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A REVIEW OF THE PARASITIC EARWIGS
(Dermaptera: Arixeniina; Hemimerina)[1]

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Abstract. Ectoparasitic earwigs are herein classified into 2 families, 4 genera (2 new) and 16 species (5 new) belonging to 2 small dermapteran suborders, viz. Arixeniina, on certain Oriental molossid bats; and Hemimerina, on certain Ethiopian murid rats. In this paper, the systematic affinities, geographical distribution and host relationships for each taxon are discussed, and synoptic keys, and descriptions and illustrations for both adults and nymphs are given. New taxa (authorship for which is to be credited to Maa alone) described are *Xeniaria* (n. g.) *truncata* (Palawan), *X. bicornis* (Mindanao), *Arixenia camura* (Mindanao), *Araeomerus* (n. g.) *hubbardi* (Tanzania), *Hemimerus prolixus* (Mozambique), n. spp. *Arixenia jacobsoni* Burr and *H. morrisi* Hanney are transferred to *Xeniaria* n. g. and *Araeomerus* n. g., respectively; *Hemimerus deceptus* "var." *ovatus* Deoras is sunk as a n. syn. of *H. vosseleri* Rehn & Rehn. Also recorded and described is a teratological 3rd stadium nymph of *Arixenia camura*, the terminalia of which are closely similar to that of an adult ♂.

[This revisionary work was, at my suggestion, started by the late Miss Setsuko Nakata in 1966. Her burden of administrative duties was however so heavy that she could by no means find sufficient time to draft the manuscript before her untimely death in 1971. A number of preliminary notes, microscopic preparations and partially studied materials left by her formed a sound foundation of the report presented here. It gives me pride to have eventually completed the work and to stand as author with her. T.C.M.]

The order Dermaptera DeGeer, 1773 (generally known as earwigs) is, in current usage, divided into 3 suborders, Forficulina, Arixeniina and Hemimerina. The Forficulina are free-living, oviparous (with very few exceptions), worldwide in distribution and comprise about 8 families and 1000 described species including some fossils dating back to the Upper Jurassic. The Arixeniina and Hemimerina, on the other hand, are ectoparasitic on (or in a stricter sense, in close association with) certain mammals and feed principally on the epidermis of the host but apparently cause no pathological effects. They are viviparous (♀ having a pseudoplacenta), are restricted to certain parts of the Oriental and Ethiopian regions, and each contain a single family, 2 genera and less than a dozen species; no fossils are known. Very often their intersegmentalia are heavily loaded with phoretic laelapid mites (*Andreacarus* and an undetermined genus), a phenomenon unknown in the Forficulina. In superficial appearance, these ectoparasitic earwigs bear little resemblance to most of the free-living ones particularly because the former are always apterous, blind (or nearly so) and have very slightly modified cerci. Giles (1963) analyzed, for the entire order, 283 external morphological (skeletal) characters which were believed to be of phylogenetic significance. He found 247 of these characters common to all the 3 suborders, and very few of them (14, 7, 13, respectively) peculiar to each sub-

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order. As the keys to these suborders in most textbooks are somewhat misleading with regard to the mandibles and cerci, a revised key follows.

1. Cerci strongly sclerotized, opposable like blades of a pair of forceps, generally robust, hairless and more or less flattened, never with patches of sensory papillae; eyes well developed — when slightly reduced on rare occasions, then each at least 3 × as large as an antennal socket; usually adults bearing wings while later nymphal stadia bear wing-buds; mandibles suitable for chewing, basal part of mesial (inner) margin forming molar region and never fringed with closely arranged, stiff setae. Free-living. Worldwide..... **Forficulina**

   Cerci weakly sclerotized, non-opposable, slender, setose, subcyclindrical — when strongly sclerotized, opposable and robust (in ♂ of the 2 *Arixenia* species only), then each with 1 or 2 patches of closely arranged sensory papillae on mesial (inner) margin; eyes either entirely wanting or each much smaller than an antennal socket; always entirely apterous; mandibles not fitted for chewing but rather for cutting and brushing, basal part of mesial (inner) margin like razor-edge and fringed with 1 or 2 series of closely arranged, stiff setae. Ectoparasitic. Palaeotropics. 2

2. Body densely uniformly haired all over except several small bare patches or strips on head capsule, thorax and femora; head as wide as pronotum, latter scarcely explanate at sides; antennae at least 2/3 as long as body (excluding cerci); eyes present, though much reduced; legs long, slender, not modified, femora 1 and 2 subequal to 3 in length and profile width, each about as long as width of pronotum; tibiae in profile about 7× as long as wide, dorsoapically not forming large slanting excavations; tarsi without membranous pads (euplantulae) beneath; tarsi 1 and 3 in dorsal view with segment 3 shorter than segments 1 and 2 together; ♀ tergites 8 and 9 well exposed behind tergite 7; ♂ sternite 9 posteriorly symmetrical; cerci in ♀ nearly straight or very gently curved, in ♂ strongly angulate and each with 1 or 2 patches of sensory papillae. On *Cheiromeles* bats; Oriental region. ..... **Arixeniina**

   Body sparsely unevenly haired; head 3/4 as wide as pronotum, latter strongly explanate at sides; antennae less than 1/3 as long as body (excluding cerci); eyes entirely wanting; legs very short and robust, strongly modified, femora 1 and 2 distinctly shorter, slimmer than 3, each shorter than 1/2 width of pronotum; tibiae in profile about 2 × as long as wide, dorsoapically obliquely truncate and each forming a very large, slanting, membranous excavation for reception of corresponding tarsus when the latter is flexed; tarsi with large membranous pads beneath; tarsi 1 and 3 in dorsal view with segment 3 about 2 × as long as segments 1 and 2 together; ♀ tergites 8 and 9 both covered by tergite 7; ♂ sternite 9 posteriorly asymmetrical; cerci showing no sexual dimorphism, nearly straight in both sexes, no sensory papillae. On *Beamys* and *Cricetomys* rats; Ethiopian region. ..... **Hemimerina**

According to Giles (1963, tables 2 & 3), 14 [actually 9, see below] of the 283 characters which he took into consideration are common to the Arixeniina and Hemimerina but do not occur in the Forficulina, viz. subocular sulci absent, epistomal sulcus incomplete mesially, occipital sulci either absent or running between posterior mandibular articulations and posterior aspect of head (not running between eyes and posterior aspect of head), * intertormal bar absent [also absent in *Bormansia* of Forficulina], * hypopharynx symmetrical dorsally [also symmetrical in *Bormansia*], mandibles without molar region on basal part of mesial margin, * anterior ventral cervical sclerite absent [present in *Xeniaria* of Arixeniina], accessory trochantinal plate of metapleura absent, genitalia (♂) cylindrical (not flattened basally), * tergites 8 and 9 (♀) slightly reduced [very much reduced in Hemimerina], tergite 10 (♀) not large and squarish but either small and triangular,

or narrow and transverse, pygidium in lateral view <-shaped either in ♀ or in both sexes (not L-shaped in both sexes), *cerci feeble and not forceps-like [strongly developed in *Arixenia* ♂]. The 5 *-marked characters listed above are to be deleted because they are either untrue for all Arixeniina plus Hemimerina, or are shared by a few Forficulina, as indicated in brackets for each of these characters. Giles (1963) also pointed out that 6 [actually 8] of the 283 characters are common to the Forficulina and Hemimerina but do not occur in the Arixeniina, 12 [actually 13] characters are common to the Forficulina and Arixeniina but do not occur in the Hemimerina, and that the Arixeniina differ in 20 characters from the Hemimerina irrespective of the condition in the Forficulina. The above analysis of external characters suggests that the Arixeniina may be closer to the Forficulina than are the Hemimerina, and that the Arixeniina and Hemimerina together may be somewhat remote from the Forficulina. Of course, assessment of internal (anatomical) and non-morphological characters may lead to a somewhat different conclusion on the interrelation of the 3 suborders, as well as the position of these with respect to the related orthopteroid orders; but it would be out of the scope of this paper to go any further on this topic.

SOURCES OF MATERIALS. Prior to the start of this revisionary work, the Arixeniina and Hemimerina in the B. P. Bishop Museum collections were represented only by a few specimens from the Philippines and E Africa. Consequently, the report presented below is based largely on materials received from the following sources.

ANSP Academy of Natural Sciences, Philadelphia, Pa., through Dr M. G. Emsley.
BMNH British Museum (Natural History), London, through Mr John Huxley.
CAS California Academy of Sciences, San Francisco, Calif., through Dr Paul D. Arnaud, Jr.
ETG Dr E. T. Giles' personal collection.
FMNH Field Museum of Natural History, Chicago, Ill., through Dr Rupert L. Wenzel.
MCZ Museum of Comparative Zoology, Harvard University, Cambridge, Mass., through Dr Howard E. Evans.
MNHL Rijksmuseum van Natuurlijke Historie, Leiden, through Drs M. A. Lieftinck and P. H. van Doesburg.
NAW Dr N. A. Wilson's personal collection.
SAIMR South African Institute for Medical Research, Johannesburg, through Dr Fritz Zumpt.
SMF Natur-Museum Senckenberg, Frankfurt a.M., through Dr Heinz Schröder.
USNM U. S. National Museum, Washington D.C., through Drs K. C. Emerson, O. S. Flint and Paul D. Hurd, Jr.
VRV Dr V. R. Vickery's personal collection.
ZMB Institut für Spezielle Zoologie und Zoologisches Museum, Berlin, through Dr H. Schumann.

TERMINOLOGY, MEASUREMENTS. The morphological terminology employed in this paper is modified from Giles (1963) and is somewhat different from that used by Jordan (1909a), Burr & Jordan (1913) and Cloudsley-Thompson (1957) for the Arixeniina, and by Jordan (1909b), Rehn & Rehn (1936) and Deoras (1940, 1941a) for the Hemimerina. The more important morphological synonyms are as follows.

Metapygidium (in Arixeniina) = telson of Burr & Jordan and Cloudsley-Thompson.
Paraproct = sternite 10 of Jordan, Burr & Jordan, Deoras and Cloudsley-Thompson.
Pygidium = ultimate tergite of the Rehns. Deoras interpreted the "telson" in *Hemimerus* to be the fusion of the epi- and paraprocts, and labeled in his fig. 1 (N) the true tergite 10 as epiproct while Burr & Jordan (to be followed by Cloudsley-Thompson) labeled the basal part of the

pygidium (ventral surface) as the metapygidium!

Sternite 7 (♀) = ultimate sternite of the Rehns. This was labeled by Giles in his fig. 47, for *H. hanseni*, as the ♀ subgenital plate and apparently by an oversight, also as sternite 9!

Sternite 9 (♂) = ultimate sternite of the Rehns. This was labeled by Giles in his fig. 50 and 61, for *H. hanseni*, as the ♂ subgenital plate.

Sternite 9 (♀) (in Arixeniina) = sternite 8 of Burr & Jordan. We follow Cloudsley-Thompson and Giles in regarding it to be sternite 9 rather than 8 because in the Arixeniina, it is clearly in alignment with tergite 9 and bears the orifice of the receptaculum seminis.

Tergite 10 = penultimate tergite of the Rehns.

Giles (1963) did not describe the ♂ genitalia in detail. For descriptive purposes, the terms endophallic sclerite, tubular rod, ventral rib and ventral sheath are introduced in this paper. The Rehns (1936) employed a number of lengthy descriptive terms which are, for simplicity and uniformity, partly revised in this paper (see discussions on diagnostic characters under the genus *Hemimerus*, p. 347–50).

Unless otherwise stated, the right and left directions as given in the descriptions are that as would be seen from the dorsum, or as evident when the insect is inverted and the ventral surface examined with the abdominal apex directed away from the viewer; the length of the entire body does not include the antennae and cerci; the length of a given structure is measured along a hypothetical median line while the width is measured at the widest part. The length of the ♂ sternite 9 in *Hemimerus* is measured very slightly right or left of the median line so as to include the subgenital process; the relative length of the tibia and its corresponding femur is determined by relaxing and closing the tibia against the femur and observing the difference in length; and the length-width of the median and lateral lobes of the ♀ sternite 7 in *Hemimerus* is measured in the way shown in fig. 70. All measurements are taken from specimens kept in glycerine or alcohol so that the width, as given in the descriptions, may be less than that taken from a flattened specimen.

DRAWINGS, ABBREVIATIONS. The drawings in this paper were made with the aid of a grid placed within the eye-piece of a stereo-microscope, and were based largely on temporary slide-mounts of dissected specimens in glycerine. These specimens were not treated with KOH in order to minimize distortion of the natural shape. As the median part of a tergite in dorsal view and that of a sternite in ventral view are more or less convex whereas the lateral parts are deflexed or decurved, drawings of the lateral parts based on such specimens may not be, and often by no means are, absolutely accurate in the relative width and curvature.

For brevity, the following abbreviations are used in this paper: i, ii, iii and iv = 1st, 2nd, 3rd and 4th stadia, respectively, of nymphs (a ♀ or ♂ symbol is placed after the stadium number when the sex can be ascertained; I, II etc. stand for January, February etc.) Abbreviations for sources of materials are listed in a preceding section.

Suborder ARIXENIINA Burr, 1911: 7

= Arixenioidea (superfamily), Chopard 1949: 762.

NOMENCLATURE. The original spelling of the suborder, as given by Burr (1911), is Arixenina which was accepted by Burr & Jordan (1913). As the type-genus is *Arixenia*, the ending *-ina* of the subordinal name must accordingly be emended to *-iina*.

SYSTEMATICS. As early as 1909, when the genus *Arixenia* and the family Arixeniidae were first described, Jordan pointed out that if the placing of *Hemimerus* in a separate suborder was justified, a 3rd suborder (for which he abstained from giving a name) would have to be erected for the reception of the genus and family. Some authors did not agree with Jordan's view, thus Handlirsch (1925, 1926) placed the family in the suborder Forficulina; Deoras (1941b), in the series Eudermaptera; and Popham (1965a, b), in the superfamily Labioidea.

The morphological specialization in the Arixeniina is less significant than in the Hemimerina (q.v.). According to Giles' (1963) analysis, only 7 of the 283 external (skeletal) characters in the Dermaptera he studied are peculiar to the former suborder, viz. anterior tentorial arms not twisted, paraglossae flattened (not cylindrical), ♀ tergites 8 and 9 not overlapped by tergite 7 and not rigidly connected with each other and with tergite 10, ♀ ♂ tergite 10 transversely quadrangular (not squarish or triangular).

The entire suborder Arixeniina now includes 1 family, 2 genera and 5 species. Contrary to those of the Hemimerina, the males and nymphs of the various species of the Arixeniina are far more distinctive than the females and while the nymphs show much weaker sexual dimorphism, they can easily be separated into different stadia by counting the number of antennal segments.

DISTRIBUTION. The Arixeniina are at present known only from a few caves and hollow trees in the Malaysian and Philippine subregions as delimited by Chasen (1940, *Bull. Raffles Mus.*, Singapore **15:** v) and as collectively termed the Indo-Malayan subregion by Bartholomew (1911, *Physical Atlas* **5**). Most probably the distributional range of the suborder coincides with that of the hosts, viz. molossid bats of the genus *Cheiromeles* Horsfield. The suborder is expected to be found in Celebes which belongs to the Austro-Oriental subregion of Chasen (1940) (included in the Austro-Malayan subregion by Bartholomew, 1911) because *Cheiromeles* occurs there. It may be added that *Ch. torquatus* has once been recorded from Thailand by Boitard (1842) and from Indo-China by Wagner (1855). — Cf. Ellerman & Morrison-Scott (1951, *Checklist Pal. & Indian Mammals 1758–1946:* 136). These odd records have not been verified or substantiated by subsequent collection of *Ch. torquatus,* and most likely this bat (and consequently its parasites *Xeniaria* and *Arixenia* as well) does not exist in those 2 countries.

HOST RELATIONSHIPS. The very first Arixeniina ever recorded in literature were 2 nymphs each of stadia i and iv of *Arixenia esau* from Borneo. They were said to have been discovered "in the sack formed by the membrane of the wings" of *Cheiromeles torquatus*, the hairless bat. Jordan (1909a) interpreted this "sack" to be the gular pouch and suggested that the nymphs might feed and thrive on the excrement of the gular gland and the young bats' excrement accumulated in the pouch, and incidentally on live or freshly killed insects. While Cloudsley-Thompson (1957: 2) reported the failure to locate any earwigs in the gular pouch of 19 *Ch. torquatus* bats brought in by aborigines from Bukit Lagong in Malaya, Medway (1958: 192) strongly criticized Jordan's suggestion and pointed out that (a) the wings of *Cheiromeles* fit actually into the subaxillary pouches, (b) there is no room in the gular pouch for such a large insect as *Arixenia,* and (c) he has not seen any *Arixenia* interested in entering or feeding at the gular pouch and doubted "if it ever will" [however, he stated on p. 193 "*Arixenia* are always.... exploring every fold and pouch"]. The type-series of *Xeniaria truncata,* almost all

nymphs and largely of stadia i and ii, was found by Dr D. Kock (in litt., 26.IV.1972) in the "folds of foreneck" of alcohol-preserved *Ch. torquatus*. It appears that the Arixeniina may, at least casually, be interested in entering the fold or pouch and feeding thereby and therein on the glandular excretion, and that there is at least enough room in the gular pouch for young nymphs, if not older nymphs and adults, of these earwigs.

