end; infra-anal plate anteriorly with spine-like setulae, posteriorly with  $2\pm$  rows of ordinary setae which are distinctly stronger than on supra-anal plate; postgenital plate with few setulae. ♂ abdomen similar; pleurite 2 shorter, its length along outer margin hardly exceeding width of pleurite 1; tergite 3 narrower; tergites 3, 4, 5 and  $6+7$  with 12-13, 8-10, 4-5 and 7-8 setae respectively; tergite  $6+7$  slightly longer than 5, partly enclosing spiracle 6. Paramere (fig. 13) in profile very weakly curved near apex; aedeagus moderately long, gently curved, gradually tapering apicad, strongly upcurved at apex; postgenital plate narrow, apically with 5-6 setae in single row.

**Lipoptena capreoli** Rondani, 1878      Fig. 22, 23, 25, 65.

**MATERIAL.** IRAQ: 1♀ (CNHM 84468), Kirkuk Liwa, Jebel Zaragahta, Sagirmah Dagħ, ex *Canis lupus*, IV.1955, C. A. Reed; 2♀♀ (CNHM 84483), Kirkuk Liwa, Chamchamal Valley, Konisard, ex *Capra hircus*, V.1955, Reed. IRAN: 1♀, 93 km ESE of Beklchan, Khuzistan Prov., ex *Vulpes* #447, II.1964, R. G. Tuck. Besides these, a good number of Indian specimens at the Indian Inst. Agric. Res., New Delhi and Zool. Surv. India, Calcutta were briefly examined.

The accompanying figures of ♂ genitalia and palpus are based upon Indian specimens. The hind tarsus is closely similar to that of *weidneri* Maa.

*Sepiacea* SUBGROUP

This subgroup was accepted as a distinct genus, *Echestypus* Speis., by Bequaert (1942a) on the only bases of the absence of ocelli and brevity of palpi. The former character was quite correctly pointed out by him to be of little importance in Hippoboscidae while the latter, to be varying widely among other genera of the subfamily. Fresh examination of the various characters and comparison with related forms revealed its very strong affinities to *capreoli* and relatives, being different only in details of chaetotaxy and in host relationships. Therefore, it is placed in the revised scheme under the Capreoli group of *Lipoptena*. A new member from India is added here and *L. hopkinsi* is also assigned to this subgroup. The following key does not include *hopkinsi* of which no material is available, but it can readily be recognized by the presence of ocelli.

KEY TO SPECIES OF *Lipoptena* (SEPIACEA SUBGROUP)

1. Palpus (fig. 69) vestigial, not or barely protruding beyond anterior margin of frons, and in lateral view, hardly longer than wide; anterior (outer) pulvillus of leg 3 vestigial, posterior pulvillus fully developed; tibia 3 with 3 apical spurs; tarsomeres 4 and 5 of leg 3 (fig. 86) each with 2 plantar spines (not including marginal spines); mesosternal spines (fig. 31) fairly regularly arranged in 4-5 rows, and except those of first row, all spines practically uniform in length and robustness; metabasisternal spines in 2 regular rows and all similar in length and robustness as in 3 posterior rows of mesosternum; tergites very short but broad, for instance, tergite 3 only 1/6 or 1/7 as long as wide; (2, rarely 3 pairs of scutellars; inner orbit distinctly narrower than eye; posterior surface of tibia 3 with 1 apical bristle; ♀ pregenital plate not less than 2< as large as basal papilla of neighboring seta). ..... **paradoxa**
- Palpus (fig. 66-68) well developed, distinctly protruding beyond anterior margin of frons, in lateral view 2.5 × or more as long as wide; anterior and posterior pulvilli of leg 3 both vestigial; tibia 3 with 4 apical spurs; tarsomeres 4 and 5 of leg 3 (fig. 84, 85) with 3 and 4 plantar spines, respectively; mesosternal spines (fig. 28-30) either in 5 rows or irregularly distributed and clearly not uniform in length and robustness; spines on metabasisternum in 3-4, rarely 2 rows, those of hindmost row distinctly longer than in mesosternum; tergites not so short and broad as above described ..... 2
2. One pair of scutellars; spines on mesosternal disc not stouter than, or hardly so, on ventral disc of coxa 3, mesosternal spines (fig. 30) of anteriormost row not stouter than on posterolateral margin; ♀ pregenital plate not larger, or hardly so, than basal papilla of neighboring seta; posterior surface of tibia 3 with only 1 apical bristle; inner orbit as wide as or wider than eye..... **binoculus**

- Two pairs of scutellars; mesosternal spines not so fine, spines of anteriormost row (fig. 28, 29) distinctly stouter than on posterolateral margin; ♀ pregenital plate not less than  $2\times$  as large as basal papilla of neighboring seta; posterior surface of tibia 3 with 2, rarely 3 apical bristles; inner orbit distinctly narrower than eye ..... 3
3. Mesosternal spines in ♀ clearly uneven in distribution (fig. 29), those at lateral area much denser than at submedian area where it is extensively bare; median length of ♂ sternite 1 hardly less than that of its lateroposterior lobe, inner and outer margin of that lobe distinctly though weakly curved; apices of ♂ pleurites 1-2 in dorsal view rounded; posterior margin of ♀ pleurite 1 (fig. 41) subequal in length to inner posterior margin of pleurite 2. India ..... *iniqua*
- Mesosternal spines in ♀ fairly even in distribution (fig. 28), submedian mesosternal area not extensively bare; median length of ♂ sternite 1 markedly exceeding that of its lateroposterior lobe, inner and outer margins of that lobe straight or very nearly straight; apex of dorsum of ♂ pleurite 2 acute, apex of ♂ pleurite 1 angulate; posterior margin of ♀ pleurite 1 (fig. 40) distinctly shorter than inner posterior margin of pleurite 2. Africa ..... *sepiacea*

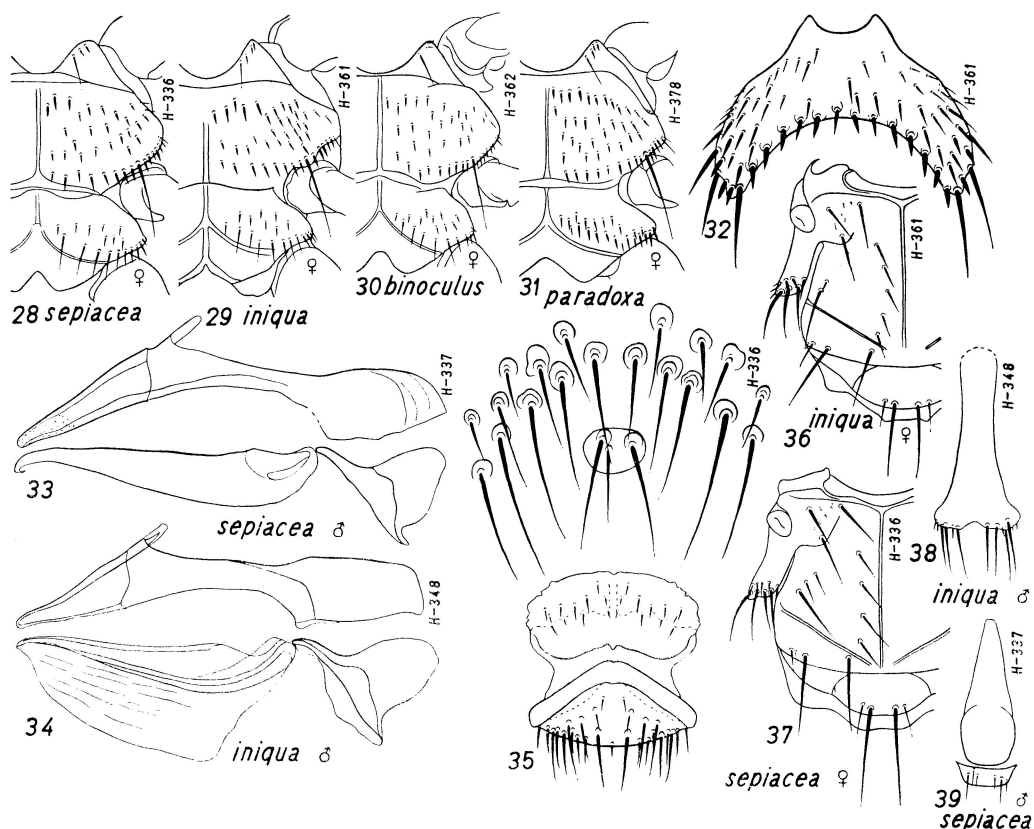


Fig. 28-39. *Lipoptena*, *Sepiacea* subgroup. 28-31, ♀ thoraxes, ventral view; 32, ♀ sternite 1; 33-34, ♂ genitaliae; 35, ♀ terminalia, ventral view (compare fig. 93 for ♀ terminalia of *L. iniqua* Maa); 36-37, ♀ thoraxes, dorsal view; 38-39, ♂ postgenital plates.