The Arixeniina, unlike the Hemimerina, are in no way beneficial to, nor welcomed or even tolerated by their hosts (Taylor 1934). Most of their time is spent on or in guano and on the walls or ceilings of bat roosts. They go onto host bats (dead, dying or young ones in particular) probably only for feeding, although no close observation has ever been undertaken on the actual feeding on bats. They may crawl over the hosts with an excited jerky gait, explore every fold and pouch or graze restlessly on the pitted skin (Medway 1958). The very abundant erect setae on the body of *Xeniaria* vs the much fewer such setae on *Arixenia* suggest that earwigs of the former genus may spend more time on the guano and elsewhere in bat roosts, while earwigs of the latter genus may spend more time on the body of host bats. The principal diet of *Xeniaria* earwigs is probably various kinds of insects in bat roosts (Jacobson 1912, Burr & Jordan 1913) while that of *Arixenia* is apparently some product of the glandular skin of bats (Medway 1958). This disparity in diet is evidently related to the texture of the bat skin and to the structure of the earwig mouthparts. The skin of *Cheiromeles*, here considered to be the primary host, is virtually hairless, very loose and wrinkled, and densely pitted with glandular pores (in addition to a large gland at the base of the throat), the excretion from which possesses a very strong, unpleasant odor; the mouthparts of *Xeniaria*, notably the mandibles, are very powerful, very large and strongly modified mainly for the mastication of the food (cf. Burr & Jordan 1913 and generic definition of *Xeniaria*). On the other hand, the skin of *Tadarida* (*Chaerephon*), here considered to be an incidental host, is fairly tight and hairy, and bears only sparse glandular pores; the mouthparts of *Arixenia* are as a whole much reduced in size and are devised largely for brushing rather than mastication. The frequent co-existence of *Xeniaria* and *Arixenia* in the same roosts of *Ch. torquatus* may partly be attributed to the lack of competition for food because of the above-mentioned disparity in diet. It should be noted that when earwigs of the 2 genera co-exist in a same bat roost, *Xeniaria* are significantly outnumbered by *Arixenia*. For instance, 19 *X. jacobsoni* vs 185 *A. esau* were collected from a hollow tree at Bukit Lagong in Malaya (Cloudsley-Thompson 1957); 9 *X. bicornis* vs 39 *A. camura* were collected by Dr D. S. Rabor from a hollow tree at Kibawalan in Mindanao, and an average of 1.5 *Xeniaria* vs 3.5 *Arixenia* were found on each infested bat.

As far as we know, *Xeniaria* and *Arixenia* have been found together on and about *Ch. torquatus* roosting in hollow trees in Malaya and Mindanao; but only either *Xeniaria* or *Arixenia*, not both, has been found on and about *Ch. torquatus* roosting in caves in Java and Borneo (roost sites for the Sumatra and Palawan records are not yet known). This does not mean that there are no caves in Malaya and Mindanao, and no hollow trees in Java and Borneo suitable for *Ch. torquatus*. It is impossible at present to explain why this bat should have different roost sites in different countries and why caves vs hollow trees, when each is used as roost by *Ch. torquatus*, should have different earwig faunulae. In earlier times, *Ch. torquatus* most probably roosted in large to very large colonies and only in caves and hollow trees. As a result of deforestation and man's other disturbance of nature, some of such colonies have been forced to split into much

smaller ones and to disperse into human dwelling areas. Lim (1966, *Fed. Mus. J. Malaya* **11:** 61–76) noted that colonies of a few to as many as 50 *Ch. torquatus* each were found roosting near the forest edge in crevices of roof tiles, corners of adjoining wooden beams that supported the roofs, and on the wooden beams themselves. No Arixeniina have been found in these recently acquired habitats, probably because the colony size of bats and the microclimate in houses are unfavorable for these earwigs.

Available collection data all indicate that the Arixeniina are highly gregarious and associated only with large colonies of *Ch. torquatus* roosting high above the ground. For instance, the cave at Babakan in Java is about 40–50 m high and once housed a "tremendous number" of this bat species and "countless numbers" of *Xeniaria* (Jacobson 1912, Burr & Jordan 1913); the hollow of a large durian tree (*Durio zibethinus* L.), some 13 m up the trunk, at Bukit Lagong in Malaya, before the tree was felled, harbored an estimated 1000 *Ch. torquatus*, and at least a few hundred earwigs were collected there, with many others having escaped (Audy 1952, Harrison 1954, Cloudsley-Thompson 1957); in the Niah Caves in Borneo, approximately 20,000 *Ch. torquatus* were found roosting about 60 m overhead and a "large number" of *Arixenia* roaming thereabout (Medway 1958).

In an attempt to explain the interrelation of the 2 different kinds of earwigs existing in the same bat roosts, Cloudsley-Thompson (1957) suggested that *Xeniaria* might feed mainly on the guano while *Arixenia* fed mainly on the body of *Ch. torquatus* or, alternatively, the former might be parasitic on *Tadarida* (*Mops*) *mops* and the latter on *Ch. torquatus*. The first of the 2 alternatives is here accepted because it is supported by collection data for these earwigs and by the available information regarding habits of their recorded host bats. There are 2, possibly only 1, records of the occurrence of *X. jacobsoni* (q.v.) on *T. mops*: "Malay Pen.", ex *T. mops* and in debris from hollow tree, 7. VII.1919 [this date was given simply as 1920 by Cloudsley-Thompson], H. P. Hacker; Kuala Lumpur, ex *T. mops*, 3.VII.1919, R. A. Lever. Quite possibly these 2 lots of *Xeniaria* were collected from the same hollow tree near Kuala Lumpur because they were collected almost on the same day and because both Hacker and Lever were then government officers stationed at Kuala Lumpur. It is also quite possible that *T. mops* was a misidentification for *T.* (*Chaerephon*) *plicata*. Harrison (1966, *An Introd. Mammals Singapore & Malaya*: 111–112) separated these 2 bats by the following couplet: "First upper molar, although small, set in space between canine and large premolar, tail 35–45 mm, forearm 44–50 mm ····· *T. plicata*. First upper molar, if present, set outside tooth-row, with canine and second premolar almost touching one another, tail 34 mm, forearm 43–45 mm ····· *T. mops*." From the couplet, it is evident that *T. plicata* may easily be mistaken for *T. mops* on cursory examination.

Mr B. L. Lim (in litt., 12.IX.1972) pointed out that *T. mops* in Malaya roosts on its own, generally under roofs of dwelling houses and he has never found it in association with *Ch. torquatus* which in turn may share roosting places with *T. plicata* (in Mindanao, the latter 2 bats may also roost together in hollow trees, see Taylor 1934). The following unpublished notes were generously provided by Mr Lim. (a) Four roosts of *T. plicata* were found in hollows of decaying rubber trees fringing the forests near Kuala Lumpur; the number of individual bats were 16, 34, 28 and 8; no Arixeniina earwigs were discovered on the bodies or in the roosts of these bats. (b) Two small colonies of *Ch. torquatus* of 22 and 18 individual bats were collected and examined but without finding any earwigs nor *T. plicata* associated with them; both roosts were under roofs of

houses situated near forests, one at 4 1/2 mi., Cheras Road nr Kuala Lumpur, collected in IX.1964 and another at Alai, nr Malacca in VIII.1963. (c) On 7 occasions between XII.1971 and II.1972, a total of 31 *Ch. torquatus* bats was netted at 20 m high at Bukit Lanjan Forest Reserve, Sungei Buloh, Selangor; 4 of these bats revealed 7 earwigs. (d) A small colony of about 75 *Ch. torquatus* (no *T. plicata*) in a large hollow tree nr Kuala Lumpur was discovered by aborigines who brought in 3 of the bats; no earwigs were found on them, and the roost was not examined for earwigs. (e) Four mixed roosts of *Ch. torquatus* and *T. plicata* in hollow trees were discovered by aborigines; in total an estimated 2030 and 87+ individual bats of the 2 species respectively were present, small fractions of which[4] were brought in to the laboratory, and 24 *Ch. torquatus* and only 1 *T. plicata* revealed 56 and 2 earwigs respectively; hundreds of additional earwigs were found on the floor and in the roosts after the trees were felled and the bats therein were caught or frightened away by the aborigines; roost A was at Ampang Forest Reserve nr Kuala Lumpur and was discovered in II.1969; roost B, at Sungei Tua For. Res. nr Kuala Lumpur, III.1970; roost C, at Bukit Lagong For. Res. nr Kuala Lumpur, IV. 1970; roost D, at Simpang Pertang, Kuala Pilah, Negri Sembilan; the estimated bat populations etc. of the 4 roosts are given in Table 1. (f) For 2 weeks, 20 and 10 live Arixeniina earwigs were kept in glass containers along with fresh feces (which were changed every 5 days) of *Ch. torquatus* and *T. plicata* respectively but no signs of their feeding on the feces were noted; at the end of the 2-week period, only 6 earwigs in the lot with *Ch. torquatus* feces survived and they were, 3 each, placed together with 2 live *Ch. torquatus* and 1 live *T. plicata*; those with *Ch. torquatus* started moving around the body of the bats and, after about 5 minutes, settled themselves in the folds of the gular pouch; the next favored place was the underside of the wing membrane along the axillary margins; when the bats were disturbed, the earwigs started moving again; the 3 earwigs were still alive when the *Ch. torquatus* died 16 days after the infestation was initiated; the other 3 earwigs, when introduced onto the *T. plicata* bat, also started moving around the whole body before settling eventually under the belly of the bat but on the 4th day, all of the earwigs were found dead.

From the above interesting observations, it appears that the Arixeniina earwigs are much more numerous in and about bat roosts than on bat bodies, and they may incidentally be found on *T. plicata* in Malaya in hollow trees only when this bat roosts together with *Ch. torquatus*. It is also apparent that in mixed roosts, the former bat is always considerably outnumbered by the latter, and that the earwigs cannot survive on fresh bat-feces alone. Yet it remains to be confirmed whether they may survive or even propagate solely on the guano plus guanophilous arthropods.

An examination of the distributional patterns of the recorded host bats also reveals that *Cheiromeles* bats appear to be the only true host of the Arixeniina as a whole. The known range of the genus *Cheiromeles* Horsfield, 1824 (2 spp.) coincides with that of the Arixeniina, although in certain peripheral areas of the former, none of these earwigs has been discovered, probably because of the lack of intensive collecting. The genus *Tadarida* Rafinesque, 1814 (= *Nyctinomus* E. Geoffroy, 1818) (about 390 spp.) is worldwide in distribution and is divisible into about 6 subgenera. The subgenus *Mops* Lesson, 1842 (11 spp.) is widespread and rich in species in the Ethiopian region, and is represented in the

[4] Most of the bats thereby collected were used as food by the aborigines.

Oriental region by *T.* (*M.*) *sarasinorum* Meyer, 1899 of Celebes and *T.* (*M.*) *mops* Blainville, 1840 of Malaya, Sumatra, Java, Borneo and Palawan (but not other parts of the Philippines). The subgenus *Chaerephon* Dobson, 1879 (9 spp.) is also chiefly Ethiopian in distribution and is represented in the Oriental region solely by *T.* (*Ch.*) *plicata* Buchanan, 1800 of India, Ceylon, Tenasserim, Thailand, Cambodia, Hainan, Malaya, Sumatra, Java, Borneo, New Guinea and the Philippines. From the above, it is clear that the distributional patterns of the subgenera *Mops* and *Chaerephon*, even for their Oriental representatives, do not match that of the Arixeniina.

By summing up the foregoing discussions, one might surmise that (a) in all probability, *Cheiromeles* is the primary while *Tadarida* (*Chaerephon*) is the incidental host of both *Xeniaria* and *Arixenia*; (b) the attractiveness of *Cheiromeles* to the earwigs is possibly the virtually hairless body and the rich glandular excretion of the gular area; (c) *Arixenia* probably feed on a more restricted diet and are more host-specific than do *Xeniaria*; (d) the co-existence of *Xeniaria* and *Arixenia* in the same bat roosts probably happens only under certain special circumstances.

Table 1. Arixeniina in some mixed roosts of *Cheiromeles* and *Tadarida* in Malaya

Roost	*Ch. torquatus*				*T. plicata*				Earwigs found in and about roost
	Estimated population	Bats examined	Bats infested	Earwigs on infested bats	Estimated population	Bats examined	Bats infested	Earwigs on infested bats	
A	180	15	1	2	18+	18	0	0	not examined
B	700	12	2	4	36+	16	0	0	185
C	350+	13	3	6	5+	5	0	0	85
D	800	92	18	44*	28+	28	1	2	348
Total	2030	132	24	56	87+	67	1	2	618+

*The number of earwigs per infested bat varied from 1 to 12.

DEFINITION. Entirely apterous. Body moderately flattened, almost uniformly covered with hairs except some small, bare, slightly paler markings on head capsule, thorax and femora. Epistomal sulcus strongly arcuate, indistinct (mesial section obsolete); anterior arms of ecdysial line forming together an almost continuous straight transverse line. Eye strongly reduced, much smaller than an antennal socket, of 50 – 90 facets. Antenna about 2/3 as long as body, of 14 segments (8 in nymph i, 11 in nymph ii, 12 in nymph iii, 13 in nymph iv); flagellomeres each with 2 patches of sensory pores. Mandible with either 2 apical and 1 intermediate tooth, or with 3 apical teeth and no intermediate one; incisor edge lined with long series of rigid setae or spines; no molar edge. Lacinia with 2 apical teeth. Thoracic nota scarcely explanate laterad, when moderately so, then lateral margins reflexed and lateral marginal areas longitudinally concave; venter of explanate areas not modified for reception of antennae in repose. Prothoracic spiracle exceedingly large. Legs long, slender, unmodified, without membranous pads beneath tarsi. ♀ Terminalia: Tergites 8 and 9 not reduced, not rigidly connected with each other and with tergite 10, not covered by tergite 7. Sternite 7 evenly broadly rounded posteriorly. Sternites 8 and 9 not or hardly reduced in size; either both entire and entirely (or almost entirely) submembranous, or each broadly interrupted medially and with sternite 8 largely submembranous while sternite 9 heavily sclerotized; in both cases, sternite 9 more or less well exposed behind sternite 7. Paraproct largely amalgamated with tergite 10. Clutch and metapygidium present or absent. Pygidial apex either broadly rounded, or pyramidal and acute. Cercus hairy, slender, subcylindrical, weakly curved, seldom pale-speckled. ♂ Terminalia: Sternite 9 posteriorly symmetrical; manubrium separated from sternite 9,

with single flat M- or ∩-shaped strip. Paraproct almost entirely amalgamated with tergite 10. Metapygidium present or absent. Cercus hairy, dissimilar to that of ♀, strongly angulate at basal 1/3 or near midlength, robust (rarely somewhat flattened) before angulation, and slender and subcylindrical beyond angulation, with 1 or 2 patches of very dense sensory papillae on mesial margin. Parameres small, symmetrical, sometimes lightly sclerotized. Praeputial sac single, with ventral sheath and 1 or 4 very heavily sclerotized endophallic sclerites. Ejaculatory duct contained in heavily sclerotized tubular rod. For further details of external characters, see Giles (1963); and for certain internal characters, see Jordan (1909a) and Burr & Jordan (1913).

SEXUAL DIMORPHISM. Sexes of adults of this suborder, particularly in the genus *Arixenia,* may easily be separated by several external characters. In the adult ♀, hairs on the anterior (inner) surface of basal flagellomeres are always subequal in length to those on the posterior surface, tergite 10 never has a conspicuous bristle-tuft, sternite 9 is either submembranous (in *Arixenia*) or well sclerotized but medially interrupted and appended with a "clutch" (in *Xeniaria*) whereas the cerci are slender throughout, almost straight and have no patch of sensory papillae on the mesial surface. In the adult ♂, hairs on the posterior surface of antennal segments 3 – 7 (i.e. the 5 basal flagellomeres) in *Arixenia* are about 2 × as long as those on the anterior surface, tergite 10 (in *A. esau*) discally bears a conspicuous bristle-tuft, sternite 9 is heavily sclerotized and strongly produced posteriorly, and the cerci are more or less robust basally, distinctly angulate and each has 1 or 2 patches of very dense sensory papillae on the mesial surface. The sexual dimorphism in nymphs of this suborder is so weak that the 2 sexes are practically inseparable except that the average body size in all stadia is smaller in the ♀ than in the ♂, the paraprocts in *Arixenia* extend posteriorly beyond the level of tergite 10 in the ♀ and extend just to that level in the ♂, and the cerci in *Arixenia* are slender in females of stadia iii and iv, but fairly robust in males of these 2 stadia.

NYMPHAL STADIA. Burr & Jordan (1913) first pointed out that the antennal segments of *Xeniaria jacobsoni* increase in number during the metamorphosis, from 8 to 13 in the nymphal stadia and 14 in the adult, and that the increase takes place by a division of segment 3 (meriston). They did not give the precise number of nymphal stadia, nor that of antennal segments for different stadia. On the other hand, Cloudsley-Thompson (1957) concluded that both *Xeniaria* and *Arixenia* pass through 5 nymphal stadia because the smallest nymphs he studied "are so large and heavily chitinised that I feel convinced they represent the second instar." A little later he (1959) corrected this by saying they probably have 4 nymphal stadia. Giles (1961) examined the embryo, compared the nymphs of the Arixeniina with those of other Dermaptera, and stated that the typical antennae in nymph i of all Dermaptera are undoubtedly 8-segmented, and that the Arixeniina have 4 nymphal stadia because pre-birth moulting does not take place in the suborder and consequently Cloudsley-Thompson's (1957) presumed stadia ii, iii, iv and v are in fact stadia i, ii, iii and iv, respectively.

Cloudsley-Thompson (1957) also pointed out that the ratio of the head widths of the nymphal stadia to one another was "remarkably constant, ... about 1.14 in *Arixenia* [*Xeniaria*] *jacobsoni* and 1.17 in *Arixenia esau.*" But in his Table 1, the overlapping of the head widths in successive stadia (76 instances in 185 specimens of *esau*) and the fluctuation of the ratios (1.03 – 1.36 in *jacobsoni,* 1.08 – 1.19 in *esau,* both from Malaya) were so considerable that the head width ratio is evidently unreliable for determining the various nym-

phal stadia (Giles 1961).

Besides being smaller in body size and having fewer antennal segments and more generalized terminalia including cerci, the nymphs of the Arixeniina may be separated from the adults by the following characters: basal flagellomeres never with outstandingly long, erect hairs on posterior surface, posterior margins of tergite 10 and sternite 9 always evenly weakly curved and similar to those of their corresponding preceding sclerites.

TERATOLOGY. Teratology or monstrosity appears to be not a rare phenomenon among the Arixeniina. Several adults and nymphs show, as in those of the Hemimerina, slight anomaly or asymmetry in the relative lengths of certain antennal segments, in the curvature of posterior margins of certain tergites and sternites and in the shape of cerci. The following 3 cases, particularly the 3rd one, deserve some brief notes. The 1st case is a nymph iii ♂ of *Arixenia esau*, both cerci of which are partly regenerated and are seemingly 2-segmented. The 2nd case is a nymph iv ♀ of *Xeniaria bicornis*, the stadium of which is so determined because the specimen is noticeably larger than normal nymphs iii of the species (no normal nymph iv is available). The right antenna is 12- while the left antenna is 13-segmented, with their apices reaching levels of posterior margins of tergites 6 and 7 respectively and with their apical segments normal and symmetrical. On the right antenna, segment 3 is markedly longer (23: 17) than 5 while segment 4 is about 1/2 longer than wide; on the left antenna, segment 3 is slightly longer (19: 15) than 5 while segment 4 is scarcely longer than wide. The 3rd case is a nymph iii ♂ of *A. camura* which shows a combination of both adult and nymphal characters and was found together with 6 normal nymphs (1 iv ♀, 1 iii ♀, 1 iii ♂, 3 i) off the same bat (SU-BBM 177). The size of the body and the number of antennal segments are the same as in a normal nymph iii ♂ of the species but the very long hairs on the posterior surface of antennal segments 3 – 5 (not 3 – 7 as in typical adult ♂), the modified sternite 9, the robust and angulate cerci, the well developed cercal sensory papillae and the sclerotized endophallic sclerite are clearly more or less similar to those in a typical adult ♂. A description of the specimen follows. Antenna 12-segmented, with sensory pores on flagellomeres about as numerous as in adult ♂, i.e. more numerous than in normal nymph iii ♂; relative lengths of segments 3 – 7, 27: 10: 12: 14: 22; posterior (outer) surface of segments 3 – 5 with long hairs which are about 2 × as long as width of those segments. Posterior margin of tergite 10 weakly trisinuate, hence forming a pair of weak projections. Sternite 9 strongly modified, shorter and posteriorly much narrower than sternite 8, and strongly protruding, shallowly emarginate at middle; no trace of manubrium but membrane between sternites 8 and 9 with a transverse ribbon-like sclerite. Pygidium as in adult ♂. Cercus (fig. 20–21) similar to but slightly more slender than in typical adult ♂, with 2 series of sensory papillae which are slightly sparser than in typical adult ♂. Paired asymmetrical apical projections of endophallic sclerite well sclerotized, slightly more slender than in typical adult ♂ (other parts of genitalia apparently membranous). Body 15 mm long, mesonotum 3.2 mm wide.

LITERATURE. The only comprehensive works on the morphology of the Arixeniina are by Jordan (1909a), Burr & Jordan (1913) and Giles (1963), and that on the nymphal development is by Cloudsley-Thompson (1957). There is no recent taxonomic revision of the suborder.

Family ARIXENIIDAE Jordan, 1909: 323

Characters and other remarks same as for the suborder.

KEY TO GENERA AND SPECIES OF ARIXENIIDAE (Adults and Nymphs)

1. Pro- and mesonota truncate posteriorly and with lateral marginal areas longitudinally concave, pronotum somewhat trapezoidal and widest at midlength; mesosternum about as long as wide; cercus in adult ♀ about 2 × as long as width of tergite 9; cercus in adult ♂ angulate before midlength, slender and evenly attenuate apicad, with a single patch of sensory papillae on mesial surface. Genus **Xeniaria**. 2

   Pro- and mesonota very broadly rounded posteriorly and with lateral marginal areas longitudinally convex, pronotum semicircular and widest at anterior end; mesosternum about 2/3 as long as wide; cercus in adult ♀ about as long as width of tergite 9; cercus in adult ♂ angulate behind midlength, robust before and slender behind the angulation (hence basal and apical parts distinctly contrasted in thickness), with 2 patches of sensory papillae on mesial surface. Genus **Arixenia.** 4

2. Metapygidium (fig. 2, 4) in adult ♂ transversely rectangular, i.e. with straight or almost straight posterior (lower) margin; pygidium in adult ♂ posteriorly produced at middle, pygidial apex in nymphs iv and iii more or less upcurved, ventral pygidial surface in nymphs ii and i with 4 – 6 strong setae scattered near base; dorsal margin of basalmost endophallic sclerite in adult ♂ (fig. 12, B) very gently curved. 3

   Metapygidium (fig. 8, 9) in adult ♂ posteriorly with pair of strong triangular projections; pygidium in adult ♂ evenly concavely curved posteriorly, pygidial apex in nymphs iv and iii not upcurved, ventral pygidial surface in nymphs ii and i with about 12 strong setae in 2 irregular rows near base; dorsal margin of basalmost endophallic sclerite in adult ♂ (fig. 15, B) strongly serrate. (Adult ♀ unknown). Mindanao. ..... 3. **X. bicornis**

3. Pygidial apex in adult ♀ horizontal, not upcurved, that in nymphs iv and iii very weakly upcurved; prosternum in adult ♀ and nymphs i to iv truncate posteriorly; tergite 10 in adult ♀ and nymphs iv and iii with pair of angulate or even tuberculate sublateral projections on posterior margin above cercal bases; metapygidium very short, in nymph ii only 1/4 while in nymph i about 1/3 as long as pygidium. (Adult ♂ unknown). Palawan. ..... 1. **X. truncata**

   Pygidial apex in adult ♀ and nymphs iv and iii distinctly upcurved; prosternum in adult ♀♂ and nymphs i to iv rounded posteriorly; tergite 10 in adult ♀♂ and nymphs iv and iii with pair of broadly rounded sublateral projections on posterior margin above cercal bases; metapygidium comparatively long, in nymph ii about 1/2 while in nymph i about 2/3 as long as pygidium. Malaya, Java. ..... 2. **X. jacobsoni**

4. Adult ♀: Upper margin of mesepimeron weakly concave; ventral pygidial surface uniformly setose all over. Adult ♂: Sternite 8 distinctly shorter than but similar in degree of sclerotization and other features to sternite 7; sternite 9 (fig. 22) shorter than wide, its posteromedian lobe broad and unmodified whereas posterolateral lobe truncate and not projecting caudad. Nymphs: Anterior (upper) part of pygidium distinctly narrower than widest part of cercus. Mindanao. ..... 4. **A. camura**

   Adult ♀: Upper margin of mesepimeron distinctly angulate at middle; anterior 1/2 of ventral pygidial surface bare, in contrast to posterior 1/2 which is setose. Adult ♂: Sternite 8 distinctly longer than and quite dissimilar to sternite 7 in degree of sclerotization (particularly at posterior 1/2), curvature of posterior margin and chaetotaxy of posterolateral margin; sternite 9 (fig. 30) longer than wide, posteromedian lobe narrow, very much thickened and unevenly setose whereas posterolateral lobe rounded and strongly projecting dorsocaudad. Nymphs: Anterior (upper) part of pygidium almost as wide as widest part

of cercus. Malaya, Sumatra, Borneo. ..... 5. **A. esau**

Genus **Xeniaria** Maa, n. g.

TYPE-SPECIES. *Arixenia jacobsoni* Burr, 1912.

DISTRIBUTION. At present known from the Malaysian (Malaya, Java, Palawan) and Philippine (Mindanao) subregions, expected to be found in the Austro-Oriental subregion (Celebes).

HOSTS. Molossid bats of the genus *Cheiromeles* Horsf., incidentally those of the genus *Tadarida* Raf. subgenus *Chaerephon* Dobs.

AFFINITIES. The shape and/or armature of the mandibles, laciniae, labial palpi (apical segment) and mentum, the more numerous lateral and ventral cervical sclerites, the strongly sclerotized and medially divided ♀ sternite 9, the conspicuous clutch (♀) and metapygidium, the very irregularly shaped endophallic sclerites (♂) and the more generalized ♂ cerci in *Xeniaria* are, as described below, so markedly different from those in *Arixenia* that the recognition of the former taxon as an independent genus appears to

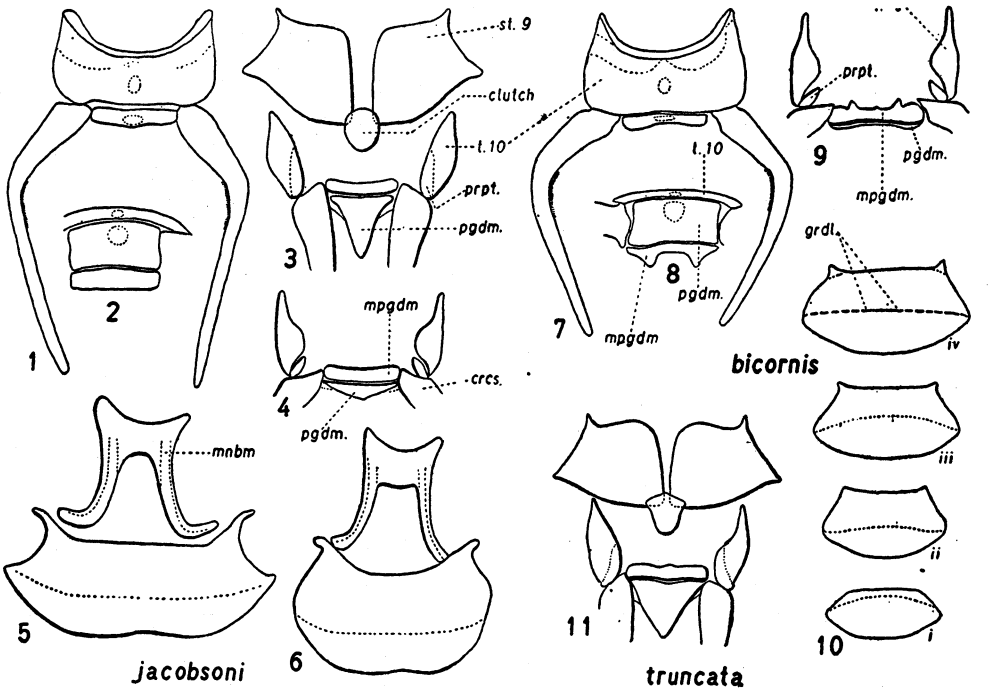


Fig. 1 – 11. *Xeniaria* species, ♂ ♀ terminalia, and sternites 9 of the 4 nymphal stadia (fig. 1 – 6, *jacobsoni* Burr, Java; 7 – 10, *bicornis* n. sp.; 11, *truncata* n. sp.)

1, 7, ♂ abdominal apices, dorsal; 2, 8, same, caudal view. 3, 11, ♀ abdominal apices, ventral, with sternites 9 fully distended. 4, 9, ♂ abdominal apices, ventral. 5, ♂ sternite 9 and manubrium, both flattened; 6, ♂ sternite 9 and manubrium of same specimen but in natural shape. 10, sternites 9 of the 4 nymphal stadia, sex uncertain. *crcs*, cercus; *grdl*, gradulus; *mnbm*, manubrium; *mpgdm*, metapygidium; *pgdm*, pygidium; *prpt*, paraproct; *st*, sternite; *t*, tergite.

be fully justifiable. Burr (1912) and Burr & Jordan (1913) assigned both *A. esau* and "*A.*" *jacobsoni* to the same genus probably because the adult ♀ and ♂ of the former species were then unknown. Cloudsley-Thompson (1957) did the same presumably because he did not evaluate the relative importance of the various diagnostic characters with respect to whether they were of subordinal, familial, generic or specific value (cf. discussion under *A. esau*). He also mentioned, as part of the description of *A. esau* adults, that "the ♂ genitalia are extruded in most of the specimens of *A. esau*, but this has not occurred in any of the *A. jacobsoni* that I have examined." This phenomenon is most probably due to the presence of the well sclerotized ventral rib of the praeputial sac in the former species, and the entire absence of the same in the latter species. It is also interesting that the interspecific differentiation in nymphs of *Xeniaria* is stronger than in *Arixenia*.

Xeniaria and *Arixenia* also differ from each other in several respects other than external morphology. The posterior portion of the stomach in *Xeniaria* has no convolutions in the adult ♀ and has $1^1/_2$ to 2 convolutions in nymphs and the adult ♂, while in *Arixenia* it has 3 convolutions in nymphs (Burr & Jordan 1913). The mating posture in *Xeniaria* has the heads of the couple turned toward opposite directions and one of the couple pulling the other backward (Jacobson 1912, Burr & Jordan 1913); while in *Arixenia*, the ♀ is in front, and the ♂ carries his abdomen arched over his head to clasp the slightly elevated ♀ abdominal terminalia (Medway 1958). The more powerful and more setose-spinose mouthparts and the shorter stomach in *Xeniaria* than in *Arixenia* strongly suggest that the diet of the 2 genera is different, that the former genus is more capable of feeding on insects and other harder food material while the function of the mouthparts in *Arixenia* is principally brushing, rather than masticating. The more numerous erect setae on the body of *Xeniaria* probably also suggest its looser association with the host bats than in *Arixenia*.

The more numerous cervical sclerites, the strongly developed ♀ sternite 9 and metapygidium, the weaker sexual dimorphism in the adult antennae and cerci and in the nymphal terminalia, as well as the weaker host specificity in *Xeniaria* than in *Arixenia*, all indicate that the former genus is more generalized than the latter.

The name *Xeniaria* is an anagram of *Arixenia*. The gender is feminine.

DEFINITION. *Body* generally less robust, with more numerous erect setae, and with fewer and often smaller bare markings than in *Arixenia*. *Head* relatively short. Eye very small, prominent, elliptical or reniform. Antenna with total length of segments 2 – 8 distinctly greater than that of 5 apical segments; segment 1 relatively short, practically straight in profile; segment 3 in ♀ with fairly long, erect hairs and some recumbent setae; segments 3 – 6 in ♂ with short fine erect hairs which are largely shorter than width of these segments; segment 7 in ♂ with only recumbent setae. Clypeus relatively short, length only about 1/3 of width. Mouthparts much larger and more powerful than in *Arixenia*. Labrum large, 5/9 as long as wide. Mandibles very large, slightly asymmetrical, each with 2 apical and 1 intermediate tooth, all strong; intermediate tooth on right mandible large, curved and simple while that of left mandible shorter, more regularly triangular and notched; setiferous part of incisor edge less extensive than in *Arixenia*, with rather few unmodified setae. Lacinia long, narrow; lateral margin evenly gently curved; apical teeth long, almost conical; spines on mesial margin rather few in number, straight, those of upper row moderately developed while those of lower row weakly so. Galea more curved than in *Arixenia*. Maxillary palpus with segments 3 and 4 each about 1.5 × as long as segment 5 [Burr & Jordan (1913) considered the palpus to be 4-segmented]. Labium relatively long; sclerotized area of labiostipes with a long posterolateral lobe in ventral view; paraglossa distinctly longer than wide, as slender as labial palpus, almost evenly narrow from base to apex. Labial palpus relatively long, segment 2 about 2.5

× as long as wide, mesial margin of segment 3 lined with dense strong curved spines. Mentum ⊥-shaped, about as long as wide, extending anteriorly beyond level of apex of labial palpal segment 1, posterior margin deeply concave. Gula [=submentum of Burr & Jordan 1913] almost bare, well separated from anterior ventral cervical sclerite; 2 pairs of anterior lateral cervical sclerites. *Thorax* with nota strongly explanate laterad, their lateral margins reflexed while lateral marginal areas concave longitudinally; pro- and mesonota truncate posteriorly, former somewhat trapezoidal, partly overlapping latter, widest at midlength and with lateral margins converging at both ends; prosternum about 2 × as long as wide, with lateral margins concavely curved well behind midlength; mesosternum about as long as wide, rounded both anteriorly and posteriorly, widest near anterior end. Legs relatively slender; tibial apices lined with curved spine-like setae; tarsomeres 1 in ventral view about 2 × as long as corresponding tarsomeres 2. ♀ *Terminalia*: Sternites 8 and 9 widely interrupted at middle and extensively setose, former almost uniformly submembranous, latter heavily sclerotized; clutch large, well sclerotized. Paraproct separated from tergite 10 by a short posterior oblique slit visible in ventral view, otherwise only by color. Metapygidium large, well defined; pygidium posteriorly acute, pyramidal. Cercus about 2 × as long as width of tergite 9. ♂ *Terminalia*: Sternite 9 posteriorly entire. Paraproct similar to that in ♀. Metapygidium present. Cercus slender, angulate much before midlength, rather evenly attenuate apicad, with 1 patch of sensory papillae on mesial surface. Praeputial sac without ventral rib as found in *Arixenia*; ventral sheath single, triangular, slightly longer than wide, largely submembranous, sclerotized narrowly along lateral margins; 4 endophallic sclerites, all very heavily sclerotized and very irregular in shape; tubular rod (which contains the ejaculatory duct) apically twisted and rigidly fused to basalmost endophallic sclerite; paramere small, weakly sclerotized.

1. **Xeniaria truncata** Maa, new species Fig. 11.

MATERIAL EXAMINED. Holotype adult ♀, paratypes 13 nymphs (6 i, 4 ii, 2 iii, 1 iv), PALAWAN: Maojan, ex 31 alcohol-preserved *Cheiromeles torquatus* (SMF 28577–78, SMF 28601–29), 1964/65 & II–III.1965, found in "folds of foreneck" of hosts. Holotype ♀ and 9 paratype nymphs in SMF; 4 paratype nymphs in Bishop Mus.

DISTRIBUTION. Probably confined to Palawan which belongs politically to the Philippines but zoogeographically to the Malaysian subregion as delimited by Chasen (1940, *Bull. Raffles Mus.*, Singapore **15:** v).

HOST. *Cheiromeles torquatus*. The collection data of the type-series were kindly provided by Dr D. Koch who did see the *Cheiromeles* (with *Xeniaria* in situ) and other Philippine bats when they were catalogued by the staff of the SMF Mammal Section. The original label of the series gives *Pteropus* sp. as the host and does not mention the precise site of the *Xeniaria* on the host.

AFFINITIES. This species is so closely related to *X. jacobsoni* that it was at first thought to be merely a geographical race of the latter. A closer examination of the adult ♀ and particularly various nymphal stadia of the 2 taxa revealed some noticeable though slight differences and it appears advisable to recognize both taxa as independent species. The nymphs of *truncata* are smaller than those of *jacobsoni*. The chief specific characters are enumerated in the key, couplet 3; additional ones are expected to be found on the adult ♂ when discovered. The name *truncata* refers to the shape of the prosternum.

DESCRIPTION. Adult ♀. Antennal segment 3 shorter (14: 18) than 5. Prosternum truncate posteriorly. Sublateral projections on posterior margin of tergite 10 overlapping cercal bases and slightly raised like pair of tubercles. Pygidial apex horizontal, not upcurved. Body 18 mm long, mesonotum 4.5 mm wide.

Adult ♂ unknown.

Nymph iv. Antennal segment 3 slightly longer (28: 25) than 5. Anterior pronotal margin virtually straight. Prosternum with length about 2 × minimum width, truncate posteriorly. Tergite 10 with pair of angulate sublateral projections on posterior margin. Metapygidium comparatively short, anterior margin evenly weakly concave. Pygidium very weakly upcurved at apex. Body 13 mm long, mesonotum 4.2 mm wide.