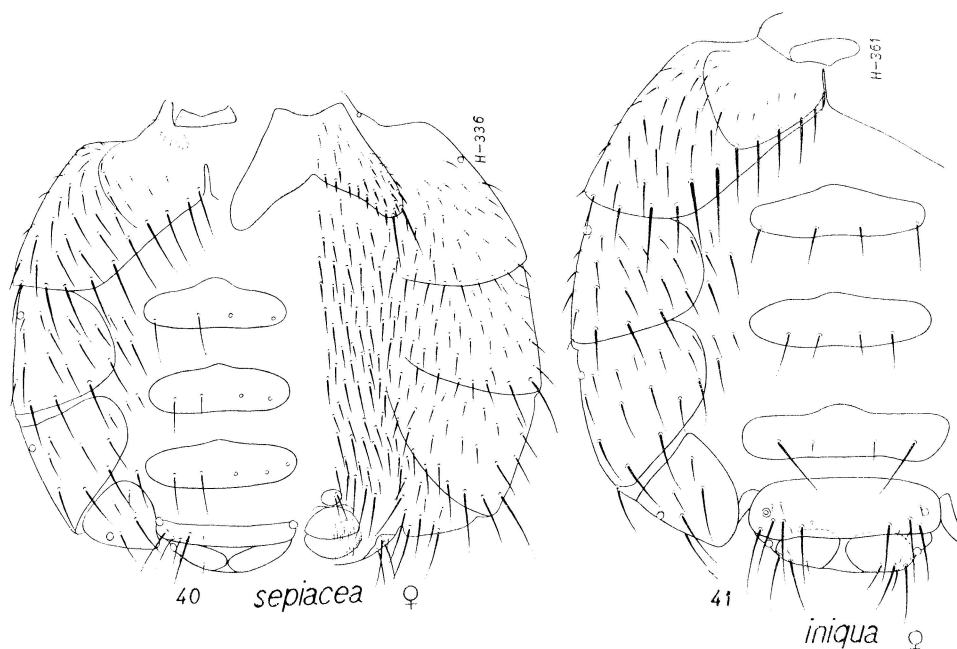


Fig. 40-41. *Lipoptena*, *Sepiacea* subgroup, ♀ abdomens.

***Lipoptena sepiacea*** Speiser, 1905

Fig. 28, 33, 35, 37, 39, 40, 66.

**MATERIAL.** SUDAN: 15♂♂, 17♀♀, Torit, Equatoria, 600 m, ex *Ourebia* sp. (fld. nos. 4894, 4895, 4978), XII.1949-II.1950, H. Hoogstraal; 1♂ (CNHM), *id.*, ex duiker (fld. no. 5036), I.1950. In addition, there is 1♀ (CNHM) labeled Hacienda Cadena, Marcapata, Cuzca, Peru, 1000 m, no date, no host, C. Kalinowski; apparently a result of mislabeling.

For comparison with *L. iniqua*, some drawings from the Sudan material are here presented.

***Lipoptena iniqua*** Maa, new species

Fig. 29, 32, 34, 36, 38, 41, 67, 84, 93.

**TYPE SERIES.** 2♂♂, 4♀♀. Holotype ♀ (BISHOP 7600), allotype ♂ and 3 paratypes (BISHOP), 1 (USNM). INDIA: 2♂♂, 4♀♀ Sikandra nr Agra, Uttar Pradesh State, ex *Antilope cervicapra* found dead in captive herd (♂ I 9), 23.II.1965, G. Schaller. In addition, I saw at the Zool. Surv. India, Calcutta in August 1966 one seriously damaged pinned specimen, labeled "Punjab, ex *A. cervicapra*. *Echestypus apodixis* Speis. Type." The name *apodixis* is unpublished, and the specimen is almost certainly referable here.

**Habitats.** India, more exact type locality uncertain, most probably breeding on *A. cervicapra* Linn. which is widely distributed over entire Peninsular India, from the Punjab, Kathiawar and Sind, eastward to Bengal and southward to Cape Comorin.

**Affinities.** This is the first species of the so-called genus *Echestypus* to be described from the Orient. Previously the subgroup was known to be confined to the Ethiopian Region

and to the antelopes. The discovery of the new species not only greatly extends the range of the subgroup but also provides another example of host-parasite evolutionary parallelism. The species is hardly separable from *L. sepiacea* and differs from the latter only in the shape of palpus, pleurites 1-2 and sternite 1 and in details of chaetotaxy. The specific name *iniqua* (Latin, uneven, unequal) refers to the non-uniformity of mesosternal and pregenital setae.

**Description.** Body moderately dark. Length (head + thorax) ♂ 2.2-2.3 mm, ♀ 2.2-2.4 mm. Head strongly narrowed behind eyes. Eye fairly large, laterally almost reaching margin of head. Inner orbit less than 1/2 as wide as eye, with 1 vertical and 3-5 orbitals. Postvertex *ca* 1/2 as long as wide, distinctly raised; mediovertex nearly as long as wide. Palpus (fig. 67) slightly shorter than antennal pit, in lateral view *ca* 2.5× as long as wide. Pronotum (fig. 36) ribbon-like, short, posterior margin subangulate at middle, anterior margin not so; median notal and transverse mesonotal sutures stopping at same level, not reaching scutellum; longitudinal intrascutal groove not definable. Mesonotal chaetotaxy: 3 humerals, 5 (occasionally 6) acrostichals, 2 laterocentrals (1 large, 1 small), 2-3 postalars, 1 prescutellar, 7-9 mesopleurals (in 2 rows), 4 (occasionally 3) scutellars (in 2 pairs). Prosternal lobe (fig. 29) much shorter than wide, anteriorly acute, inner margin with 4-5 setae arranged in single, occasionally double series. Mesosternal spines quite uneven in distribution and robustness, those of anteriormost row markedly stouter than in other rows, and about as long as in hindmost row, those of intermediate rows irregularly arranged and distinctly shorter, finer than in anteriormost and hindmost rows. Lateral area of mesosternum densely spinose, submedian area extensively bare. Metabasisternum with 1, occasionally 2 rows of spines and 1 row of very long setae; these spines are about as short and fine as in intermediate rows of mesosternum. Wing (?). Legs as stout and as thinly setose as in *sepiacea*; femora 1 and 2 each with 3 bristles arranged along dorsomedian line; tibia 2 with 1 major and 1 minor apical spur, major one *ca* 2× as long as minor; tibia 3 with 2-3 major and 2-3 minor spines arranged together in single series along anteroventral margin and 4 spurs and 2 (occasionally 3) bristles at extreme apex; tarsomeres 4 and 5 of leg 3 (fig. 84) with 3 and 4 plantar spines, respectively; anterior pulvilli of legs 1 and 2 vestigial, less than 1/2 as long as corresponding posterior pulvilli; anterior claws of same legs longer than corresponding posterior claws; anterior and posterior pulvilli of leg 3 both vestigial whereas claws of same leg both long. ♀ abdomen (fig. 41): Pleurite 1 nearly reniform, posterolaterally subangulate, distinctly wider (20:17) than interdistance of bases of vertical setae, its hind margin subequal in length to inner posterior margin of pleurite 2, and bearing 5 (occasionally 4) long setae; pleurite 2 short, in dorsal view truncate at apex. Tergites 3-6 large, practically of same size and shape, bearing 4-9, 4-7, 2-3, 6-7 setae, respectively; tergite 7 rather narrowly interrupted at middle, bearing 4-5 setae at each side; in addition to above mentioned setae, tergites 5-7 also with varied number of setulae. Supra-anal plate moderately long. Sternite 1 (fig. 32) as wide as prosternum, its posterior emargination almost semicircular; outer margin of its posterior lobe gently curved. Setae on ventral membrane fairly uniform in length and robustness. Urogenital area (fig. 93) anteriorly fenced by 20-26 setae of varied length arranged in 2 arcuate rows; pregenital plate roundish, fairly small, with 2 strong setae at base; infra-anal plate largely bare, posteriorly with 2-3 rows of setae; postgenital plate with small group of setulae. ♂ abdomen similar. Mesosternal spines slightly less uneven in distribution and robustness. Pleurites 1 and 2 in dorsal view rounded at apices; hind margin of pleurite 1 longer than that of dorsum of pleurite 2. Tergite 3, 4, 5 and 6+7 with 5-6, 6-7, 2-4 and 5-6 setae, respectively. Posterior emargination of sternite 1 narrower, subangulate at middle. Genitalia (fig. 34, 38) as figured.

## Depressa GROUP

This group was termed by Bequaert (1942a) as his subgenus *Lipoptenella* which originally included 3 American species plus *L. pteropi* Denny (= *gracilis* Speis.) of the Orient. The following key indicates that the inclusion of *pteropi* is evidently unnatural and that the crowding of tergal plates toward abdominal apex and the lengthening of pleurite 2 and discal membranous area of abdominal dorsum in the 4 species are merely superficial similarities. An independent group is therefore suggested for the reception of *pteropi*. In addition, *L. depressa* is here divided into 2 subspecies.

KEY TO SPECIES OF *Lipoptena* (DEPRESSA GROUP, s. l.)

1. Discal membranous area (representing dorsum of abdominal segment 3) of abdominal dorsum extensively setose; 2 wide (i. e., ca as wide as postvertex or scutellum) tergal plates in ♀, 1 in ♂; each leg with pair of fully developed pulvilli; pronotum constricted or interrupted at middle; hind margin of metasternellum deeply, angularly notched at middle; veins C and R<sub>4+5</sub> suddenly thickened knob-like at their junction which lies at a point of apical 1/3 of wing-length; first 4 tarsomeres of all legs (fig. 87-89) each with 1 or more black stout spines, tarsomere 5 with single long plantar seta; ♂ tergite 6+7 only enclosing spiracle 6 in part, leaving spiracle 7 free; ♀ pregenital plate (fig. 46, 48, 50) roundish or transverse, not laterally flanked by a pair of setiferous tubercles; aedeagus (fig. 43-45) in dorsal aspect broad, rounded at apex; thorax longer in proportion, median length from pronotum to scutellum equal to interdistance of 2 notopleura. New World ..... 2
- Discal membranous area of abdominal dorsum entirely bare; 3 wide tergal plates in both sexes; each leg with 1 vestigial and 1 fully developed pulvillus; pronotum very slightly lengthened at middle, never interrupted; hind margin of metasternellum straight (though deeply depressed at middle); veins C and R<sub>4+5</sub> evenly thin, their junction lying at a point of nearly apical 1/6 of wing-length; first 4 tarsomeres of all legs (fig. 76) lacking black stout spines, tarsomere 5 with pair of long plantar setae; ♂ tergite 6+7 enclosing both spiracles 6 and 7 in part; ♀ pregenital plate elongate, flanked by pair of tiny setiferous tubercles; aedeagus in dorsal aspect slender, sharply pointed at apex; thorax shorter in proportion, median length from pronotum to scutellum less than interdistance of 2 notopleura. Oriental Region ..... *pteropi*
2. Membranous area of abdominal dorsum with not less than 80 setae, usually much more; posterior fringe of metabasisternum (fig. 47, 49) chiefly composed of bristles which are 2× or more as long as discal spines of mesosternum; posterior fringe of mesosternum including 3 or more pairs of bristles; femur 1 with 5 bristles arranged along dorso-median line; abdominal segment 5 dorsally represented either by few setae or by setae plus small tergal plate; ♀ tergite 7 (last visible tergal plate) either entire or when divided medially, then side-pieces each wider than their interspace; 2-5 orbitals, 10-15 prescutals (i. e., acrostichals plus laterocentrals)..... 3
- Membranous area of abdominal dorsum with not more than 55 setae, usually much less; posterior fringe of metabasisternum (fig. 51) chiefly composed of short spines which are as long as those on disc of mesosternum, with only 1 pair of submedian bristles; posterior fringe of mesosternum including only 1 pair of posterolateral bristles; femur 1 with only 4 bristles along dorsomedian line; abdominal segment 5 dorsally entirely bare and membranous; ♀ tergite 7 widely divided medially, with side-pieces each distinctly narrower than their interspace; 1 (rarely 2) orbitals, 4-7 prescutals; (apical spur of tibia 1 stout; tarsomere 4 of all legs (fig. 89) with 1 spine; tibia 2 usually with



- 1 major and 1 minor apical spur; ♂ postgenital plate (fig. 45) lacking short peg-like spines.) All over Neotropical Region, normally breeding on *Mazama* ..... **mazamae**
3. Apical spur of tibia 1 as stout as major apical spur of tibia 2; tarsomere 4 of all legs (fig. 88) with 2 stout spines; tergite 5 only represented by 1-3, usually 2 setae which arise from membrane rather than sclerite; tibia 2 usually with major and 2 minor apical spurs; ♂ postgenital plate (fig. 44) with short peg-like spines; ♀ tergite 7 narrowly divided at middle. Brazilian Subregion, normally breeding on *Ozotoceros*...**guimaraesi**
- Apical spur of tibia 1 very thin, seta-like, distinctly thinner than major apical spur of tibia 2; tarsomere 4 of all legs (fig. 87) with only 1 stout spine; tergite 5 represented by small setiferous sclerite, usually also by an arcuate series of setae leading to spiracle 5 at each side; tibia 2 usually with 1 major and 1 minor (very tiny) apical spur; ♂ postgenital plate (fig. 42) with only ordinary setae, no short peg-like spines; ♀ tergite 7 entire, at most, posteromedian area slightly paler and less sclerotized. Normally breeding on *Odocoileus* ..... 4
4. Female abdominal segment 5 (fig. 52) dorsally with 18-29 (average 22.6) setae which usually form a continuous arcuate series between left and right spiracles 5; length

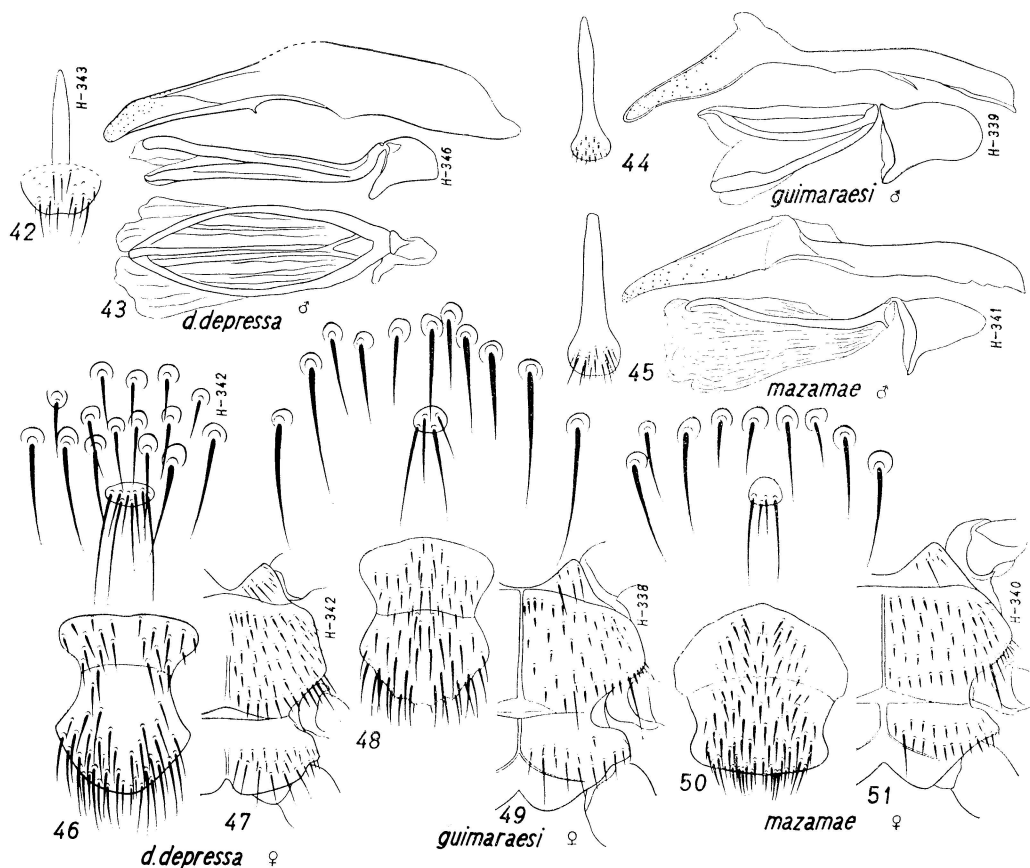


Fig. 42-51. *Lipoptena*, *Depressa* group. 42, ♂ postgenital plate; 43, paramere and aedeagus (latter in lateral and dorsal views); 44-45, ♂ genitalia; 46, 48, 50, ♀ terminalia, ventral view; 47, 49, 51, ♀ thoraces, ventral view.

(head + thorax) 2.05 mm in average. Rocky Mtn Subregion ..... **depressa depressa**  
 Female abdominal segment 5 (fig. 54) dorsally with 7-17 (average 12.0) setae which never form above described continuous series but leave conspicuous bare gap between tergite 5 and pleurite 5; length (head + thorax) 1.84 mm in average. Californian Subregion..... **depressa pacifica**

**Lipoptena depressa depressa** (Say, 1823)      Fig. 42, 43, 46, 47, 52, 53, 72, 87.

**MATERIAL.** 3♂♂, 11♀♀ (CNHM), Chadron, Dawes Co., Nebraska, ex "doe deer", III. 1954, B. Nelson.

**Habitats.** Eastern slope of the Rocky Mts, highlands. Bequaert's (1957) records from western Montana (Lincoln, Lake, Lewis, Missoula, Clark, Ravalli and Meagher counties), northern Wyoming (Big Horn Co.) and southwestern South Dakota (Pennington, Custer and Fall River Co.) are probably referable here. The northwestern Nebraska record given above is new for that state. According to Bequaert (*l. c.*), the type specimens (now lost) were most probably collected in Colorado, although no *Lipoptena* has been definitely recorded therefrom. The subspecies, as segregated here, is very rare in collections. The host is *Odocoileus h. hemionus* Rafinesque, the mule deer.