Nymph iii. Antennal segment 3 distinctly longer than 5. Pronotum, prosternum, tergite 10, metapygidium and pygidium similar to those of nymph iv. Body 9.5 mm long, mesonotum 3.2 mm wide.

Nymph ii. Antennal segment 3 shorter (13: 16) than segments 4 and 5 together. Prosternum truncate posteriorly. Metapygidium 1/4 as long as pygidium, with straight anterior margin. Pygidium as in nymph i of *jacobsoni*. Body 8.6 mm long, mesonotum 2.9 mm wide.

Nymph i. Antennal segment 3 longer (21: 16) than segments 4+5. Prosternum as in nymph ii. Metapygidium 1/3 as long as pygidium. Pygidium as in nymph i of *jacobsoni*. Body 6.0 – 6.5 mm long, mesonotum 2.6 mm wide.

2. **Xeniaria jacobsoni** (Burr, 1912), **n. comb.** Fig. 1–6, 12–14.

Arixenia jacobsoni Burr 1912: 105, fig. 1, ♂♀, original descr. — Jacobson 1912: xi–xiv, habits & habitat. — Burr & Jordan 1913: 398–421, fig. 12, 14, 17, 18, 21–28, anatomy. — Burr 1916a: 266, fig. 18, opisthomeres; 1916b: 269, function of manubrium. — Hagan 1951: 274–90, fig. 87–98, viviparity. — Audy 1952: 133, Malaya record. — Boeseman 1954: 3, Java record. — Harrison 1954: 67, Malaya record. — Cloudsley-Thompson 1955 (pt.): 16, Java & Malaya records; 1957: 3–6, fig. 1–3, 4 (f–h), growth stages; 1959: 139–140, growth stages. — Giles 1961: 21–25, Malaya record, 1st stadium nymph, life cycle. — Popham 1961b: 324–25, feeding habits; 1962: 431–40, 447–49, fig. 3, 4, 6, 8, 24, anatomy related to feeding habits. — Giles 1963: 128–37, fig. 53–64, comparative external morphology.

PREVIOUS RECORDS. This species was previously known from a single cave (type-locality) (type in BMNH) in Java and from 2 or 3 lots of specimens from Malaya. All the Javanese specimens were from S coast, Banjoemas (= Banjumas) Residency, Babakan, Goewa Lawa (which means *bat-cave*) nr seashore, 10 m, host unknown (Burr 1912, Burr & Jordan 1913, Hagan 1951, Boeseman 1954, Cloudsley-Thompson 1957). The Malayan

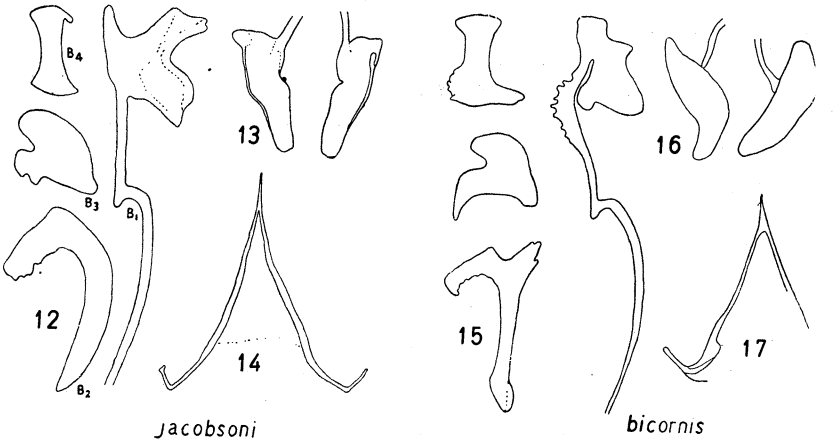


Fig. 12 – 17. *Xeniaria* species, ♂ genitalia (fig. 12 – 14, *jacobsoni* Burr, Java; 15 – 17, *bicornis* n. sp.). 12, 15, endophallic sclerites, symbols B_4 to B_1 after Burr & Jordan 1913; 13, 16, parameres; 14, 17, vesicles.

specimens were collected by H. P. Hacker on 7.VII.1919 from "Malay Peninsula" ex *Tadarida mops* and debris from a hollow tree (Giles 1961) (these specimens were recorded by Cloudsley-Thompson 1957 as "taken from *T. mops* in Malaya by Dr H. P. Hacker in 1920"); by R. A. Lever on 3.VII.1919 from Malaya: Kuala Lumpur ex *T. mops* (Cloudsley-Thompson 1957) and more recently by J. R. Audy on 10. & 14.III.1952 from Malaya: Selangor, Bukit Lagong Forest Reserve, Dusun Wam nr Kepong, ex *Cheiromeles torquatus* and scrapings of guano etc. from a hollow tree which harbored the bat colony (Audy 1952, Harrison 1954, Cloudsley-Thompson 1955, 1957).

MATERIAL EXAMINED. 53 adults (45 ♂, many seriously damaged, 8 ♀), 9 nymphs (4 i, 2 ii, 2 iii, 1 iv). For more details of the Babakan cave and the Dusun Wam hollow tree, see the preceding paragraph, and the section on Host Relationships, p. 311.

JAVA: All from Babakan cave, host undetermined: III.1911, E. Jacobson (ANSP, ETG); XI.1932, M. A. Lieftinck (MNHL); III.1933, K. W. Dammermann (MCZ); XI. 1937, J. Benner (MNHL).

MALAYA: "Malay Pen.", ex *Tadarida mops* and in debris from hollow tree, 7.VII. 1919, H. P. Hacker (ETG); "Malaya", no host record, 17.VII.1919, H. Henson (BMNH 1969–117). Selangor, Dusun Wam, ex *Cheiromeles torquatus* and debris in hollow tree, III. 1952, J. R. Audy (MCZ). The Hacker specimens (1 ♂ 1 ♀, pinned) were labeled simply as "Malay Pen. 7.VII.1919. On *Nyctinomus mops.* (Dr. Hacker)", the details of the habitat given above are from Giles (1961). The Henson specimens (5 nymphs) were originally from the Kuala Lumpur Mus., the insect collection of which was transferred a few years ago to the BMNH; the date and collector's name "17.VII.1919, H. Henson" on the label are presumably a mistake for 7.VII.1919, H. P. Hacker.

DISTRIBUTION. Malaya, Java; either in hollow trees or caves; in former habitat, often associated with *Arixenia esau.*

HOSTS. *Cheiromeles torquatus.* The recorded host *Tadarida* (*Mops*) *mops* is most probably a misidentification for *T.* (*Chaerephon*) *plicata,* see discussions on host relationships in the introduction to the suborder, p. 311.

AFFINITIES. This species is quite distinct from and apparently more generalized than *X. bicornis* (adult ♀ of which is yet unknown). In the adult ♂, the total length of the antennae is greater, sternite 9 is shorter, and the metapygidium and endophallic sclerites are simpler than in *bicornis.* The species is closely related to *truncata* (q.v.). As noted by Cloudsley-Thompson (1957), the adults and nymphs from Malaya are noticeably larger than topotypical ones from Java, but we are so far unable to disclose morphological differences of the 2 races. The measurements of the body and mesonotum in the following description are based on Malayan specimens.

DESCRIPTION. Adult ♀. Eye reniform, anterior margin weakly concave. Antennal segment 3 shorter (16: 19) than 5. Prosternum broadly rounded posteriorly. Sublateral projections on posterior margin of tergite 10 broadly rounded, overlying on cercal bases and not raised like pair of tubercles. Pygidial apex distinctly upcurved. Sternite 9 as in fig. 3. Body 17 – 21 mm long, mesonotum 4.7 – 4.9 mm wide.

Adult ♂. Eye elliptical. Antenna comparatively longer than in *bicornis,* segments 3 and 5 equal in length. Maxillary palpus with segment 4 much shorter (13: 18) than 5; labial palpus comparatively longer and more slender than in *bicornis.* Sternite 9 distinctly shorter than manubrium. Metapygidium simple, posterior (lower) margin straight and parallel to anterior margin. Pygidium

in caudal view distinctly swollen at center like a tubercle, in dorsal or ventral view distinctly produced at middle of posterior margin. Dorsal margin of basalmost or lst endophallic sclerite (= B_1 of Burr & Jordan 1913) entire, very gently curved; apex of 2nd endophallic sclerite simple. Body 14–16 mm long, mesonotum 3.7–4.0 mm wide.

Nymph iv. Antennal segment 3 scarcely longer (33: 31) than 5. Anterior pronotal margin distinctly bisinuate. Prosternum with length more than 2 × minimum width, broadly rounded posteriorly. Sublateral projections on posterior margin of tergite 10 broadly rounded. Metapygidium comparatively long, anterior margin evenly weakly concave. Pygidium with distinctly upcurved apex. Body 15 mm long, mesonotum 5.5 mm wide.

Nymph iii. Antennal segment 3 distinctly longer than 5. Anterior pronotal margin very weakly bisinuate. Prosternum, tergite 10 and metapygidium similar to those of nymph iv. Pygidium weakly upcurved at apex. Body 12 mm long, mesonotum 4.2 mm wide.

Nymph ii. Antennal segment 3 shorter (17: 19) than 4+5. Prosternum rounded posteriorly. Metapygidium 1/2 as long as pygidium, with straight anterior margin. Pygidium ventrally with some very fine hairs on surface and with 4–8 strong setae scattered near base; apex not upcurved. Body 10.5 mm long, mesonotum 3.9 mm wide.

Nymph i. Antennal segment 3 longer (29: 21) than 4+5. Prosternum as in nymph ii. Metapygidium 2/3 as long as pygidium. Pygidium with setae similar to those in nymph ii, ventrally with anterior margin about as long as lateral margin. Body 8.5 mm long, mesonotum 3.4 mm wide.

3. **Xeniaria bicornis** Maa, new species Fig. 7–10, 15–17.

Arixenia (?) sp.: Taylor 1934: 323, Mindanao record.
Arixenia jacobsoni (misidentification) (pt.): Cloudsley-Thompson 1957: 1, Mindanao record.

PREVIOUS RECORDS. The occurrence of this species and *Arixenia camura* was first noted by Taylor (1934). His remarks on these Arixeniina were included in his discussion on *Cheiromeles torquatus*. They may be quoted in full: "The specimens [*Ch. torquatus*, 1 ♂, 3 ♀] were infested with two species of forficularid [sic] parasites of, or closely related to, the genus *Arixenia* Jordan. The parasites seemed to obtain their food from the surface of the interfemoral membrane, but whether it was blood or epidermis I could not certainly determine. As many as six or eight parasites, each 15 millimeters in length, were found in this region, holding on tightly and refusing to escape or loosen their hold when they were seized. Specimens are in the hands of Dr. K. Jordan, Tring Museum, England. Associated with this bat was another species of the family Molossidae, *Philippinopterus lanei*, and several dozen specimens [about 40 specimens] of this species were obtained. These likewise were infested with the parasites which caused great unrest among the immature forms; at least they were continuously trying to rid themselves of the pests, which seemed to be ever able to escape their jaws." Taylor's specimens of these bats and earwigs were collected at Mindanao: Cotabato Prov., Saub on 27.IV.1923 from the trunk of a newly felled tree. They have since then been recorded by Cloudsley-Thompson (1957) imprecisely as from "Mindanao, Philippines, 1912 [sic], Dr. E. H. Taylor" without mentioning the host, and were listed collectively under the name *Arixenia jacobsoni*.

MATERIAL EXAMINED. Holotype adult ♂ (BISHOP 10188), paratypes 8 nymphs (4 i, 1 ii, 2 iii, 1 iv ♀), MINDANAO: Davao Prov., Malalag, Kibawalan, ex bats (SU-BBM 175, 177, 181, 182, 184, 185), 5.I.1964, D. S. Rabor. 1 nymph (ii), Mindanao: Cotabato Prov., Saub, ex bodies of living bats, *Cheiromeles torquatus* and "*Chaerephon plicatus*?", 27.IV.1923, E. H. Taylor (ANSP). Type-series in Bishop Mus., except for 1 paratype nymph in ANSP.

DISTRIBUTION. Mindanao (Cotabato and Davao Provs.), found in association with *Arixenia camura* in hollow trees. The Kibawalan series of specimens are in 6 lots (i.e. off 6 bats), each containing both *Xeniaria* and *Arixenia*. As an average there were 1.5 *Xeniaria* earwigs per bat.

HOSTS. *Cheiromeles torquatus*. The accidental or incidental hosts, *Philippinopterus lanei* mentioned by Taylor (1934), and "*Chaerephon plicatus*?" (in pencil, presumably of Taylor's handwriting) on the label are the same and are now known as *Tadarida* (*Chaerephon*) *plicata lanei* (Taylor).

AFFINITIES. As suggested by the name (Latin, *bi-* two; *cornis*, horned), one of the most distinctive characters of this species is the pair of strong triangular projections on the anterior margin of the metapygidium in the adult ♂. These projections are found in all nymphal stadia, though not so strongly developed. Most probably they are also present in the adult ♀ which will probably provide additional criteria for the recognition of the species. The 2 basal endophallic sclerites of the adult ♂ are more complicated and probably more specialized in *bicornis* than in *jacobsoni*.

DESCRIPTION. Adult ♂. Eye elliptical. Antenna comparatively shorter than in *jacobsoni*; segment 3 shorter (12: 14) than 5. Maxillary palpus with segment 4 longer (18: 15) than 5; labial palpus relatively shorter and more robust than in *jacobsoni*. Sternite 9 about as long as manubrium. Metapygidium posteriorly with pair of strong triangular tubercle-like projections which are visible in both ventral and caudal views. Pygidium in dorsal or ventral view with posterior margin evenly concave. Basalmost or 1st endophallic sclerite with strongly serrate dorsal margin; 2nd endophallic sclerite with forked apex. Body 15 mm long, mesonotum 3.8 mm wide.

Adult ♀ unknown.

Nymph iv. (Described from a single specimen, the right antenna of which is abnormal and 12-segmented, the left one is normal, cf. section on Teratology, p. 317). Segment 3 of normal antenna (left) markedly longer (19: 15) than 5. Anterior pronotal margin distinctly sinuate. Prosternum as in nymph iv of *jacobsoni*. Posterior margin of tergite 10 with pair of angulate sublateral projections. Metapygidium much longer than in *truncata* and *jacobsoni*, anterior margin medially with a triangular notch, the depth and width of which are, respectively, about 1/2 the length and 1/3 the width of the sclerite itself. Pygidial apex not upcurved. Body 13.5 mm long, mesonotum 4.0 mm wide.

Nymph iii. Antennal segment 3 distinctly longer than 5. Anterior pronotal margin weakly bisinuate. Prosternum, tergite 10 and metapygidium similar to those in nymph iv. Body 11 mm long, mesonotum 3.2 mm wide.

Nymph ii. Antennal segments 3 and 4+5 subequal (12: 13) in length. Prosternum subtruncate posteriorly. Metapygidium similar to that in nymphs iv and iii, anteriorly strongly emarginate. Ventral pygidial surface with some very fine hairs and with a transverse patch of about 12 strong setae in 2 irregular rows near anterior margin. Body 8.5 mm long, mesonotum 2.8 mm wide.

Nymph i. Antennal segment 3 longer (20: 14.5) than segments 4 and 5 together. Prosternum, metapygidium and pygidium as in nymph ii; anterior margin of pygidium distinctly longer than lateral margin. Body 8 mm long, mesonotum 2.4 mm wide.

Genus **Arixenia** Jordan, 1909a: 324

TYPE-SPECIES. *Arixenia esau* Jord., 1909.

DISTRIBUTION. Malaya, Sumatra, Borneo, Mindanao; expected to be found in Java and other islands where *Cheiromeles* bats occur.

HOSTS. Molossid bats of the genus *Cheiromeles* Horsf., which has been recorded from Malaya, Tioman, Rhio Arch., Banka, Simalur, Sumatra, Java, Borneo, Palawan, Mindanao and Celebes.

AFFINITIES. These are discussed under the genus *Xeniaria* and are not repeated here. The generic name is apparenty derived from Greek, *ari-* (intensive, very) and *xenia* (hospitality)[5] and presumably implies the supposed hospitality of *Cheiromeles* bats in providing both food and shelter for these earwigs.

DEFINITION. *Arixenia* was originally based on nymphs i and iv of a single species *esau* (the adult ♀ ♂ of which were undescribed until 1957). Following the erection of *Xeniaria* n. g. for *jacobsoni*, it becomes necessary to redefine the genus, as hereby delimited, on the basis of adults. Many of the generic characters enumerated by Jordan (1909a) now prove to be of familial or subordinal, rather than of generic significance. They are: "Wingless, hairy; head broader than long, clypeus longer than frons; upperlip [labrum] with anterior edge very slightly bent downwards in centre; space between 2 rows of bristles at molar edge of inner lobe [lacinia] of maxilla very narrow; mentum [submentum] broader than long, strongly rounded at sides; antenna 3/4 length of body, segment 1 extending to middle of pronotum, segment 2 very short; legs long, all of nearly equal length and same in structure; femora about as long as tibiae, equalling thorax in length; 1st and 2nd tarsal segments without very dense covering of hairs on underside, 3rd segment almost 3 times length of 1st and 2nd together." A revised definition of the genus follows.