**Affinities.** This species is apparently more generalized than *guimaraesi* and *mazamae*. Its face and mesonotum are more setose, pleurite 2 dorsally more rounded at apex and

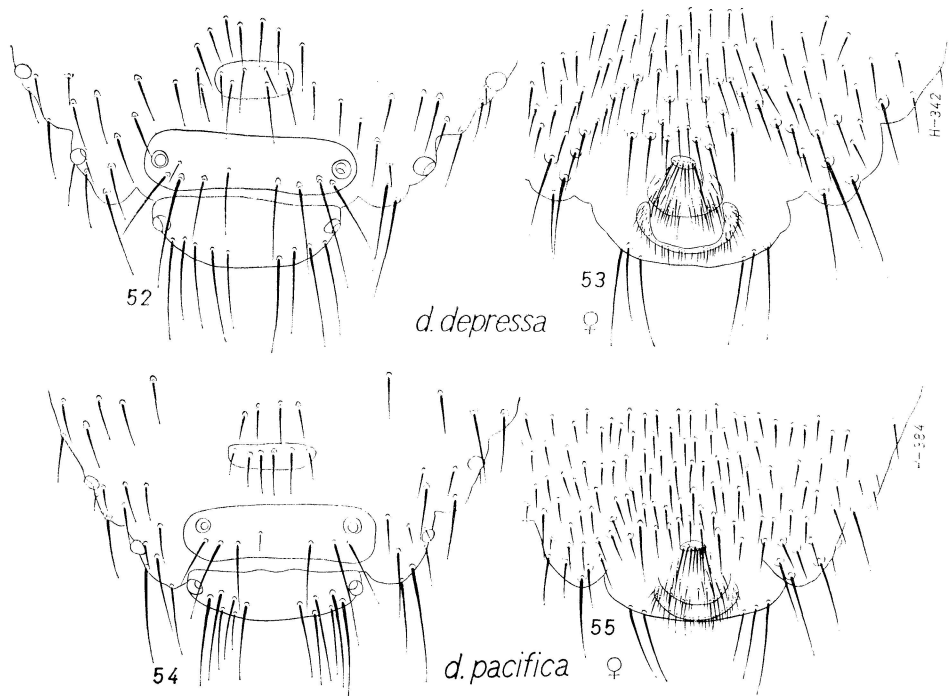


Fig. 52-55. *Lipoptena depressa* Say, ♀ terminaliae of subspecies. 52, 54, dorsal view; 53, 55, ventral view.

anterior tibial spur more poorly developed than in the 2 latter species. The palpus (fig. 72) is weakly narrowed apicad, gently convexly curved along both upper and lower margins with rather numerous basal setae. The ♂ genitalia (fig. 42, 43) has been illustrated by Ferris et al. (1922: 184, fig. 2F), Bequaert (1942a: 121, fig. 11 E, reproduced in 1957: 496, fig. 100 E) and Theodor (1963: 13, fig. 25). The paramere in profile is long, almost evenly broad and setulose near extreme apex; aedeagus long, slender; postgenital plate moderately long, apical part unusually broadened, with  $20 \pm$  setae, no spines. The ♀ urogenital area (fig. 46, 53) is anteriorly fenced by 2-3 rows of setae; pregenital plate comparatively large, bearing  $10 \pm$  setae; infra-anal plate discally bare, apically densely setose. The thoracic venter, ♀ terminalia (dorsal) and hind tarsus, respectively, are as in fig. 47, 52, 87.

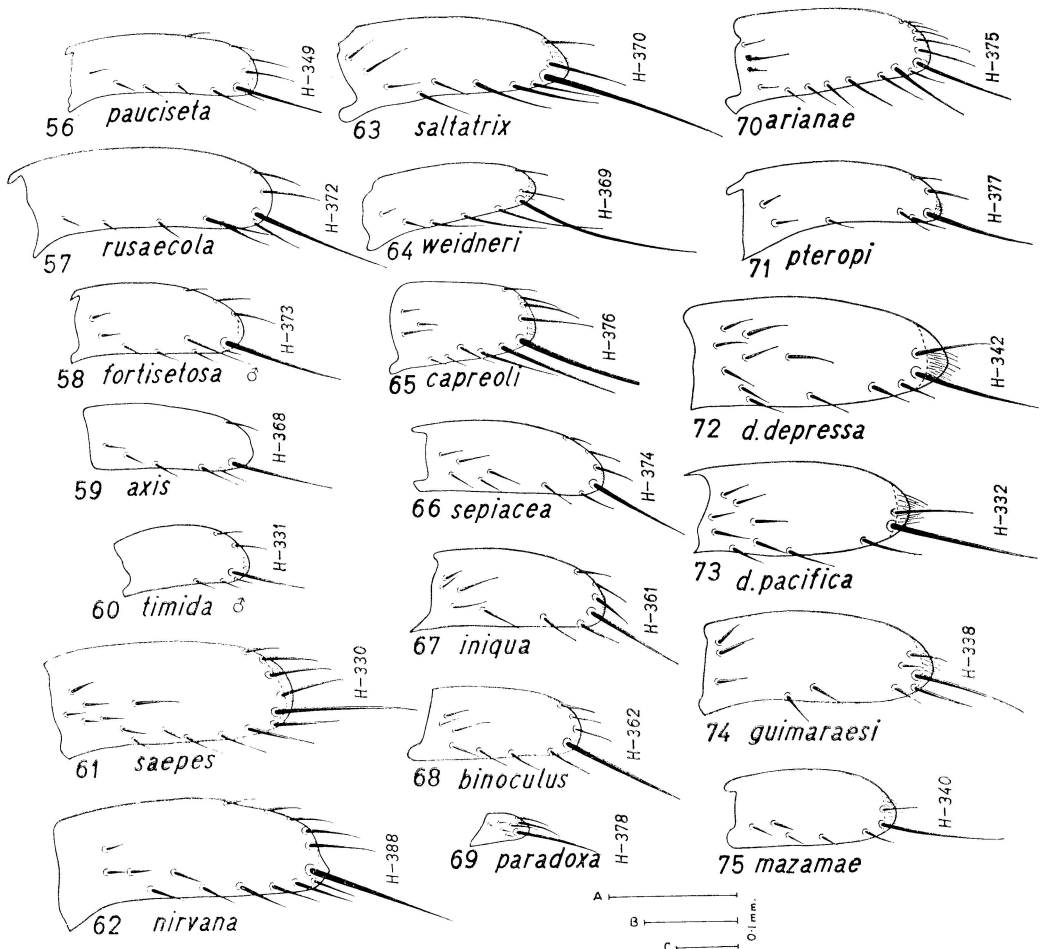


Fig. 56-75. *Lipoptena*, right palpi, lateral view, all of ♀♀ unless otherwise indicated. Scale A for fig. 56-62, 70 and 72-75; scale B for fig. 63-69; scale C for fig. 71.

***Lipoptena depressa pacifica* Maa, new subspecies**      Fig. 54, 55, 73.

**TYPE SERIES.** 8♂♂, 5♀♀, engorged. Not included in type series are many alate and pinned specimens (USNM, CAS, etc.). Holotype ♀ (CAS), paratypes (BISHOP, Los Angeles Mus., Canadian Nat. Coll., USNM). CALIFORNIA: 7♂♂, 3♀♀ incl. holotype, "California", ex mule deer, 11.VIII.1962, P. Bess. BRIT. COLUMBIA: 1♂, 2♀♀ (CNC), Lumby, ex mule deer, XI.1929, A. Dennys.

**Habitats.** Western slope of the Rocky Mts, lowlands, i. e., Brit. Columbia (to ca 50° N), Washington (state), Oregon, Idaho and California (to ca 33° N). Normally breeding on *Odocoileus hemionus columbianus* Richardson and *O. virginianus leucurus* Douglas. There are many stray records of newly emerged alate adults off man, horses and birds.

**Affinities.** A very weak geographical race, differing from the nominotypical one only in slightly smaller average body size and fewer setae on ♀ abdominal apex. No appreciable differences in genital plates of both sexes and in ♂ genitalia. In the following description, figures for *d. depressa* are in parentheses.

**Description.** Length (head + thorax) 1.8-2.0 mm, average 1.84 (2.05) mm. Palpus and abdominal spiracles slightly smaller than in *d. depressa*, as in fig. 54, 55, 73. ♀. Abdominal dorsal segment 4 incl. dorsum of pleurites 4 with 4-15 (15-32) setae, average 9.9 (21.4) setae; segment 5 with 7-17 (18-29) setae, average 12.0 (22.6) setae which never form a continuous series linking tergite 5 and pleurite 5, setae on tergite 5 always in single row — in *d. depressa*, usually (in 8 of 11 specimens available) forming such continuous series and on tergite 5, often arranged in 2 rows. Abdominal setae on the average shorter and less stout than in *d. depressa*. ♂. Basal hook-like appendix of aedeagus stouter than in *d. depressa*.

***Lipoptena guimaraesi* Bequaert, 1957**      Fig. 44, 48, 49, 74, 88.

**MATERIAL.** BRAZIL: 4♂♂, 3♀♀ (CNC), Barra do Tapirape, ex "deer", X.1962, B. Malkin & C. Pinheiros.

**Habitats.** Heretofore known from the type series, 5♂♂, 11♀♀ plus 7 specimens of "doubtful sex" ex *Ozotoceros bezoarticus* J. E. Gray, Matto Grosso and Goiás States in Brazil. Since *O. bezoarticus* is also found in Bolivia and northern Patagonia, *L. guimaraesi* probably occurs in those 2 countries too.

**Affinities.** From the terminalia (fig. 44, 48) of both sexes, including the size and shape of their dorsal abdominal sclerites, *guimaraesi* is closer to *mazamae* than to *depressa*. The paramere in profile is comparatively short, distinctly tapering apicad and rather extensively setulose; aedeagus short; postgenital plate long, slender, with 10± peg-like spines plus 3-4 fine setae near apex. The ♀ urogenital area is anteriorly fenced by single row of strong setae; pregenital plate small, with 4-5 setae of varied length; infra-anal plate with fewer and slightly shorter setae than in *depressa*, its discal area not bare. In the chaetotaxy, however, *guimaraesi* is more similar to *depressa* than to *mazamae*, perhaps being a result of climatic similarities of habitats with *depressa*. Counts of the setae in the material at hand are: 3-4 (3.1) orbitals, 4-6 (4.9) humerals, 9-15 (11.9) prescutals (i. e., acrostichals plus laterocentrals), 2 postalars, 4-5 prescutellars, 2, very rarely 3 scutellars, 1-3, usually 2 on membrane of tergite 5, 4-5 on ♀ tergite 6, 5-6 on ♀ tergite 7, 5-7 on ♂ tergite 6+7. The palpus (fig. 74) in profile is more slender than and differs from that of *mazamae* and *depressa* in having lower margin gently concave (not convex)

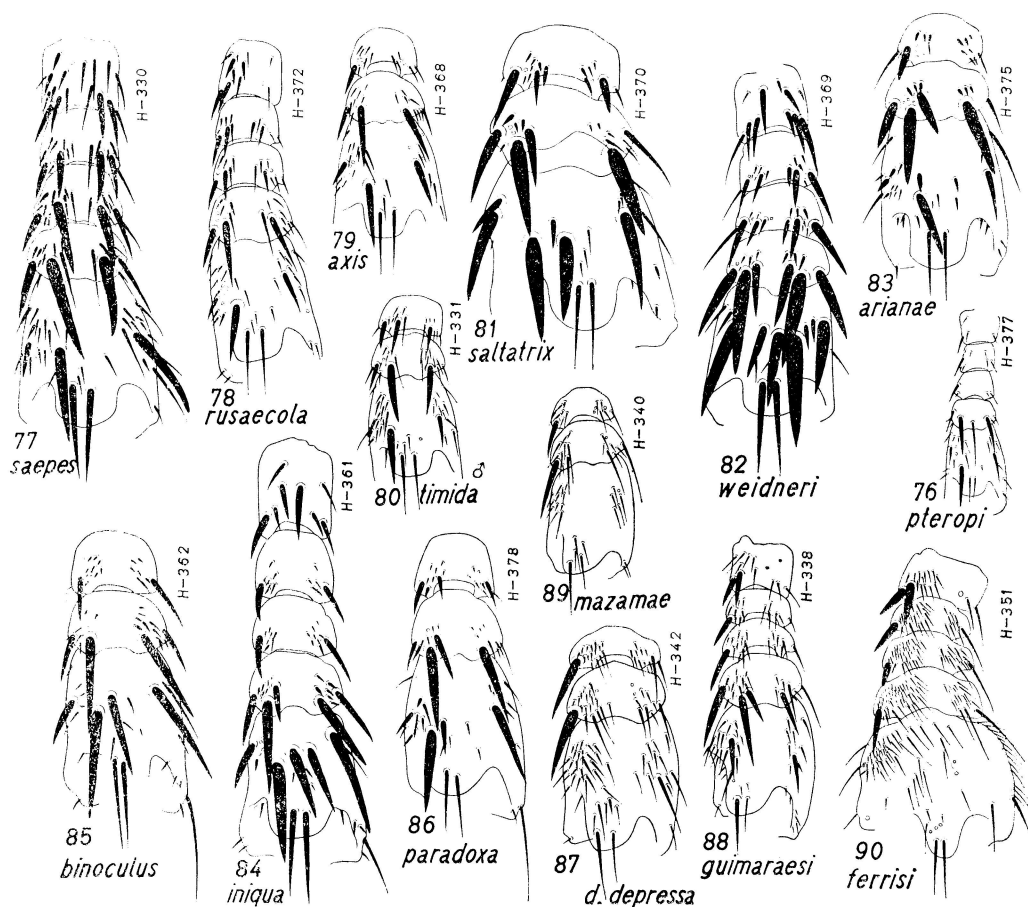


Fig. 76-90. *Lipoptena* and *Neolipoptena*, hind tarsi, ventral view, all of ♀♀ unless otherwise indicated. All in same magnification.

and subparallel to upper margin. The thoracic venter and hind tarsus are as in fig. 49 and 88.

***Lipoptena mazamae* Rondani, 1878** Fig. 45, 50, 51, 75, 89.

**MATERIAL.** COLOMBIA: 22♂♂, 24♀♀ (CNHM 87865, 97869), Meta, La Macarena, Rio Guapaya, 300 m, ex *Mazama americana*, III.1957, K. von Sneidern. 1♂, 3♀♀ (CNHM 68804), San Juan Nepomuceno, Dept. Bolivar, 180 m, ex *M. guazupita*, I.1949, P. Hershkovitz. PERU: 16♂♂, 12♀♀ (CNHM 88808), Loreto, Maynos Rio Mirim, Quebrada Esperanza, ex *M. americana*, IX.1957, C. Kalinowski.

**Habitats.** Widely spread over entire continental tropical America, sporadically distributed in southeastern United States (to ca 33° 30' N) and southward to 27° 30' S in Argentina; normally breeding on *Odocoileus virginianus* Boddaert, and *Mazama* spp. Stray records were from *Tayra barbara* Linn., *Tayassau angulatus* Cope and domestic cattle.

*Affinities.* Ferris et al. (1922: 185, fig. 2A, 2E) were the first workers to point out the close affinities of *mazamae* and *depressa* and their differences in the relative robustness of fore tibial spurs and the size and shape of ♂ genitalia. Bequaert (1942a: 56), on the other hand, separated the 2 species by the number of orbital and mesonotal setae in addition to the relative robustness of fore tibial spurs. In his more recent key (1957: 488), *mazamae* and *guimaraesi* were placed in the same couplet, and they were separated by the number of orbital setae, relative bareness of mesonotum and number of mid tibial spurs (*mazamae* was said to have 1, *guimaraesi*, to have 3 stout spurs). The last character probably led the description of *odocoilei* by Byram (1964: 155-57) who claimed that 9 specimens of his presumed new species had 1 mid tibial spur, 33 specimens had 2, and another 9 specimens had 3. As I can see from specimens at hand, there are 3 mid tibial spurs in *mazamae*, too; the median one is long and robust, the anterior one is *ca* 1/3 as long as and much finer than median, the posterior one is pale, like a very small seta and easily overlooked. Other characters supposed by that author (obviously his concept of *mazamae* was entirely based upon Bequaert's drawing rather than any actual specimens) to be diagnostic are: extent of median notal suture (to level of transverse mesonotal suture in *odocoilei*, "confined to anterior end" of thorax in *mazamae*), number of orbital and prosternal setae (*odocoilei* said to be usually with 5 frontal bristles, but in his figure it is clearly shown that 4 very minute setae were also counted in), number of spine-rows on anepisternum (2 rows in *odocoilei*, "1" in *mazamae*), number of setae on ♀ tergal plates (4 setae each in *odocoilei*, "6" in *mazamae*), and number of setae on ♂ "median dorsal plate" (3 setae in *odocoilei*, "2" in *mazamae*). The original description of *odocoilei* was said to have been based on 29♀♀, 21♂♂, plus 9 specimens of undetermined sex. It is unbelievable that there should have been no individual variation in such details of chaetotaxy. As pointed out in my (1965: 245) previous paper, *odocoilei* must be suppressed as a synonym of *mazamae*.

The number of setae on dorsal abdominal membrane appears to be a very convenient character for distinguishing *mazamae* from the 2 other species. Counts in the 54♂♂, 60♀♀ listed above are: Range ♂ 15-52 setae, ♀ 12-52; average ♂ 30.1 setae, ♀ 36.3; frequencies of various intergradations as follows:

	10-14 setae	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-52
♂♂	0	2	7	15	18	10	2	0	0
♀♀	2	0	3	4	14	19	8	7	3

The ♂ genitalia (fig. 45) of this species has been illustrated by Ferris et al. (*l. c.*). The paramere in profile is moderately long, distinctly tapering apicad and rather extensively covered with setulae; aedeagus long and slender; postgenital plate long, slender, with  $15 \pm$  setae near apex, no spines. The ♀ urogenital area (fig. 50) is anteriorly fenced by single row of setae; pregenital plate small, with  $4 \pm$  setae of varied length; infra-anal plate large, densely setose. The thoracic venter, palpus and hind tarsus are as in fig. 51, 75 and 89, respectively.

**Neolipoptena ferrisi** (Bequaert, 1935)

Fig. 90, 94-96.