Body generally more robust, with fewer erect setae, and on head capsule and thorax, with more numerous and often larger bare markings than in *Xeniaria*. *Head* comparatively long. Eye slightly larger than in *Xeniaria*, elliptical, not prominent. Antenna with total length of segments 2–8 subequal to that of 5 apical segments; segment 1 relatively long, distinctly curved in profile; segment 3 in ♀ with only recumbent setae, no erect ones; segments 3–7 in ♂ with very long, fine erect hairs. those on posterior (outer) surface about 2.5 × as long as width of these segments. Clypeus relatively long, length about 1/2 of width. Mouthparts much smaller than in *Xeniaria*. Labrum small, about 1/3 as long as wide. Mandibles symmetrical, with 3 rather weak apical teeth, no intermediate tooth; setiferous part of incisor edge very extensive, with numerous, flexible, apically curved spines. Lacinia short, broad; lateral margin distinctly angulate at basal 1/3; apical teeth short, concave beneath; spines on mesial margin numerous, distinctly curved at apices and well developed in both upper and lower rows. Galea less curved than in *Xeniaria*. Maxillary palpus with segments 3 and 4 each slightly longer than 5. Labium relatively short; sclerotized area of labiostipes without long posterolateral lobe in ventral view; paraglossa about as long as wide, much more robust than labial palpus, strongly narrowed apicad. Labial palpus relatively short, segment 2 about 1/2 longer than wide, mesial margin of segment 3 with scattered fine straight setae, no strong curved spines. Mentum transverse, length only about 1/3 of width, extending anteriorly only to level of base of labial palpal segment 1, posterior margin practically straight. Gula (=submentum of Burr & Jordan 1913) distinctly setose, entirely fused to anterior ventral cervical sclerite [Giles (1963: 129, 140) simply described this sclerite to be

[5] Dr F. J. Radovsky (in litt.) kindly pointed out "*Xenos*, from the same root, means *foreign* or *stranger*. Perhaps Jordan meant to indicate the *very strange location or association* for an earwig." — According to Liddell & Scott's Greek-English lexicon, abridged ed. (1926), p. 471, *xenos, a guest* or *host*, Lat. *hospes:* either as I. the friend, with whom one has a treaty of hospitality: in this sense both parties are *xenoi* and the relationship was hereditary. II. in Homer mostly *the guest*, as opposed to *the host*. 2. *any stranger*, as being entitled to the rights of hospitality. ... As adjective, *foreign, strange*. ...

"absent"]; 1 pair of anterior lateral cervical sclerites. *Thorax* with nota scarcely explanate laterad, their lateral margins deflexed while lateral marginal areas are convex longitudinally; pro- and mesonota very broadly rounded posteriorly, former nearly semicircular, not overlapping latter, widest at anterior end and with lateral margins strongly converging posteriorly; prosternum about as long as wide, lateral margin concavely curved slightly before midlength; mesosternum with length only about 2/3 of width, truncate and widest at both ends. Legs relatively robust, particularly femora; tibial apex with only unmodified setae; tarsomeres 1 in ventral view scarcely longer than corresponding tarsomeres 2. ♀ *Terminalia*: Sternites 8 and 9 both entire and largely submembranous, setose and sclerotized along narrow portions of posterior margins; clutch absent except for a pale membranous swelling. Paraproct separated from tergite 10 by a short posterior oblique slit visible in dorsal view, otherwise only by color. Metapygidium absent; pygidium broadly rounded posteriorly. Cercus scarcely longer than width of tergite 9. ♂ *Terminalia*: Sternite 9 posteriorly trilobed. Paraproct as in ♀. Metapygidium absent. Cercus basally robust, angulate near midlength, abruptly becoming slender beyond angulation, with 2 patches of sensory papillae on mesial surface. Praeputial sac with wide flattened ventral rib of which the apex (cf. legend of fig. 33, 36) is free, projecting, spine-like and heavily sclerotized; when genitalia retracted, posterior parts of above-mentioned sac (including most parts of rib) inverted inside, leaving only free apex of rib exposed and directed caudad; when extended for coition, rib attached to outer surface of everted sac, with free apex of rib directed cephalad. Ventral sheath of praeputial sac paired, leaf-like, extensively sclerotized. Only 1 endophallic sclerite which is long, basally rather weakly sclerotized, preapically widened and apically with 2 strong asymmetrical projections; right projection long, curved, and slender or flattened; left projection short, claw-like and more heavily sclerotized. Tubular rod (which contains the ejaculatory duct) free-ended, very gently curved throughout, well separated from endophallic sclerite. Paramere fairly large, well sclerotized.

4. **Arixenia camura** Maa, new species Fig. 18–24, 33–35.

Arixenia (?) sp.: Taylor 1934: 323, Mindanao record.
Arixenia jacobsoni (misidentification) (pt.): Cloudsley-Thompson 1957: 1, Mindanao record.

PREVIOUS RECORDS. Same as for *Xeniaria bicornis* (q.v.).

MATERIAL EXAMINED. Holotype adult ♂ (BISHOP 10189), paratypes 4 adult ♀, 34 nymphs (11 i, 1 ii, 19 iii, 1 iv ♂, 2 iv ♀), MINDANAO: Davao Prov., Malalag, Kibawalan, ex bats (SU-BBM 175–185), 5.I.1964, D. S. Rabor. Type-series in Bishop Mus.

DISTRIBUTION. Mindanao (Cotabato and Davao Provs.), often in association with *Xeniaria bicornis*. The type-series is of 11 lots, of which 6 contain both *Xeniaria* and *Arixenia* while the remaining 5 contain only *Arixenia*; an average of 3.5 *Arixenia* earwigs were found per bat.

HOST. *Cheiromeles torquatus*.

AFFINITIES. This new species is related to but markedly different from *esau*. The most important differences between these 2 species are in the pygidium of the ♀, and in tergite 10, sternites 8 and 9, cerci, and endophallic sclerite of the ♂. The differences in the relative lengths of antennal segments and in the shape of mesepimera are less conspicuous.

The name *camura* (Latin, turned inward) refers to the strongly inwardly curved ♂ cerci.

DESCRIPTION. Adult ♀. Antenna slightly longer than in *esau*. Mesepimeron triangular, upper margin weakly concave, anterior arm almost as narrow as posterior arm. Pygidium with anterior (upper) part slightly narrower than widest part of cercus, ventral surface uniformly setose all over. Body 18–21 mm long, mesonotum 4.4–4.9 mm wide.

Adult ♂. Antenna similar to that of ♀; relative length of segments 3–6, 15: 7: 9: 10. Mes-

epimeron triangular, with concave upper margin. Tergite 10 slightly more than 2 × as long as tergite 9, discal area of surface evenly gently convex, posterior area with moderately long and dense curved setae which do not form a conspicuous transverse bristle-tuft, posterior margin weakly trisinuate, superior margin in profile gently curved. Sternite 8 distinctly shorter than 7, unmodified, evenly covered with soft setae, posterior margin very broadly rounded off into lateral margins. Sternite 9 transverse, moderately sclerotized; dorsal surface without median slit; anterolateral process short, broad; posterolateral process truncate posteriorly, rather weakly pigmented and sclerotized, not protruding, most parts of ventral surface evenly covered with dense setae; posteromedian lobe about 1/2 as long as wide, posterior margin sinuate at middle, dorsal surface medially rather densely setose and laterally bare, ventral surface gently convex mesiad and rather densely setose. Pygidium in dorsal view shorter, broader than in *esau* and with posterior margin evenly weakly concave, in caudal view about 2 × as wide as high and much widened at lower end. Cercus hook-like, strong-

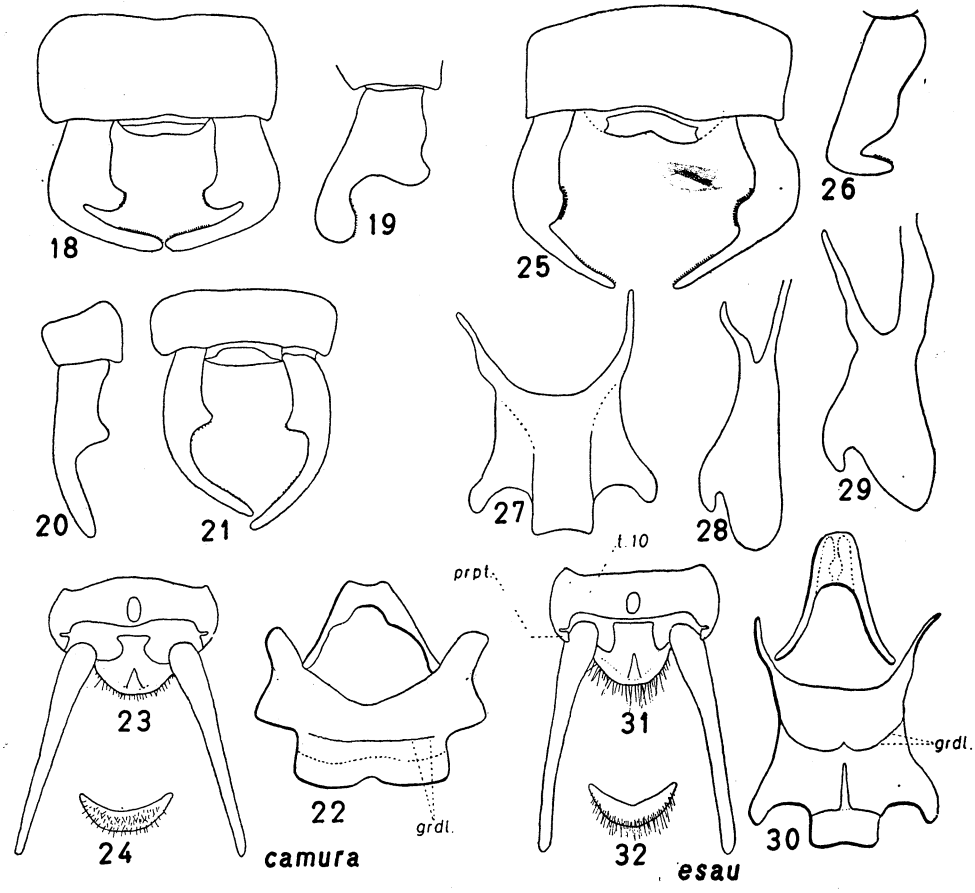


Fig. 18–32. *Arixenia* species, ♂ ♀ terminalia (fig. 18–24, *camura* n. sp.; 25–28, 30–32, *esau* Jord., Borneo; 29, *esau*, Malaya).

18, 25, ♂ abdominal apices, dorsal. 19, 26, ♂ cerci, lateral view. 20, 21, abdominal apex of an abnormal nymph, lateral and dorsal views. 22, 30, ♂ sternites 7 and manubria, dorsal. 23, 31, ♀ abdominal apices, dorsal. 24, 32, ♀ pygidia, ventral. 27, ♂ sternite 7, ventral; 28, 29, ♂ sternites 7, lateral view from right side. *grdl*, gradulus; *prpt*, paraproct; *t*, tergite.

ly widened at midlength, apical part strongly curved mesiad. Genitalia as in fig. 33–35. Body 18 mm long, mesonotum 4.2 mm wide.

Nymph iv ♀. Body more slender and generally with longer hairs than in nymph iv ♀ of *esau*. Hairs on tergite 10 uniform in length and density, not forming a conspicuous discal tuft. Body 19–22 mm long, mesonotum 4.2–4.4 mm wide.

Nymph iv ♂. Tergite 10 without conspicuous tuft of long dense hairs on discal area, posterior margin gently convex. Pygidium weakly swollen, anterior (upper) part much narrower than widest part of cercus. Cercus widest near base, where it is about as robust as antennal scape, mesial margin in dorsal view and superior margin in profile markedly concave, apex slightly curved mesiad. Posterior margin of sternite 8 almost straight, that of sternite 9 rather evenly convex, i.e. median section inseparable from lateral sections. Body 17 mm long, mesonotum 3.5 mm wide.

Nymphs iii, ii, i. Apparently indistinguishable from those of *esau* except anterior (upper) part of pygidium distinctly narrower than widest part of cercus. Body in iii ♀ 13–15 mm, iii ♂ 12–14 mm, ii 12 mm, i 7–9 mm long; mesonotum in iii ♀ 3.5–3.7 mm, iii ♂ 3.1–3.4 mm, ii 2.9 mm, i 2.2–2.5 mm wide. For the description of an abnormal nymph iii bearing adult characters, see the Teratology section, p. 317, fig. 20–21.

5. **Arixenia esau** Jordan, 1909 Fig. 25–29, 36–40.

Arixenia esau Jordan 1909a: 313, pl. 16, 17, 18 (1), nymphs, original descr. — Burr & Jordan 1913: 398–421, fig. 13, 19, 20, comparative notes with *jacobsoni*. — Shelford 1916: 19, habitat. — Hebard 1927: 24, Sumatra record. — Audy 1952: 133, Malaya record. — Boeseman 1954: 3, Sumatra record. — Harrison 1954: 67, Malaya record. — Cloudsley-Thompson 1955: 16, Malaya record; 1957: 3–6, fig. 1–3, 4 (a–e), growth stages, descr. of ♂ ♀ adults. — Medway 1958: 191–95, pl. 1, habits. — Cloudsley-Thompson 1959: 139–40, growth stages. — Giles 1961: 21–25, fig. 1, 1st stadium nymph, life cycle. — Popham 1961b: 324–25, fig. 2, feeding habits; 1962: 431–40, 447–49, fig. 1, 2, 5, 7, 9, 10, 18, 25, anatomy related to feeding habits. — Giles 1963: 128–37, comparative external morphology.

PREVIOUS RECORDS. The type-series (BMNH) of this species is composed of 4 nymphs. In 2 of them, the antennae were described as 8-segmented while in another 2, as 13-segmented. Accordingly they are of stadia i and iv respectively. These nymphs were said to have been found by a taxidermist in the breast pouch of *Cheiromeles torquatus* which was collected by Charles Hose in Borneo: Sarawak (no further detail). The more precise type-locality might have been the Niah Caves since Hose was the Resident of the Baram, a district in those days including Niah, and he is known to have visited and collected in those caves (Medway 1958: 191). Other earlier records of *esau* were from the Niah Caves, ex *Ch. torquatus* (Medway 1958); Sumatra: W coast, Aur (Kumanis), ex *Ch. torquatus* (Hebard 1927, Boeseman 1954); Malaya: Selangor, Bukit Lagong Forest Reserve, Dusun Wam nr Kepong, NW of Kuala Lumpur, in association with *Xeniaria jacobsoni*, ex *Ch. torquatus* and scrapings etc. in a hollow tree (Audy 1952, Harrison 1954, Cloudsley-Thompson 1955, 1957).

MATERIAL EXAMINED. 28 adults (11 ♂, 17 ♀), 60 nymphs (17 i, 17 ii, 12 iii, 8 iv ♂, 6 iv ♀).

MALAYA: Selangor, Dusun Wam, ex *Ch. torquatus*, III.1952, J. R. Audy (MCZ); Bukit Lanjan Forest Reserve, ex *Ch. torquatus*, XII.1970, B. L. Lim.

SUMATRA: W coast, Aur (Kumanis), III.1914, E. Jacobson (ANSP).

BORNEO: All from Sarawak, Niah Caves: III.1957, N. Tweedie (BMNH 1959. 353); XI.1959, also 1963, Lord Medway (BMNH, ETG); II.1967, G. Rothschild (VRV).

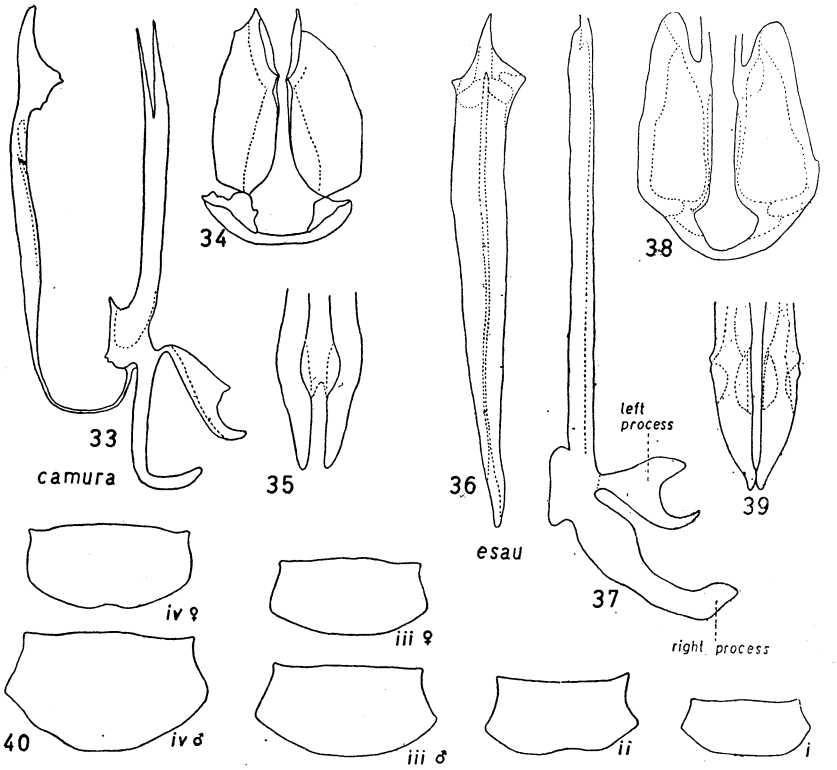


Fig. 33 – 40. *Arixenia* species, ♂ genitalia, and sternites 9 of 4 nymphal stadia (fig. 33 – 35, *camura* n. sp.; 36 – 39, *esau* Jord., Borneo; 40, *esau*, Malaya).

33, 36, 37, ventral rod of praeputial sac and apical endophallic sclerite (sac in fig. 33 in lateral view, that in fig. 36 in ventral view and detached from the sclerite). 34, 38, vesicles. 35, 39, parameres. 40, sternites 9 of 4 nymphal stadia. sex of ii and i uncertain.

DISTRIBUTION. Malaya, Sumatra, Borneo; either in hollow trees and in association with *Xeniaria jacobsoni*, or in caves and not associated with the latter species.

HOST. *Cheiromeles torquatus*.

AFFINITIES. This species is closely related to and most probably more specialized than the preceding one. The partly bare ♀ pygidium, the presence of the bristle-tuft on the ♂ tergite 10, the strongly modified ♂ sternites 8 and 9 and the greatly dilated apical processes of the ♂ endophallic sclerite in *esau* all appear to be in a more or less advanced state of modification. However, in the outline of the cerci, adult *esau* is more comparable than adult *camura* to the nymphal ♂.

The specific name is taken from the Bible — Esau is the son of Isaac and Rebecca and twin brother of Jacob.

The ♂ from Malaya which we have examined are somewhat different from those from Java. The manubrium is shorter and anteriorly more dilated, the inferior margin of sternite 9 in profile is distinctly concave (fig. 29) and the anterolateral processes of

that sternite are longer. More material is necessary to see if such differences are more than individual variation.

DESCRIPTION. Cloudsley-Thompson (1957) was the first to describe adults of this species. The following specific characters given in his description are actually applicable to the entire suborder or family, rather than to the species alone: "Head prognathous, more or less heart-shaped, broader than long, widest just behind eyes; clypeus and frons separated by a curved depression, coronal and frontal sutures [ecdysial line and epistomal suture] not well marked and appearing as pale yellow lines; muscle attachments [indicated by] pale hairless areas; eyes small, oval [sic] in shape; antennae inserted laterally, composed of 14 segments; mouthparts similar in both sexes; pronotum the longest of 3 thoracic tergites and half as long as wide; tarsi with stout claws; wings absent; abdomen in both sexes having a full complement of tergites; cerci non-segmented." The remaining characters he enumerated are in fact largely good for both *camura* and *esau*. This is also true for the nymphal characters mentioned by Jordan (1909a) and Burr & Jordan (1913).