**Habitats.** Confined to the Californian Subregion and the western part of Rocky Mountain Subregion, northward to 51°N in Brit. Columbia, southward to Baja California (Sierra Laguna), eastward to 103°30' W in North Dakota. Practically in coincidence with the range of its present-day breeding host *Odocoileus hemionus* Rafinesque. In addition to stray records ex *O. virginianus* Boddaert and the quail *Lophortyx californica* Shaw, there were 2 records ex *Antilocapra americana* Ord which is the only genus and species of Recent Antilocapridae. It seems possible that the original host of *ferrisi* might have been certain extinct Antilocapridae and might have become permanently adapted to Cervidae (*Odocoileus*) onto which it has strayed at-first accidentally. The following evidences seem to support this presumption: (a) in structure of terminalia of both sexes, *ferrisi* is clearly closer to the Capreoli than to the Cervi group of the genus *Lipoptena* (see below), these 2 groups are host specific to Bovidae (Caprinae in particular) and Cervidae, respectively, while the family Antilocapridae is much more closely related to Bovidae than to Cervi-

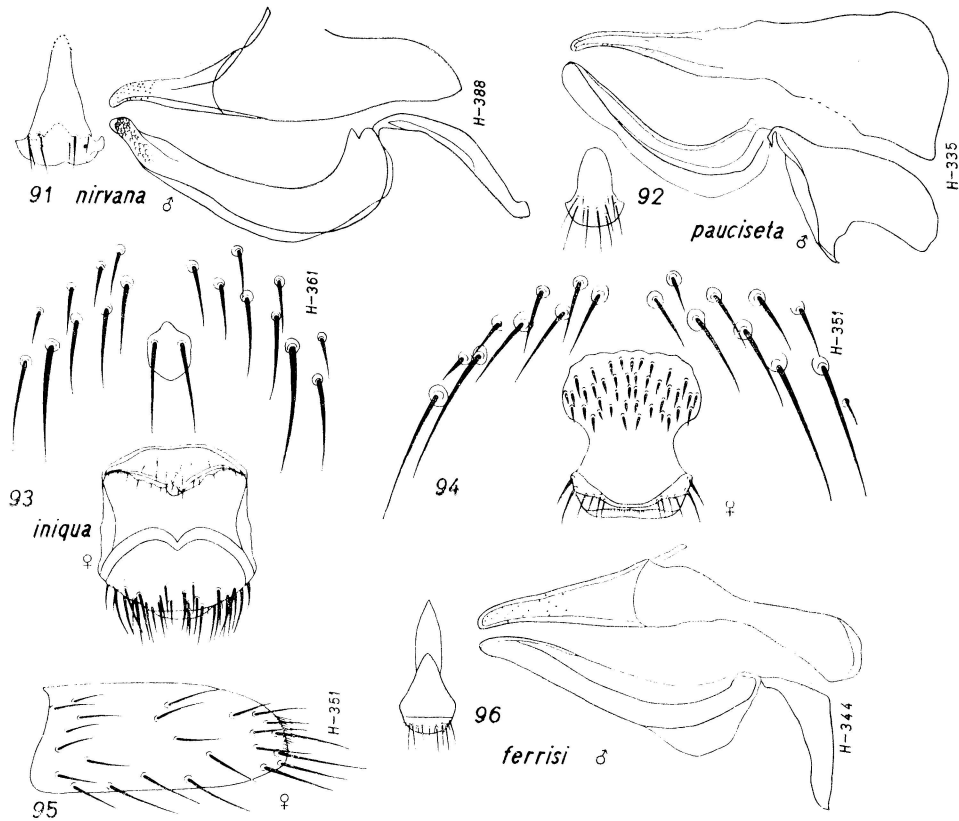


Fig. 91-96. *Lipoptena* and *Neolipoptena*. 91, ♂ genitalia, *L. nirvana* Maa; 92, *id.*, *L. pauciseta* Edw.; 93, ♀ terminalia, ventral view, *L. iniqua* Maa (compare fig. 35 for that of *sepiacea* Speis.); 94, *id.*, *N. ferrisi* Beq.; 95, ♀ left palpus, lateral view, *N. ferrisi*; 96, ♂ genitalia, *N. ferrisi*.

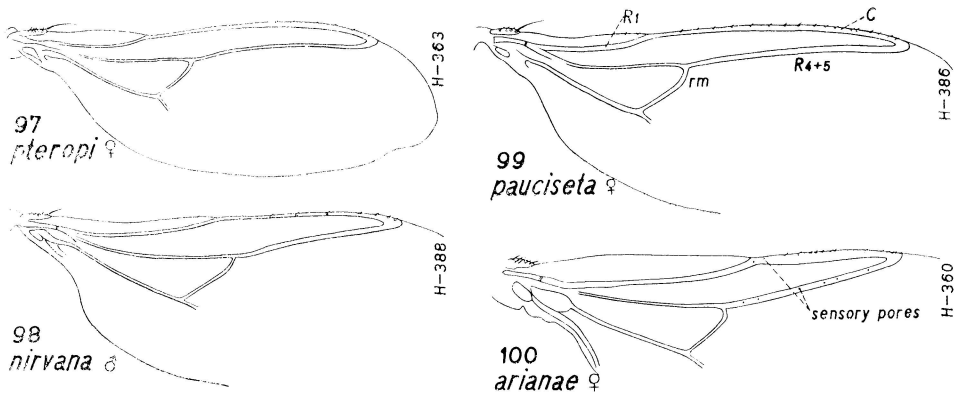


Fig. 97-100. *Lipoptena*, wings. Magnifications varied.

dae; (b) the Antilocapridae is endemic to N. America since its first appearance in Middle Miocene, 10 extinct genera were listed by Simpson (1945: 156-57) from Miocene, Pliocene and Pleistocene, the scarcity of *ferrisi* ex *Antilocapra* may perhaps be attributed to the difficulty to collect and to the rarity now of this mammal; (c) the genus *Neolipoptena* itself is also endemic to N. America.

*Affinities.* *Neolipoptena* was placed by Bequaert (1942a, 1957), without giving reasons, at the very beginning of the subfamily, and then by Maa (1963, 1965) at near the top of the same, i. e., between *Lipoptena* and *Melophagus*. The genus has several characters unique or unusual for Lipopteninae. Among them the very large and roundish eyes, the non-decurved and rather evenly setose palpi (fig. 95), and the semicircular sternite 1 may be considered generalized while most of the remaining characters, highly specialized. The ocellar triangle is distinctly shorter than wide; anterior and posterior thoracic spiracles both roundish, subequal in size to each other; mesepisterna clearly separated from mesepimera by deep sutures; metasternum posteriorly truncate; claws very much asymmetrical, posterior ones of same legs only *ca* 1/2 as long as anterior and with poorly developed "heels"; anterior pulvilli *ca* 2/3 as long but 2× as broad as posterior; apparently no remnants of tergite 1; no entire median tergal plates; pleurite 2 membranous; ♀ infra-anal plate much reduced. The chaetotaxy is quite characteristic: orbitals more crowded to outer than to inner margins of inner orbits; acrostichals and laterocentrals not clearly distinguishable from one another; mesopleurals much thicker than mesonotals and usually in single row; first row of mesosternals arranged well behind anterior mesosternal margin; metabasisternals in only 1 row; posterior fringe of pleurite 1 composed of closely spaced heavy spines rather than well spaced long bristles, in strong contrast to posterior fringe of pleurite 2; surface of pleurite 1 elsewhere entirely bare; sternite 1 with only single series of marginal setae rather than very heavy marginal spines plus several rows of setae on surface; setae on abdominal membrane comparatively short but strong. The terminalia in both sexes is similar to that in the Capreoli group: ♀ (fig. 94) lacking pregenital plate but with well defined pregenital setal fence; ♂ paramere with sclerotized apodeme, aedeagus in dorsal aspect long and slender. The general outline of legs as well as the setal arrangement of prosternum and legs are also similar to



that in the Capreoli group. By weighing the relative importance of afore-mentioned characters, *Neolipoptena* is clearly a quite distinct genus, more specialized than *Lipoptena* and comparatively closer to the Capreoli group of the latter genus. The reduction of tergal plates and the thickening of junction of C and  $R_{4+5}$  veins which are similar in *Neolipoptena* and in the Depressa group of *Lipoptena* are apparently outweighed by the details of terminalia and other characters. The ♂ genitalia (fig. 96) of *N. ferrisi* has briefly been described by Cole (1927: 453), and figured by Bequaert (1942a: 49, fig. 4D, reproduced