Adult ♀. Antenna slightly shorter than in *camura*. Mesepimeron L-shaped, with upper margin angulate at midlength, and with anterior arm much narrower than posterior arm. Pygidium with anterior (upper) part wider than widest part of cercus, and with anterior 1/2 of ventral surface bare. Body 17–27 mm long, mesonotum 4.5–5.0 mm wide.

Adult ♂. Antenna with relative lengths of segments 3–6, 20: 6: 7: 8. Mesepimeron similar to that in ♀ but anterior arm about as wide as posterior arm. Tergite 10 about 2 × as long as tergite 9, discal area strongly transversely swollen and with a large conspicuous transverse tuft of very long and dense setae which are markedly longer than those elsewhere on the sclerite; posterior margin strongly trisinuate, superior margin in profile very strongly curved, with anteriormost section almost perpendicular to posteriormost section. Sternite 8 distinctly longer than 7, posterior 1/2 unusually heavily sclerotized, posterior margin straight, posterolateral marginal area strongly flexed dorsocaudad and bearing a tuft of dense rigid erect bristles. Sternite 9 elongate, very heavily sclerotized, dorsal surface with a short narrow median slit before base of posteromedian lobe; anterolateral process long, narrow; posterolateral process rounded at apex, strongly protruding, sparsely evenly setose on ventral surface. Posteromedian lobe of sternite 9 dorsally about 2/3 as long as wide, with short, very dense setae along lateral margins and on anterolateral areas, elsewhere bare, posterior margin concave; ventral surface about 2.5 × as long as wide, widened apicad, with long sparse fine setae, abruptly and very strongly raised above (in ventral view) level of posterolateral processes of sternite, thus forming on each side distinct vertical slope which is about as wide as above-mentioned very strongly raised area. Pygidium in dorsal view longer, narrower than in *camura* and with posterior margin angulately notched at middle, in caudal view almost as wide as high and widened at lower end. Cercus in dorsal and lateral views slightly widened at midlength, apical part less strongly curved mesiad than in *camura*. Genitalia as in fig. 36–39. Body 15–20 mm long, mesonotum 3.8–4.3 mm wide.

Nymph iv ♀. Body more robust and in general, with shorter hairs than in *camura*. Tergite 10 with conspicuous tuft of dense long hairs around discal bare spot, elsewhere surface with markedly shorter finer setae. Body 16–24 mm long, mesonotum 4.2–4.6 mm wide.

Nymph iv ♂. Tergite 10, as in iv ♀, with conspicuous hair-tuft and with practically straight posterior margin. Pygidium strongly swollen, anterior (upper) part slightly wider than widest part of cercus. Cercus with basal 2/5 evenly robust, mesial margin in dorsal view and superior margin in profile very weakly concave. Posterior margin of sternite 8 distinctly convex, that of sternite 9 with median section subangulate to lateral sections which are distinctly oblique. Body 16–22 mm long, mesonotum 4.0–4.5 mm wide.

Nymphs iii, ii, i. Apparently inseparable from those of *camura* except anterior (upper) part of

pygidium almost as wide as widest part of cercus. Body in iii ♀ 12–18 mm, iii ♂ 11–14 mm, ii 11–15 mm, i 6–9 mm long; mesonotum in iii ♀ 3.7–4.1 mm, iii ♂ 3.2–3.7 mm, ii 2.9–3.4 mm, i 2.5–2.8 mm wide.

Suborder HEMIMERINA Burr, 1911: 8

= Diploglossata (order) Saussure, 1879: 412.
= Dermodermaptera (suborder) Verhoeff, 1902b: 89.
= Hemimeroidea (superfamily) Heymons, 1915 (cited by Handlirsch 1925: 476, original not seen).

NOMENCLATURE. As listed above, Diploglossata is the earliest name for the group. Although it has been used by Meinert (1880), Handlirsch (1908, 1925, 1926) and several other authors since then, it is not accepted herein because (a) the law of priority in the current International Code of Zoological Nomenclature does not apply to ordinal and subordinal names, (b) the uniformity of the ending *-ina* in the names Hemimerina, Arixeniina and Forficulina in the order is more convenient for users, and (c) the name Diploglossata (double-tongued, double-labiumed) is a misnomer. The next earliest name Dermodermaptera is also not accepted herein because of the reasons (a) and (b) given above and because it has gained no popularity since first published. Incidentally, the ending *-dermaptera* in this name conforms with that in another set of subordinal names Protodermaptera and Eudermaptera which are now out of general use.

SYSTEMATICS. It is now quite clear that the Hemimerina should be accorded subordinal status within the order Dermaptera, i.e. equal in rank to the Forficulina and Arixeniina. The vicissitude of the systematic position of this group in the past may be briefly narrated. Saussure (1879), Meinert (1880), Handlirsch (1908, 1925, 1926) and Popham (1961a), who were followed in several entomological textbooks, considered the group to be a separate order. Meinert (1880) suggested that it should stand between the orders Thysanura and Orthoptera; Sharp (1892) stated it might be placed in the Coleoptera near Platypsyllidae; Verhoeff (1902b) assigned it an intermediate position between the Blattaria and true Dermaptera; while Deoras (1941b) placed it in the series Protodermaptera near Labiduridae. Superficially the Hemimerina are blattid-like and bear little resemblance to the Forficulina or true earwigs because the body is much flattened, the legs are strongly shortened and modified; the antennae as well as tarsi are, when flexed, placed in their respective receptacles; and the cerci are slender and seemingly multisegmented. Apparently these characters are adaptative devices for the parasitic life and are of little phylogenetic significance. Giles (1963) found 14 of the 283 external characters in the entire order to be peculiar to the Hemimerina, viz. eyes wanting, frontal arms of ecdysial cleavage line running toward antennae (not toward eyes), ocular sulci absent, laciniae each with 4 (not 2) apical teeth and with double (not single) comb-like row of bristles, tarsi with euplantulae, accessory coxal plate of mesopleura absent, metatergal phragmata absent, manubrium (♂) separated from sternite 9 and with pair of stout rods, parameres (♂) curved to left (not longitudinally straight), virga (♂) very weakly sclerotized, tergite 10 small and triangular (not large and squarish or transversely quadrangular), metapygidium absent, pygidium (♂ ♀) >-shaped (not L-shaped in one or both sexes).

Compared with the Arixeniina, the Hemimerina are certainly more specialized because the structural specialization is more evident; intergeneric and interspecific differentiation weaker; sexual dimorphism, even in nymphal stadia, more significant; host specificity probably more strict; and, in addition, the rats (hosts of the Hemimerina) are evidently

more advanced than the bats (hosts of the Arixeniina) among the Mammalia.

The entire suborder Hemimerina includes 1 family, 2 genera and 11 species. Unlike the Arixeniina, the males and nymphs of the various species of the Hemimerina are far less distinctive than the females; and while the nymphs show much stronger sexual dimorphism, it is not easy to separate them into different stadia, and it is impossible to construct a key to species on the basis of the nymphal characters alone.

DISTRIBUTION. This suborder is confined to the W and E African subregions. Rehn & Rehn (1936) suggested that the geographical range of *Hemimerus* most probably coincides with that of its hosts, i.e. murids of the genus *Cricetomys* Waterhouse, 1840 (giant rats). The discovery of the n. g. *Araeomerus* from murids of the genus *Beamys* Thomas, 1909 (long-tailed pouched rats) does not affect the soundness of this generalization for the entire suborder, because the distributional range of *Beamys* lies well within that of *Cricetomys*. The suborder is therefore expected to be found in Gambia, SE Sudan, Fernando Po I., Zanzibar I. and other peripheral areas where *Cricetomys* occurs. Up to the present, the Hemimerina are known in Portuguese Guinea, Guinea (former French Guinea), Sierra Leone, Liberia, Ivory Coast, Ghana (former Gold Coast), Togo, Dahomey, Nigeria (incl. a small part of former German Cameroons), Cameroons (former French Cameroons, plus most of former German Cameroons), Spanish Guinea, Zaire (former Belgian Congo), Angola, Central Africa, Uganda, Urundi, Kenya, Tanzania (former Tanganyika and Zanzibar), Malawi (former Nyasaland), Mozambique, Rhodesia (former Southern Rhodesia) and Transvaal. In most of these countries, only a single hemimerine species each is known, and in Rehn & Rehn's (1936) map of the distribution of the then-known species and records, there are no distributional overlappings. It is clear now that 2 or more species co-exist in the following countries:

Nigeria	— *Hemimerus hanseni, vicinus, talpoides, sessor*
Zaire	— *H. hanseni, vosseleri, bouvieri*
Uganda	— *H. hanseni, sessor*
Kenya	— *H. hanseni, vosseleri, sessor*
Tanzania	— *Araeomerus hubbardi*; *H. vosseleri, bouvieri*
Malawi	— *A. morrisi*; *H. deceptus, bouvieri*
Mozambique	— *H. prolixus, deceptus, bouvieri*

More intensive collecting should be undertaken in these 7 countries so as to clarify or ascertain the distributional overlappings, host range, host preference etc. of the various species involved. Kenya[6] is herein selected as an example to illustrate these features (cf. map and the section on Host Relationships, p. 334), because both *Hemimerus* and *Cricetomys* of this country are rich in species and local races and have been most extensively investigated and critically reviewed.

Only 4 species (*H. hanseni, talpoides, sessor, bouvieri*) of the Hemimerina are fairly widely distributed, while all the remaining species are more or less localized. Insofar as shown by available records, the widespread species have wide host ranges and the localized ones, narrow host ranges. Exceptions are: *H. talpoides*, widespread but reported from a single race of *C. gambianus* (plus *C. emini*) probably because it is confined to the coastal

[6] Kenya is the type-locality of *H. sessor*, *Beamys hindei* and 6 nominal subspecies of *C. gambianus* (but *Araeomerus hubbardi* and *C. emini* are not yet recorded therefrom). One of the paratypes of *H. vosseleri* is also from Kenya.

lowlands along the Gulf of Guinea where the topography, climate, biota etc. are rather uniform; *H. vosseleri*, localized but reported from as many as 3 races of *C. gambianus* probably because it has been extensively collected and occurs in both coastal lowlands and interior mountainous areas in Kenya and Tanzania, and perhaps the current taxonomy of the races of *C. gambianus* for these 2 countries is unduly complicated.

The distributional center of the Hemimerina (and their host rats also) seems to be in the mountainous strip around the Victoria, Tanganyika and Nyasa Lakes where the genus *Araeomerus* occurs and representatives of all 3 species-groups of the genus *Hemimerus* meet. As recorded, the western- and northernmost limits of the suborder are in Portuguese Guinea, ca 12°N, 16°W; the easternmost limits, in E Kenya, ca 40°E; the southernmost limits, in NE Transvaal, ca 23°S. Three species (*H. talpoides, vicinus, advectus*) appear to be confined to the Western African subregion; 5 species (*A. hubbardi, morrisi*; *H. vosseleri, prolixus, deceptus*) to the Eastern African subregion; another 3 species (*H. hanseni, sessor, bouvieri*) are widespread and common to both the Western and Eastern African subregions which are, insofar as shown by the Hemimerina, not sharply defined. No species is known in the Southern African subregion.

H. hanseni and *H. sessor* were believed by Kock (1973) to be sympatric in the Mt Elgon area on the Uganda-Kenya border. As mentioned above, both species are widely distributed. The known range of the former species overlaps that of the latter very extensively, from SE Nigeria to W Kenya but between these 2 limits, either species has scarcely been collected. The distributional overlappings of other species are very little known and most probably this does not happen in closely related species such as *H. talpoides* vs *H. sessor*.

HOST RELATIONSHIPS. Quite obviously *Araeomerus* earwigs are confined to *Beamys* rats while *Hemimerus* earwigs, confined to *Cricetomys* rats. *Araeomerus* and *Beamys* are much rarer, more localized in distribution and more generalized in structure than *Hemimerus* and *Cricetomys*. Only 2 series of *Araeomerus* have ever been collected, one was from "food stores" in burrows of *B. major* (but "never on an actual rat") in broad-leafed evergreen forests (Hanney 1963), and another from the body of *B. hindei* (2 earwigs off 15 rats) collected along mountain streams (Hubbard in litt.). This suggests that *Araeomerus* species are probably strictly host-specific, very low in population density and less intimately associated with the host, spending all (as believed by Hanney) or much more time off the host compared to *Hemimerus*, and feeding partly or largely on plant material. *Hemimerus* species are different and their host specificity is, in certain respects, far more obscure and perplexing. They are most probably much higher in population density, spend all or most of the time on the body of the host and feed largely on animal material. Dr Hubbard (in litt.) once removed as many as about 100 earwigs off a single *Cricetomys* rat, and Kock (1973) noted that on the S slope of Mt Elgon in Kenya, 250 *H. sessor* were obtained from 8 *C. gambianus elgonis* and that the average number of earwigs per infested rat for *H. sessor* in that area was 26.9 (range 12 to 49), this average for *H. hanseni* in Uganda was 25.5, and for *H. vosseleri* in Kenya and Tanzania was 12.4. Jordan (1909b) verified Vosseler's (1906, 1907) finding that the *Hemimerus* feed on the epidermis of the host. He further demonstrated that the bare patches on the skin of *Cricetomys* are not caused by *Hemimerus* but by a fungus and that these earwigs may be beneficent to their hosts by eating off the fungus

as well as the scuff. Rehn & Rehn (1936: 481) also noted that, among a number of fresh specimens of *Cricetomys* collected in Zaire, those free of *Hemimerus* were mangy in appearance, with numerous, small, partially bald areas scattered over the body. It is yet to be ascertained if the true nutrient for *Hemimerus* is derived from the fungus or the scurf, or both. Cook (1901) recorded *H. talpoides* from Liberia "not on *Cricetomys* but under rotting wood"; Rehn & Rehn (1936: 497) recorded the same species from Ghana "caught on pig's feet." There are a few other similar records but it is not clear how often *Hemimerus* may leave the body or burrows of *Cricetomys* and how high the percentage of parasitism is under natural conditions.

There seems to be a possibility that the Hemimerina may occur on other murine rats (*Saccostomus* in particular) that are phylogenetically closely related to *Beamys* and *Cricetomys* and that ecologically live in a similar environment. Simpson (1945, *Bull. Amer. Mus. Nat. Hist.* **85:** 90) and Ellerman et al. (1953, *S. Afr. Mamm. Reclassif.*: 294–95) placed the genus *Saccostomus* Peters, 1846 (generally known as the Cape pouched rat) between the genera *Beamys* and *Cricetomys* and almost at the top of the Muridae: Murinae; Hanney & Morris (1962, *J. Mamm.* **43:** 248) considered *Beamys* to be close to the ancestral stock of *Cricetomys*; while Petter (1966, *Ann. Mus. Afr. Centr. Sci. Zool.* **144:** 13–25) resurrected the subfamily Cricetomyinae Roberts to house these 3 genera. The genus *Beamys* is rare, somewhat arboricolous and is represented by *B. hindei* Thomas, 1909 in Kenya and Tanzania and *B. major* Dollman, 1914 in Malawi. The genus *Saccostomus* is, like *Cricetomys*, subterranean, and it is distributed from southern Zaire, Uganda, Kenya and Tanzania in the north, to SW Africa and Cape Prov. in the south; it is solely represented by *S. campestris* Peters, 1846 which includes about 15 nominal subspecies. The genus *Cricetomys* spreads widely, though rather sporadically, over Africa south of the Sahara, including a number of off-shore islands; some 30 nominal species and subspecies have been described and these are lumped into the single species *gambianus* Waterhouse, 1840 by most mammalogists. In Genest-Villard's (1967, *Mammalia* **31:** 390–455, 669) revision of the genus, 2 species (including *C. emini* Wroughton, 1910) and a number of subspecies were accepted as valid[7]. The specific criteria he employed were the shape of the skull (which bears no significance to our discussion) and the texture of hair covering (soft and short in *C. emini*, harsher and longer in *C. gambianus*). Coincidentally Rehn & Rehn (1936: 468–71) remarked "from the hair texture and character alone the various forms of *Cricetomys* could hardly be considered specifically identical and a very definite correlation of the hair texture and character of the host rat and the degree of specialization of the margin of the ultimate sternite [sternite 7] of the female *Hemimerus* does exist." In addition, all host rats of *H. hanseni* that they examined were said to have rather soft, adpressed and relatively short hairs; the type of *C. gambianus engavi*, i.e. the host of *H. vosseleri*, moderately soft hairs; the type of *C. gambianus raineyi*, i.e. the host of *H. sessor*, quite harsh, rather long and unusually coarse hairs; the type of *C. gambianus ansorgei* (plus another Angolan specimen), i.e. the host of *H. advectus*, rather soft hairs. An abstract of the Rehns' lengthy discussion follows.

[7] In this connection, it may be noted that G. M. Allen (1939, *Bull. Mus. Comp. Zool. Harvard* **83:** 378–81) recognized as many as 6 valid species, and that the taxonomy of other arthropods known to be parasitic specifically on *Cricetomys* also suggests this genus to be composed of more than a single species. Of the Laelapidae (Acarina), *Andreacarus petersi* Radford occurs in Sierra

Hair texture	*Cricetomys* habitats	Sternite 7 and pygidial venter of ♀ *Hemimerus*
Soft, dense, short	Lowland forests, moister mountain forests	Generalized, merely fitting one another, unable to lock tightly
Harsh, sparse, long	Gallery forests, drier mountain forests, scattered forest patches in arid land	Specialized, tightly locking to one another and effectually protecting anus and genitalia

Incorporating the findings by Rehn & Rehn and by Genest-Villard would lead to the impression as if ***H. hanseni*** is confined to the soft-haired ***C. emini***, and the remaining 8 ***Hemimerus*** species, to the harsh-haired ***C. gambianus***. This does not correspond with the following host-parasite list which is compiled from all available records.

Cricetomys emini Wroughton, 1910 — *H. hanseni, vicinus, talpoides, sessor, bouvieri.* Note: This covers all records originally given as *C. emini* and unnamed *C. emini* subspp.; *C. gambianus proparator* Wroughton, 1910 is here accepted as a synonym of *C. emini.*

Cricetomys gambianus Waterhouse, 1840 — *H. hanseni, vosseleri, talpoides, sessor, advectus, bouvieri.* Note: This covers all records originally given as *C. g. gambianus* and subspecifically undetermined "*C. gambianus*" but not those merely as *Cricetomys* sp., giant rat, forest rat, ground rat etc.

C. g. ansorgei Thomas, 1904 — *H. vosseleri, advectus.* Note: The type of *advectus* was obtained from the type of *ansorgei* from Angola: Loanda District, Pungo Andongo.

C. g. elgonis Thomas, 1910 — *H. hanseni, sessor.*

C. g. engavi Heller, 1912 — *H. vosseleri.*

C. g. haagneri Roberts, 1926 — *H. deceptus.*

C. g. kenyensis Osgood, 1910 — *H. vosseleri.*

C. g. raineyi Heller, 1912 — *H. sessor.* Note: The type-series of *sessor* was obtained from the type of *raineyi.*

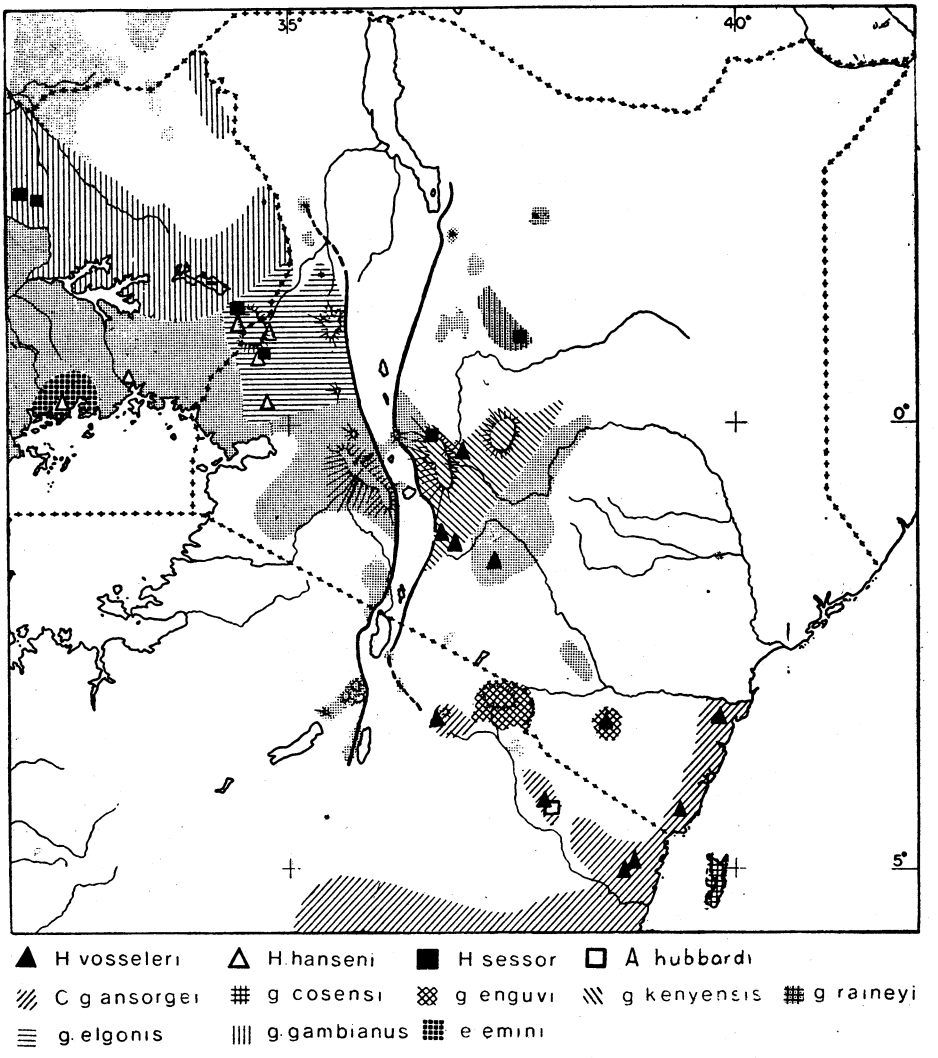
C. g. viator Thomas, 1904 — *H. vosseleri, deceptus,* (?) *bouvieri.*

The above list indicates that 4 of the ***Hemimerus*** species (***hanseni, talpoides, sessor, bouvieri***, all widespread) have been reported from both ***Cricetomys*** species; 3 (***vosseleri, deceptus, advectus***), from ***C. gambianus*** but not ***C. emini***; 1 (***vicinus***), from ***C. emini*** but not ***C. gambianus***; (the host of ***prolixus*** is yet undetermined). Many specific and subspecific identifications of the host rats in question need to be verified (for the above reason, the ***Cricetomys*** species and subspecies enumerated in the Host section for each ***Hemimerus*** species are with quotation marks), and results of further intensive collecting in various representative habitats may also necessitate corrections and modifications of the list, but it is likely that some of the widespread ***Hemimerus*** species may prefer ***C. emini*** while others may prefer ***C. gambianus.***

Kock (1973) is probably the first author to work comprehensively on the taxonomy and distributional patterns of both ***Hemimerus*** and the host rats. By studying 784 ***Hemimerus*** and 43 ***Cricetomys*** specimens from Kenya and her neighboring countries, he reached the conclusions (i) that the ***Hemimerus*** species known from that area are not

Leone and Cameroons, and *A. zumpti* Taufflieb in Congo and Zaire. Of the Pulicidae (Siphonaptera), *Xenopsylla aequisetosa* (Enderlein) occurs from Senegal to Nigeria, *X. crinita* Jordan & Rothschild in Kenya, Tanzania and Malawi, and *X. torta* Jordan & Rothschild in Zaire (SE), Malawi, Mozambique, Rhodesia and Transvaal. The only exception is in the Hoplopleuridae (Anoplura), with *Proenderleinellus calvus* (Waterston) recorded from W Africa, Kenya, Tanzania and Transvaal. Cf. Zumpt (1966), Johnson (1960, *U.S. Dept. Agric. Tech. Bull.* **1211**: 1-115) etc.

strictly host specific, (ii) that they have evolved independent of the subspecific splitting of the host species, and (iii) that at the Mt Elgon area on the Kenya-Uganda border *H. hanseni* and *H. sessor* are sympatric. Probably the point (ii) was designed to explain the occurrence of *sessor* on one set, and *vosseleri* on another set of 3 subspecies of *C. gambianus* and in general, designed to coordinate the current taxonomic scheme of *Hemimerus* with that of *Cricetomys*. To support point (i) Kock cited as evidence in his Table 1 the occurrence of *hanseni* on both *C. gambianus elgonis* (on Mt Elgon) and *C. emini* (in SE Uganda); of *vosseleri* on *C. g. ansorgei* and *Beamys hindei*, both in NE



Map of Kenya and her neighboring countries showing known distribution of various *Hemimerus* and *Cricetomys* forms. Finely dotted areas indicate the occurrence of certain unnamed *Cricetomys*. Modified from Kock 1973.

Tanzania; and again, of *hanseni/sessor* on *C. g. elgonis* on Mt Elgon, and of *vosseleri/"morrisi"* [= *Araeomerus hubbardi*] on *B. hindei* in NE Tanzania. Accordingly, one may argue that probably *hanseni* breeds primarily on *C. emini* and secondarily on *C. gambianus* (cf. below and Rehn & Rehn 1936) and that the odd record (Hubbard 1970) of *vosseleri* from *Beamys* is almost certainly a case of straggling. For point (iii) Kock studied 21 series of *Hemimerus* specimens from the S side of Mt Elgon, 1900 m, all imperfectly labelled but presumed to be each from a single individual of *C. g. elgonis* (he also studied a single series of Mt Elgon *Hemimerus* collected by himself and containing *hanseni* only). Of these 21 series, 8 contained *sessor* only, 13 contained *hanseni/sessor*, 5 were with *hanseni* prevailing, and 8 were with *sessor* prevailing. Total numbers of *hanseni* and *sessor*, excluding nymph i, were 112 and 162, respectively. Apparently *hanseni* was the less prevalent species in the area and in the absence of a primary (or most preferred) host, it had to subsist on the secondary host, *C. g. elgonis*, which was believed by Kock to be the only giant rat occurring there. [Kock's belief was based on an examination of only 6 Mt Elgon specimens. Such limited material may be inconclusive in ruling out the possible existence of *Cricetomys* other than *elgonis*.] It also seems possible that by cytological, biochemical and other means, some of the "subspecies" of *C. gambianus* may eventually prove to be independent "cryptic" species. The 2 species (or perhaps species-groups) in the current taxonomic scheme of *Cricetomys* are so clearly disharmonious with the 3 well-defined species-groups of *Hemimerus* that it is hardly possible to trace parallel evolutionary trends for these 2 genera.

The distributional patterns of *Cricetomys* are also dissimilar to those of *Hemimerus*. For instance, *C. gambianus* of Kenya (*C. emini* is unknown there though known in E Uganda) was classified by Kock (1973) into 5 named and several unnamed subspecies which represent more or less isolated and scattered populations with distributional ranges that rarely overlap. But of the 3 *Hemimerus* species occurring there, *vosseleri* is confined to the SE area of the country and confined to 3 or 4 *C. gambianus* subspecies[8] endemic to that area, and *hanseni* and *sessor* co-exist in the NW and are confined to 1 and 2 endemic *gambianus* subspecies, respectively (see map).

The males of the various *Hemimerus* species are greatly outnumbered by the females in collections (Table 2). It is not clear if the predominance of the ♀ sex, while apparently advantageous in a parasitic life, has any bearing on the degree of host specificity. In other viviparous ectoparasites, such as the Diptera Pupipara, generally the sex ratio of monoxenous and oligoxenous species is almost even, while the females of pleioxenous and polyxenous species greatly outnumber the males.

As shown by the above discussion, much more work must be done before a definite and acceptable conclusion can be reached. At present, one can only speculate that the host specificity of *Hemimerus* probably varies in degree. It may be significant and strict in the more localized and more specialized species, and not or hardly so in the more widespread and more generalized species (which may have both primary and secondary hosts and may, under certain circumstances, subsist on the secondary host).

[8] One of the subspecies was unnamed; *ansorgei* was included among those named, and this subspecies was originally described from Angola: Loanda District and is also found in NW Tanzania; we are in doubt as to whether the Kenya-Tanzania populations are identical with the Angola population.

DEFINITION. Entirely apterous. Body strongly flattened, sparsely and quite unevenly setose. Eye absent. Antenna less than 1/3 as long as body, of 11 segments (8 in nymph i, 10 in nymphs ii–iv); flagellomeres each bearing 2 patches of sensory pores. Mandible with 1 apical, 1 preapical and 1 intermediate tooth, all of which are well spaced; incisor edge lined with very short series of rigid setae; no molar edge. Lacinia with 4 apical teeth. Thoracic nota strongly explanate laterad, dorsum of explanate areas longitudinally convex, venter of explanate areas forming receptacles of antennae in repose, lateral margins deflexed. Prothoracic spiracle small. Legs exceedingly short and robust, strongly modified, tibiae dorsoapically excavated for reception of corresponding tarsi in repose; tarsi with large membranous pads beneath. ♀ Terminalia: Tergites 8 and 9 much reduced, both covered by tergite 7; tergite 9 rigidly connected with 8 and 10. Sternite 7 posteriorly produced into a broad median lobe and covering sternites 8 and 9 which are reduced, only partly pigmented-sclerotized and each divided into 2 halves. Paraproct well separated from tergite 10. Clutch

Table 2. Sex ratio of *Hemimerus* species (adults and nymphs ii-iv)*

	Rehn & Rehn 1936, 1937			Kock 1973			This paper			Mean ratio
	Specimens		Ratio	Specimens		Ratio	Specimens		Ratio	
hanseni	56♂	127♀	2.27	28♂	99♀	3.54	54♂	90♀	1.67	2.29
vosseleri	6	14	2.23	12	63	5.25	61	107	1.75	2.33
talpoides	23	43	1.88	—	—	—	21	33	1.58	1.73
sessor	7	26	3.71	110	184	1.67	87	120	1.38	1.62
deceptus	35	63	1.80	—	—	—	25	29	1.16	1.57
bouvieri	23	50	2.17	—	—	—	23	37	1.61	1.89

* Not including *vicinus*, *prolixus* and *advectus* which are known only from 3, 1 and 5 very small series of specimens, respectively. The ratios are of females to males, with latter = 1.00.

and metapygidium always absent. Pygidium posteriorly narrowly rounded. Cercus hairy, slender, subcylindrical, pale-speckled, practically straight. ♂ Terminalia: Sternite 9 posteriorly asymmetrical; manubrium separated from sternite 9, with pair of stout bars or rods strongly converging cephalad. Paraproct either well separated from or partly fused to tergite 10. Metapygidium absent. Cercus similar to that of ♀, no patches of sensory papillae. Parameres large, strongly asymmetrical, heavily sclerotized, left one much longer and more strongly curved. Praeputial sac bifurcate apically, no endophallic sclerites, but ventrally with a longitudinal, heavily sclerotized plate between parameres. Ejaculatory duct membranous. For further details of external characters, see Giles (1963), and for certain internal characters, see Jordan (1909b).

SEXUAL DIMORPHISM. Sexes of adults of this suborder can readily be distinguished by an examination of the shape of the last visible sternite, or the number of exposed abdominal segments situated before the pygidium. In the adult ♀, the last visible sternite (i.e. sternite 7) is posteriorly symmetrical and very broadly rounded, and there are 8 tergites and 6 sternites exposed before the pygidium; segments 8 and 9 are reduced, rigidly connected with each other and covered by segment 7, while sternite 1, as in other earwigs, is undefinable. In the adult ♂, the last visible sternite (i.e. sternite 9) is posteriorly asymmetrical, either broadly rounded (in *Araeomerus*) or produced into a digitiform subgenital process (in *Hemimerus*), and there are 10 tergites and 8 sternites exposed before the pygidium. Sexes of nymphs are less conspicuous, particularly in earlier stadia, and are separable only by the relative curvature of the 3 apical sternites (see fig. 98 and the section on Nymphal Stadia).

NYMPHAL STADIA. Nymphs of the genus *Araeomerus* are practically unknown.

The 4 nymphal stadia of *Hemimerus* may be rather easily differentiated. They are readily distinguishable from adults by the reduced number of antennal segments (there are 11 segments in adults) and in the ♀ sex, by the exposed, unmodified abdominal segments 8 and 9 (these are concealed and modified in adult ♀). Measurements of the width of the head and thorax between succeeding stadia failed to show any definite growth ratio. In stadium i, the antennae are 8-segmented (all 10-segmented in stadia ii – iv) and the ♀ differs from the ♂ only in the slightly smaller average body size and in the relatively more curved posterior margin of sternite 9. In the stadium ii ♀, the posterior margin of sternite 7 is almost straight and is different from that of sternite 8 which is distinctly concave, while the posterior margin of sternite 9 is evenly convex; in the stadium ii ♂, the posterior margin of both sternites 7 and 8 are similarly concave, and the apex of sternite 9 is acute. In stadia iii and iv, the sexual dimorphism becomes increasingly more significant. Both the ♀ subgenital lobe and ♂ subgenital process of the last visible sternite are apparent, the ♀ sternite 8 is often and the ♀ sternite 9 is always incised posteriorly at the middle, and the vestigial bilobed genitalia can clearly be seen attached to the dorsal surface of the ♂ sternite 9. The asymmetry of the posterior margin and the dextral or sinistral direction of the subgenital process of the ♂ sternite 9 are noticeable only in stadium iv. The ♀ sternites 7 – 9, even in stadium iv, do not provide any diagnostic character for the various species-groups.

LITERATURE. Earlier works on the morphology of the Hemimerina are by Hansen (1894), Heymons (1912), Deoras (1941a, b) and Giles (1963); those on the nymphal development are by Vosseler (1906), Heymons (1911) and Chopard (1935). The more important taxonomic revisions are by Chopard (1935) and Rehn & Rehn (1936). In the last paper, adults of the suborder, the family, the genus (*Hemimerus*) and the various then-known species are described in detail. The only additions to the taxonomy since then have been the description of the ♂ of *H. sessor* by Rehn & Rehn (1937), and the new taxa *H. deceptus* var. *ovatus* Deoras, 1940 and *H. morrisi* Hanney, 1963. In this paper, supplementary notes on the adults and new descriptions of the various nymphal stadia are given for each species to the extent that adequate material is available.

Family HEMIMERIDAE Sharp, 1895: 217

Characters and other remarks same as for the suborder.