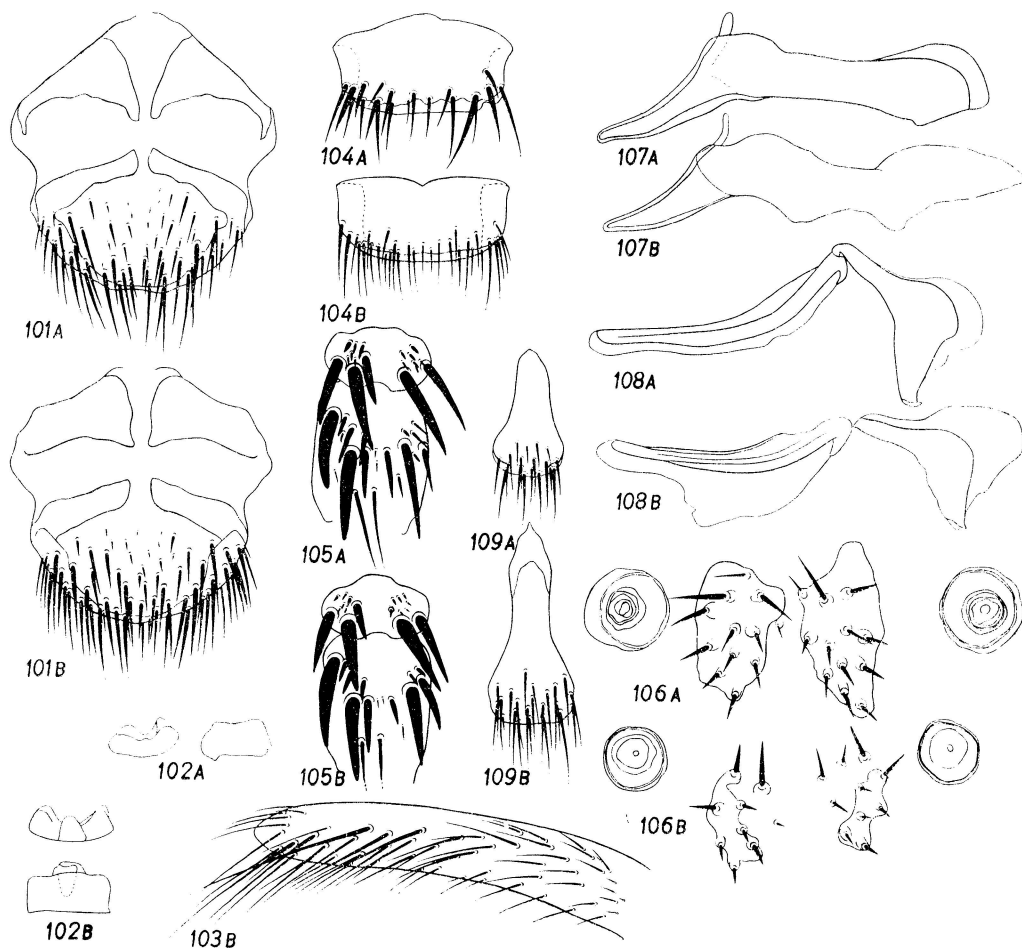


Fig. 101-109. *Melophagus ovinus* Linn., subsp. *ovinus* Linn. (A) and subsp. *himalayae* Maa (B). 101, ♀ infra-anal and postgenital plates; 102, ♀ pregenital plates, each in 2 different views; 103, ♀ left palpus (of *himalayae* only), lateral view; 104, ♀ supra-anal plates; 105, ♀ tarsomeres 4-5 of hindlegs, ventral view; 106, ♀ abdominal spiracles 7 and tergites 7; 107, parameres; 108, aedeagi; 109, ♂ postgenital plates. A and B of each figure in same magnification except in fig. 107-108 where A is slightly less magnified than B; A based on slides 364 (♀), Hawaii I. and 385 (♂), England; B based on slides 365 (♀), holotype and 367 (♂), allotype.

in 1957: 485, fig. 98D). The accompanying new figures were based upon material from California. The ♀ abdominal venter was figured by Bequaert (*l. c.*: fig. 4A, 98A) as if with 3 median sclerites at apex.

**Melophagus ovinus himalayae** Maa, new subspecies      Fig. 101B–109B.

**TYPE SERIES.** Holotype ♀ (BISHOP 7601), allotype ♂, both (BISHOP). NEPAL: 1♂, 1♀, Langtang Valley, 3300 m, ex yak [*Bos grunniens* Linn.], 17.X.1965, L. Quate.

**Habitats.** Probably confined to the Himalayas; besides the type series from Nepal, the 6 specimens ex unknown host from Rukshu on Tibetan Frontier listed by me (1965: 246) under *ovinus* apparently are also referable here (specimens not available at present for direct comparison). Bequaert (1942a: 182) listed *ovinus* ex cow, Yatung, Tibet, but I did not see such specimens. The occurrence of any *Melophagus* ex yak and cow is almost certainly accidental, and the true breeding host of *himalayae* remains uncertain.

**Affinities.** Inseparable from the nominotypical subspecies except in terminalia, size of abdominal spiracles and several minor (perhaps not quite reliable) characters. Not comparable to the subspecies *montanus* Ferr. & Cole (Alaska) which is known only from ♂ sex (genitalia undescribed) although the abdominal spiracles in the latter, as figured by those authors, are similarly reduced in size. Comparisons with the so-called var. *fera* Speis. (Caucasus, ex "Steinbock") and forma *bolivianus* Bau (Bolivia, host unknown) is unnecessary since, with all certainty, both are synonymous with typical *ovinus*.

**Description.** Differing from nominotypical *ovinus* in the following points: setae, spines and bristles on anterior and ventral surfaces of tibia 3 more regularly arranged and more even in length and robustness; basal pair of submedian plantar spines on hind tarsomere 5 distinctly not even in length; abdominal spiracles smaller, diameter of spiracle 7 in ♀ 0.17 mm (in ♀ *o. ovinus*, 0.23 mm) (both measured after KOH treatment); ♀ pregenital plate with 3 strong longitudinal ridges; side-piece of ♀ tergite 7 much smaller, partly disintergrated, ca 1/2 of its setae not much longer than diameter of their basal papillae; ♂ postgenital plate longer, more slender, with much shorter setae. Body slightly larger than average examples of *o. ovinus*, length (head + thorax) in both sexes 2.4 mm.

#### REGROUPING OF GENERA AND SPECIES

The subfamily Lipopteninae was divided into 4 genera (2 of which into 2 subgenera each) and 19 species by Bequaert (1942a), into 3 genera (2 of which into 5 species-groups) and 20 species by Maa (1963), and into 9 "series" and 23 species by Maa (1965). The revised scheme given below is chiefly based on structural characters with due considerations to geographical distribution and host relationships. It includes the genera *Lipoptena* (with 28 species and subspecies in 4 groups), *Neolipoptena* (with 1 species), and *Melophagus* (with 4 species and subspecies in 2 groups). The term "group" is here used only for convenience; hence the various groups are not necessarily of equal significance.

- a<sub>1</sub>. Wing fully developed, caduvous; halter present; mesosternum much larger than metasternum; mesopleuron not constricted, or hardly so, between coxae 1 and 2; mesonotal sutures complete, clearly defined; prosternum shortened; eye either rounded or moderately long and broad; ♀ pregenital plate (when present) and postgenital plate setose; pulvilli all, or in part, fully developed.
- b<sub>1</sub>. At least 1 entire median tergal plate; sternite 1 posteriorly distinctly bilobed; eye elon-

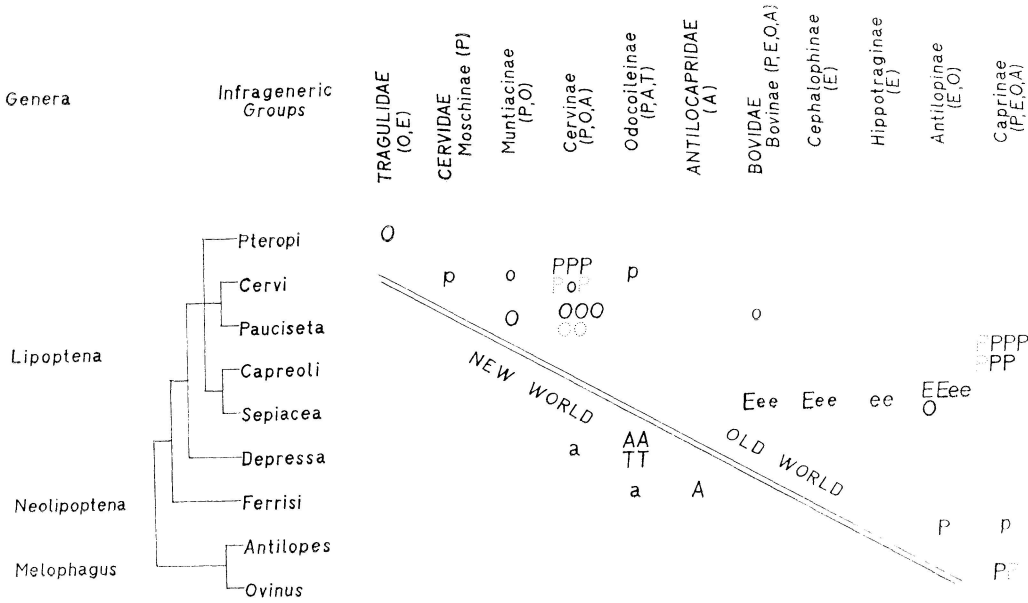


Fig. 110. Distribution, hosts and interspecific affinities of Lipopteninae. A, Nearctic; E, Ethiopian; O, Oriental; P, Palaearctic; T, Neotropical; such letters in center of the graph each represents a Lipoptenine species or subspecies; solid-lined capital letters indicating definite host relationship, those enclosed in parentheses indicating known distribution of different groups of Recent Ruminantia; broken-lined capital letters indicating uncertain but possibly definite host relationship, solid-lined small letters indicating stragglers and secondary (acquired) host relationship. Secondary distributional ranges such as that of *Lipoptena cervi* in N. America, are not included.

gate, laterally at most partly touching margin of head; posterior thoracic spiracle elliptical, smaller than anterior one; mesepisternum separated from mesepimerum by shallow suture; tergite 1 vestigial; posterior claws slightly shorter than corresponding anterior ones, with well defined "heels"; anterior pulvilli as broad as posterior ones and either vestigial or fully developed; coxa 1 normal, lacking retrograde projection; tarsomeres 1-4 of all legs (fig. 76-89) with small patches of soft setae; ♀ infra-anal plate normal; palpus with only 1 terminal setae which is 2× or more as long and stout as other palpal setae ..... **Lipoptena** Nitzsch

- c<sub>1</sub>. Pulvilli partly vestigial, not all fully developed; veins C and R<sub>4+5</sub> apically not suddenly thickened and knob-like; pronotum not constricted or interrupted at middle but often very slightly lengthened thereabout; 3 or 4 wide (i. e., ca as wide as post-vertex or scutellum) median tergal plates in both sexes; discal membranous area (representing tergite 3) of abdominal dorsum either not lengthened but quite unevenly setose, or much lengthened and entirely bare. Old World.
- d<sub>1</sub>. Posterior margin of metasternellum straight, deeply depressed at middle; membranous area of abdominal dorsum entirely bare; junction of veins C and R<sub>1</sub> (fig. 97) situated much basad to level of junction of R<sub>4+5</sub> and rm which is much closer to base than to apex of R<sub>4+5</sub>; tergite 3 not definable; tergal plates crowded together at abdominal apex; longitudinal intrascutal groove indistinct; posterolateral corner of pleurite 1 very broadly rounded; eye laterally almost touching margin of head; setae on prosternal lobe scattered over almost entire surface; ♀ pregenital

- plates in 3 pieces, anteriorly not fenced by setae; ♂ parameral apodeme membranous; ocelli present; tibiae relatively slender; remnant of tergite 1 transversely linear. Oriental Region; on Tragulidae ..... **Pteropi** group  
1 species: *pteropi* Denny.
- d<sub>2</sub>. Posterior margin of metasternellum angularly notched and shallowly depressed at middle; membranous area of abdominal dorsum setose; junction of veins C and R<sub>1</sub> (fig. 98, 99) situated slightly basad to level of junction of R<sub>4+5</sub> and *rm* which lies at midpoint of R<sub>4+5</sub>; tergite 3 always small, much more reduced in size than 4; tergal plates not crowded together at abdominal apex; longitudinal intrascutal groove distinct; posterolateral corner of pleurite 1 always very broadly rounded; eye laterally almost touching margin of head; setae on prosternal lobe scattered over almost entire surface; ♀ pregenital plates always present, in 3 pieces, anteriorly not fenced by group of setae representing sternite 6; ♂ parameral apodeme membranous, not forming sclerotized horn-like process to join postgenital plate; ocelli always present; tibiae relatively slender; remnant of tergite 1 transversely linear. Palaearctic and Oriental Regions; on Cervidae: Muntiacinae, Cervinae ..... **Cervi** group
- e<sub>1</sub>. Chaetotaxy less reduced; ♀ pregenital plates large ..... **Cervi** subgroup  
6 species: *japonica* Beq., *cervi* Linn., *efovea* Speis., *nirvana* Maa, *sigma* Maa, *saepe* Maa.
- e<sub>2</sub>. Chaetotaxy more reduced; ♀ pregenital plates small ..... **Pauciseta** subgroup  
5 species: *pauciseta* Edw., *rusaecola* Beq., *fortisetosa* Maa, *axis* Maa, *timida* Maa.
- d<sub>3</sub>. Posterior margin of metasternellum angularly notched and shallowly depressed at middle; membranous area of abdominal dorsum setose; junction of veins C and R<sub>1</sub> (fig. 100) situated much apicad to level of junction of R<sub>4+5</sub> and *rm* which lies at midpoint of R<sub>4+5</sub>; tergites 3 and 4 subequal in size, often large; tergal plates not crowded together at abdominal apex; longitudinal intrascutal groove indistinct; posterolateral corner of pleurite 1 often subangularly produced; eye laterally rather far from reaching margin of head; setae on prosternal lobe crowded near inner margin; ♀ pregenital plate either single and anteriorly fenced by setae, or entirely absent and solely represented by setal fence; ♂ parameral apodeme sclerotized, forming horn-like process to join postgenital plate; ocelli present or absent; tibiae relatively stout; remnant of tergite 1 large, subtriangular. On Bovidae ..... **Capreoli** group
- e<sub>3</sub>. Chaetotaxy less reduced; ocelli always present; palpus always moderately long; ♀ pregenital usually absent. Palaearctic Region; on Caprinae ..... **Capreoli** subgroup  
7 species: *couturieri* Séguy, *saltatrix* Maa, *grahami* Beq., *weidneri* Maa, *chalcomelaena* Speis., *capreoli* Rndn., *arianae* Maa.
- e<sub>4</sub>. Chaetotaxy more reduced; ocelli generally absent; palpus occasionally vestigial; ♀ pregenital plate always present. Ethiopian Region and India; on Bovinae, Cephalophinae, Hippotraginae, Antilopinae ..... **Sepiacea** subgroup  
5 species: *hopkinsi* Beq., *sepiacea* Speis., *iniqua* Maa, *binoculus* Speis., *paradoxa* Newst.
- c<sub>2</sub>. Pulvilli all fully developed; veins C and R<sub>4+5</sub> suddenly thickened knob-like at and near their apices; pronotum distinctly constricted or interrupted at middle; 2 wide median tergal plates in ♂, 1 in ♀; discal membranous area of abdominal dorsum much lengthened, evenly covered with setae; (posterior margin of metasternellum slightly depressed and angularly notched at middle; tergal plates crowded together at abdominal apex; longitudinal intrascutal groove indistinct; posterolateral corner of pleurite 1 always broadly rounded; eye laterally touching part of margin of head; setae on prosternal lobe scattered over almost entire surface; ♀ pregenital plate pre-

- sent, single, anteriorly fenced by setae; ♂ parameral apodeme membranous; ocelli always present; tibiae relatively stout; remnant of tergite 1 roundish). New World, on Cervidae: *Odocoileinae* ..... **Depressa** group  
3 species: *depressa depressa* Say, *depressa pacifica* Maa, *guimaraesi* Beq., *mazamae* Rndn.
- b<sub>2</sub>. No entire median tergal plate; sternite 1 posteriorly convexly curved, not bilobed; eye roundish, laterally surpassing margin of head; posterior thoracic spiracle roundish, as large as anterior one; mesepisternum separated from mesepimeron by very deep suture; no remnant of tergite 1; posterior claws *ca* 1/2 as long as corresponding anterior ones, with hardly definable "heels"; anterior pulvilli *ca* 2x as broad and 2/3 as long as posterior ones; coxa 1 dorsally with strong retrograde projection; tarsomeres 1-4 of all legs (fig. 90) with large patches of soft setae; ♀ infra-anal plate greatly shortened; palpus (fig. 95) with 2-3 terminal setae which are hardly longer, stouter than other palpal setae; (veins C and R<sub>4+5</sub> suddenly thickened, knob-like at and near their apices; pronotum not constricted nor interrupted at middle; membranous area of abdominal dorsum unevenly setose; posterior margin of metasternellum straight, deeply depressed at middle; longitudinal intrascutal groove indistinct; posterolateral corner of pleurite 1 very broadly rounded; setae on prosternal lobe crowded together to inner margin; ♀ pregenital plate absent, urogenital area anteriorly fenced by 1-2 rows of setae; ♂ parameral apodeme sclerotized; ocelli present; tibiae relatively slender). Nearctic Region (Californian & Rocky Mtn Subregions); on Antilocapridae, (? secondarily) Cervidae: *Odocoileinae*..... **Neolipoptena** Beq.  
1 species: *ferrisi* Beq.
- a<sub>2</sub>. Wing replaced by permanent solid subcylindrical knob; halter absent; meso- and metasterna subequal in length; mesopleuron strongly constricted between coxae 1 and 2; sutures of mesonotum obliterated, anepisternum incompletely separated from prescutum, transverse mesonotal suture absent, scutoscuteellar suture incomplete; prosternum lengthened; eye quite long and narrow; ♀ pregenital and postgenital plates bare; pulvilli all vestigial; (♂ with none or 1, ♀ with none or 2 entire median tergal plates; sternite 1 distinctly bilobed posteriorly; eye laterally far from reaching margin of head; both thoracic spiracles roundish, anterior one larger than posterior; no suture separating mesepisternum from mesepimeron; remnant of tergite 1 transversely linear; posterior claws slightly shorter than corresponding anterior claws, with well defined "heels"; ♀ infra-anal plate normal, not shortened; pronotum not constricted or interrupted at middle; posterior margin of metasternellum angularly notched and slightly depressed at middle; longitudinal intrascutal groove indistinct; posterolateral corner of pleurite 1 angulate; ♀ pregenital plate single, anteriorly fenced by setae; ♂ parameral apodeme sclerotized; ocelli always absent; tibiae relatively stout). Palaearctic Region; on Bovidae.....  
..... **Melophagus** Latr.
- b'. Palpus as long as or shorter than frons; ♂ with 1, ♀ with 1-2 entire median tergal plates; eye *ca* as broad as antennal pit; setae on face, mesonotum and legs more reduced; ♂ aedeagus lacking hook-like process at base. On Antilopinae, Caprinae .....  
..... **Antilopes** group  
2 species: *antilopes* Pallas, *rupicaprinus* Rndn.
- b''. Palpus nearly 2x as long as frons; ♀ with 1 medially divided tergal plate, ♂ entirely lacking such plate; eye *ca* 1/2 as broad as antennal pit; setae on face, mesonotum and legs less reduced; ♂ aedeagus with dorsal hook-like process at base. On Caprinae .....  
..... **Ovinus** group  
1 species: *ovinus ovinus* Linn., *ovinus himalayae* Maa.

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