KEY TO GENERA AND SPECIES OF HEMIMERIDAE (Adults)

1. Antennal segment 2 slightly longer than wide; pronotum (fig. 41) widest before midlength, mesonotum nearly parallel-sided and much narrower than metanotum; ♀ sternite 7 (fig. 49) simple, without submedian foveae, hence no well-defined median (subgenital) and lateral lobes; ♂ sternite 9 (fig. 47, 53) posteromedially broadly rounded, produced but not into a digitiform process. On *Beamys* rats. Genus **Araeomerus.** 2

   Antennal segment 2 about 3 × as long as wide; pronotum (fig. 43) widest behind midlength, mesonotum clearly not parallel-sided (with distinctly convex lateral margins), wider than metanotum; ♀ sternite 7 (fig. 63 – 71) with submedian foveae, hence with well-defined median and lateral lobes; ♂ sternite 9 (fig. 80 – 87) posteromedially strongly produced into a digitiform subgenital process. On *Cricetomys* rats. Genus **Hemimerus.** ...3

2. ♂: Prothorax in ventral view with pleural sutures evenly diverging caudad throughout their entire length; tergite 10 with anterior sections of lateral margins parallel; anterolateral

process of sternite 9 (fig. 47) short, broad, apically rounded. Malawi. ·····1. **A. morrisi**
♂: Prothorax in ventral view with pleural sutures anteriorly slightly diverging cephalad, posteriorly parallel; tergite 10 with anterior sections of lateral margins slightly converging cephalad; anterolateral process of sternite 9 (fig. 53) long, slender, apically subacute. (♀ unknown). Tanzania ····· 2. **A. hubbardi**

3. ♀: Pygidium (fig. 54, 55) very short and subtruncate posteriorly, hence posterior margin rather distinct from and as long as or longer than lateral margin, length of posterior margin about 2 × median length of venter; ventral pygidial surface covered with only a few short pale fine soft hairs on anterolateral corners, otherwise entirely bare; paraproct about as long as wide. ♂ (in *hanseni*, fig. 80): Subgenital process in ventral view directed mainly to right side and with only extreme apex slightly to left side. (*Hanseni*-group). ···4
♀: Pygidium (fig. 56, 58–62) more or less long and (except in *prolixus*, as in fig. 57) narrowly rounded at apex, hence posterior margin rather evenly curved into lateral margin, distinctly shorter than latter, length of posterior margin less than 2/3 median length of venter; ventral pygidial surface bearing strong setae-spines on anterior part; paraproct at least 1.5 × as long as wide. ♂: Subgenital process (fig. 81–87) in ventral (and dorsal) view directed distinctly to right or left side. ·····5

4. ♀: Subgenital lobe (fig. 63, 63a) submarginally without ventral carina but with faint dorsal impressed line; anterior (inner) margin of ventral pygidial surface (fig. 54) non-carinate, practically parallel to lateral (outer) margin; posterior margin of tergite 10 often produced at middle into a small triangular lobe. Nigeria to Kenya, Zaire. ·····3. **H. hanseni**
♀: Subgenital lobe (fig. 64, 64a) submarginally with distinct ventral carina, no dorsal impressed line; anterior margin of ventral pygidial surface (fig. 55) strongly carinate and distinctly convergent cephalad to lateral margin; posterior margin of tergite 10 always straight. (♂ unknown). Nigeria. ·····4. **H. vicinus**

5. ♀: Subgenital lobe ventrally without submarginal carina; pygidium (fig. 61, 62) ventrally with pair of short weak oblique carinae at ends of anterior margin. ♂: Subgenital process (fig. 85, 87) directed to left side in ventral view (i.e. to right side in dorsal view), its superior margin in profile scarcely curved and lying virtually on same plane as that of sternite 9. (*Advectus*-group). ·····10
♀: Subgenital lobe (fig. 65–69) ventrally with distinct submarginal carina; pygidium (fig. 56–60) without such oblique carinae. ♂: Subgenital process (fig. 81–84, 86) directed to right side in ventral view (i.e. to left side in dorsal view), its superior margin in profile and that of sternite 9 lying clearly not on same plane. (*Talpoides*-group). ·····6

6. ♀: Pygidium (fig. 56, 57) ventrally concave mesiad, with anterior margin V-shaped and very weakly pigmented-sclerotized at middle, setae on ventral surface largely or entirely spine-like; submedian foveae of sternite 7 (fig. 65, 66) parallel, or subparallel and weakly converging at both ends. ♂: Subgenital process (fig. 73, 74) in profile with apex strongly deflexed ventrad; anterolateral process of sternite 9 (fig. 81, 84) about 2/5 or 1/3 as long as manubrial bar and broadly rounded at apex. ·····7
♀: Pygidium (fig. 58–60) ventrally deplanate or weakly convex, with anterior margin U-shaped and uniformly strongly pigmented-sclerotized throughout, setae on ventral surface largely fine, only a few spine-like; submedian foveae of sternite 7 (fig. 67–69) straight, converging caudad. ♂: Subgenital process (fig. 75–77) in profile directed caudoventrad; anterolateral process of sternite 9 (fig. 82, 83, 86) only about 1/4 as long as manubrial bar and subacute or narrowly rounded at apex. ·····8

7. ♀: Free portion of subgenital lobe of sternite 7 (fig. 65) semicircular (i.e. length about 1/2 of basal width), about 2 × as wide as lateral lobe and with marginal strip not deflexed ventrad and flap-like; lateral lobe with transverse posterior margin and rectangular pos-

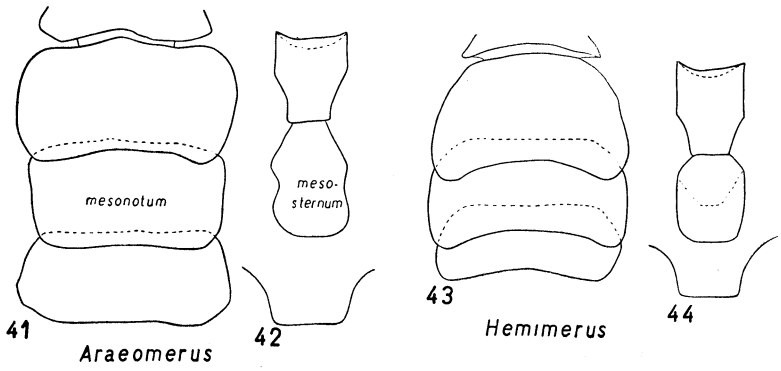


Fig. 41 – 44. *Araeomerus* and *Hemimerus*, type-species, thoraces, dorsal and ventral views; fig. 41 and 42 more highly magnified than 43 and 44.

terolateral angle. ♂: Subgenital process (fig. 81) in ventral view narrowed apicad and with narrowly rounded apex; left 1/2 of posterior marginal strip of sternite 9 in dorsal view evenly narrow. Zaire, Kenya, Tanzania. ·····5. **H. vosseleri**

♀: Free portion of subgenital lobe of sternite 7 (fig. 66) evenly narrowed apicad, scarcely shorter than wide at base, scarcely wider than lateral lobe and with marginal strip distinctly deflexed ventrad and flap-like; lateral lobe with oblique posterior margin and with acute posterolateral angle. ♂: Subgenital process (fig. 84) in ventral view evenly broad and with seemingly truncate apex; left 1/2 of posterior marginal strip of sternite 9 in dorsal view distinctly narrowed mesiad. Mozambique. ·····6. **H. prolixus**

8. ♀: Submarginal carina of subgenital lobe (fig. 68) close to actual margin (hence marginal strip narrow) and mesially convergent to latter; pygidium (fig. 58) sparsely setose on anterior 1/2 of ventral surface. ♂: Both subgenital process and posterior marginal strip of sternite 9 as in *H. sessor* (see below), ventral surface of pygidium (fig. 75) short (i.e. transversely narrow). Portuguese Guinea to Ghana. ·····7. **H. talpoides**

♀: Submarginal carina of subgenital lobe (fig. 67, 69) well apart from and virtually parallel to actual margin (hence marginal strip very broad); pygidium (fig. 59, 60) ventrally either densely setose on anterior 1/2 or rather sparsely so almost on entire surface. ♂: Not in above combination of characters ·····9

9. ♀: Anterolateral process of sternite 7 about 2 × as long as wide; free portion of subgenital lobe (fig. 69) about 1/3 as long as wide. ♂: Subgenital process (fig. 76) in profile narrowed apicad and with superior margin evenly arcuate onto apical margin; marginal strip of sternite 9 (fig. 82) in dorsal view evenly broad at right 1/2 and narrowed mesiad at left 1/2; pygidium (fig. 76) ventromedially fairly long. Togo to Nigeria, Uganda, Kenya. ·····8. **H. sessor**

♀: Anterolateral process of sternite 7 scarcely longer than wide; free portion of subgenital lobe (fig. 67) about 1/2 as long as wide. ♂: Subgenital process (fig. 77) in profile evenly broad and with superior margin distinctly sinuate preapically and subangulate to apical margin which is obliquely weakly arcuate; marginal strip of sternite 9 (fig. 86) in dorsal view slightly narrowed laterad at right 1/2 and evenly narrow at left 1/2; pygidium (fig. 77) ventromedially short. Malawi, Mozambique, Transvaal. ·····9. **H. deceptus**

10. Superior margin of tergite 10 and that of pygidium lying on same plane in profile. ♀: Free portion of subgenital lobe (fig. 71, 71a) about 1/2 as long as wide; lateral lobe of sternite 7 about 1.5 × as long as wide and with distinctly concave lateral margin. ♂:

Marginal strip of sternite 9 (fig. 85) in dorsal view much wider at right 1/2 than at left 1/2. Angola. ·····10. **H. advectus**

Superior margin of tergite 10 and that of pygidium not lying on same plane in profile, latter slightly flexed ventroposteriorly. ♀: Free portion of subgenital lobe (fig. 70, 70a) scarcely shorter than wide; lateral lobe of sternite 7 hardly longer than wide and with nearly straight lateral margin. ♂: Marginal strip of sternite 9 (fig. 87) in dorsal view almost equally wide at right and left 1/2. Tanzania to S Rhodesia. ·····11. **H. bouvieri**

Genus **Araeomerus** Maa, n. g.

TYPE-SPECIES. *Hemimerus morrisi* Hanney, 1963.

DISTRIBUTION. Confined to the E African subregion, at present known only from Tanzania and Malawi, expected to be found in Kenya.

HOSTS. Murid rats of the genus *Beamys* Thomas, 1909, which are endemic to E Africa and are rare in collections.

AFFINITIES. *Araeomerus* is closely related to *Hemimerus*. The structural details of the antennae, the thoracic nota and, in particular, the terminalia as described below and under *Hemimerus* clearly show that these 2 genera are quite distinctive and that the former genus is more generalized than the latter. Coincidentally *Beamys* species (hosts of *Araeomerus*) are generally considered to be more generalized than *Cricetomys* species (hosts of *Hemimerus*). The very low population density of *Araeomerus* on individual hosts (see below) also suggests that the development of parasitism or host dependence in the genus may be less advanced than in *Hemimerus*. The paler integument in *Araeomerus* than in *Hemimerus* may imply that the former genus is more adapted to life in darkness.

The generic name *Araeomerus* is derived from Greek *araios* (lean, narrow) and *merus* (representing *Hemimerus*) and alludes to the slender body. The gender is masculine.

DEFINITION. *Body* slender, with a few setae arranged mainly along posterior margins of sclerites. *Head* about 2/3 as long as wide, in dorsal view weakly produced posterolaterally. Antenna with apex reaching level of anterior margins of coxae 2, segment 2 slightly longer than wide, segments 3 and 4 each about 1 1/2 longer than wide, segments 5 – 10 each slightly widened apicad and about 3× as long as wide. *Thorax* about 1.35× as wide as head, narrowest at mesothorax. Pronotum scarcely wider than metanotum and much wider than mesonotum, widest before midlength; mesonotum almost parallel-sided; metanotum slightly shorter and distinctly wider than mesonotum; lateral explanate areas of thoracic nota narrow, ventrally shallowly concave mesiad. Prosternum unpigmented narrowly along anterior margin, distinctly shorter than mesosternum, of which the middle sections of lateral margins are distinctly concave; metasternum relatively long, with sternal pits situated immediately before midlength. Tibia 2 as long as femur 2, tibia 3 slightly shorter than femur 3. ♀ *Terminalia*: Sternite 7 without submedian foveae, nor well-defined median (subgenital) and lateral lobes, gradulus situated much behind midlength, median lobe posteriorly never with submarginal carina; halves of sternite 9 pigmented and sclerotized throughout. Ventral surface of pygidium with weakly concave anterior margin which is never carinate, nor with a shallow membranous infolded flange. ♂ *Terminalia*: Sternite 9 posteriorly very broadly roundly produced at middle, without a digitiform or spur-like subgenital process. Paraproct partly fused to ventrolateral extension of tergite 10. Right paramere widened and hook-like at extreme apex.

1. **Araeomerus morrisi** (Hanney, 1963), **n. comb.** Fig. 41 – 42, 45 – 49.

Hemimerus morrisi Hanney 1963: 38, fig. 1 – 5, ♀♂.

PREVIOUS RECORD. This species is known so far only from the type-locality, S

Nyasaland [= Malawi]: Zoa, in several food caches in burrows of *Beamys major* (but never found on an actual rat). The type is a ♀ (BMNH).

MATERIAL EXAMINED. 2 adults (1 ♂, 1 ♀) (ANSP), both labeled "*H. morrisi*, paratype, Nyasaland, Feb. 1961." According to the original description of this species, the type-series was composed of 4 ♂, 2 ♀ collected in VI.1961 (not II.1961), and the holotype, allotype and 1 ♂ paratype were deposited in the BMNH and the remaining paratypes (2 ♂, 1 ♀), in the Nyasaland Museum, Blantyre. The authencity of the 2 paratypes in the ANSP is therefore somewhat doubtful.

DISTRIBUTION. S Malawi.

HOST. *Beamys major* Dollman, 1914 which is, according to Hanney (1963), confined to broad-leafed evergreen forests in the Northern Province (Nyika Plateau) and Southern Prov. (Zoa and Mlanje).

AFFINITIES. Closely related to *A. hubbardi* (q.v.). In the original description of this species, only tergite 10, pygidium and sternites 7 (♀) and 9 (♂) were described and figured, and the measurements of the body and thorax were given. The species was considered to be most closely related to *Hemimerus hanseni*, differing in the structure of the ♀ sternite 7 and the ♂ tergite 10 and sternite 9. Obviously because of the lack of actual specimens for comparison Hanney (describer of *morrisi*) did not realize that the differences he noted are of generic importance while Kock (1973) surmised the ♂, and possibly the ♀ as well, of what Hanney described and illustrated were nymphs rather than adults.

DESCRIPTION. The following redescription is based on the 2 paratypes listed above. Adult ♂: Prosternum relatively longer, narrower than in *A. hubbardi;* pleural sutures in ventral view of prothorax evenly diverging cephalad throughout entire length. Tergite 9 with posterior margin rather deeply concave; tergite 10 with anterior sections of lateral margins parallel. Paraproct with long anteromesial lobe. Sternite 9 with slender manubrial bars; its anterolateral process short, broad and apically rounded; left section of posterior margin gently arcuate onto median lobe which is short, ill-defined and lined with heavy spines. Ventral surface of pygidium with anterior (inner) margin laterally convergent to anterior section of lateral (outer) margin whereas posterior margin laterally rounded off into lateral margins. Left paramere more robust than in *hubbardi*.

Adult ♀: Tergite 8 distinctly longer than 9. Pygidium somewhat trapezoidal, shorter (9: 17) than tergite 10 [this ratio is about 2:5 in Hanney's drawing], lateral margin very weakly concave whereas posterior margin very weakly convex; ventral surface convex mesiad, largely bare, anterior 1/3 with some short fine setae, anterior margin very weakly concave. Sternite 7 almost circular in general outline, with short anterolateral process and with pregradular area nearly 3× as long as postgradular area; posterior margin with, in addition to 2 or 3 pairs of heavy setae, very numerous fine cilia which are 2–3× as long as their interspaces [about as long as interspaces in Hanney's drawing]; subgenital lobe poorly developed, with scarcely concave posterior margin. Halves of sternite 8 each with mesial portion slightly curved caudad and with anteromesial portion paler. Halves of sternite 9 darkened, heavily sclerotized along posterior margin. Paraproct about as long as wide, anteriorly widened and forming a long triangular mesial lobe.

Nymphs undescribed.

2. **Araeomerus hubbardi** Maa, new species Fig. 51 – 53.

Hemimerus morrisi (misidentification): Hubbard 1970: 235.

MATERIAL EXAMINED. Holotype adult ♂, paratype nymph ♂ (both in BMNH),

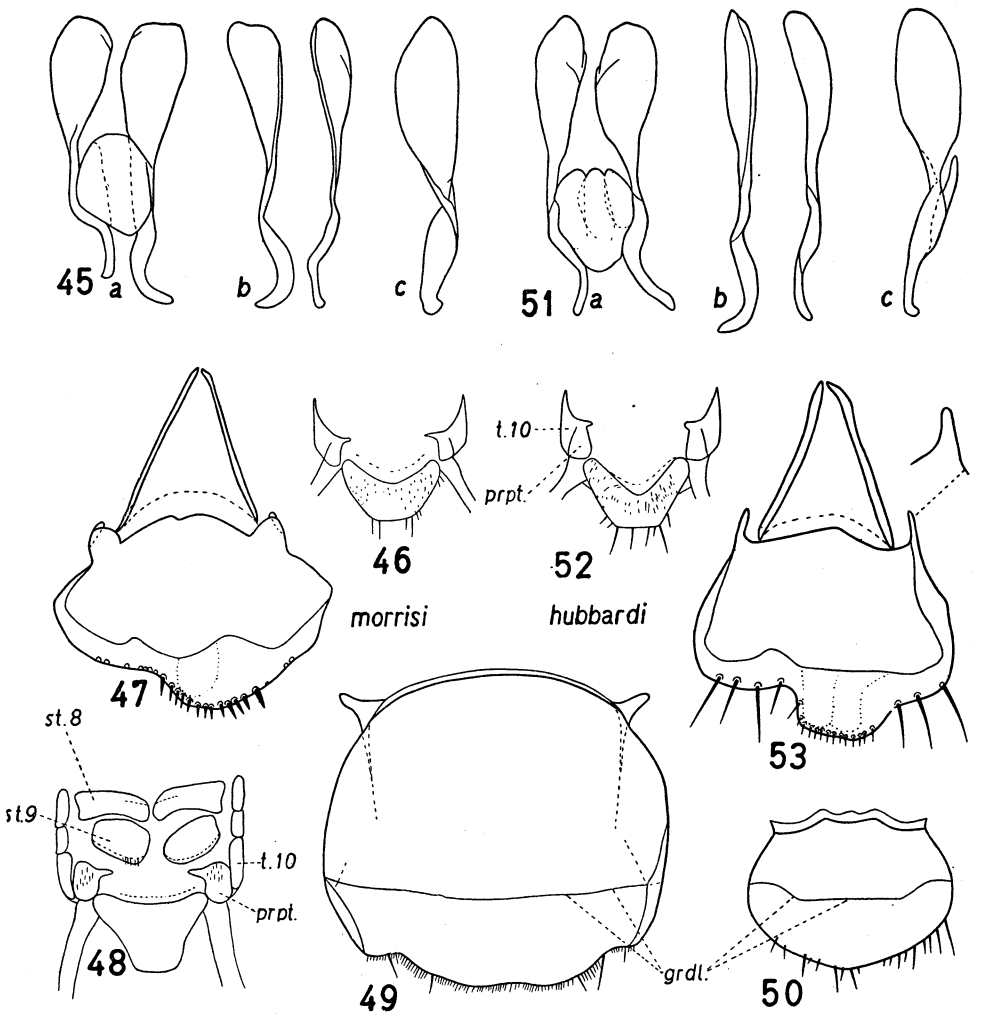


Fig. 45 – 53. *Araeomerus* species (fig. 45 – 49, *morrisi* Hanney, paratypes; 50 – 53, *hubbardi* n. sp.). 45, 51, ♂ genitalia, (a, ventral; b, dorsal; c, right paramere viewed from right side). 46, 52, ♂ terminalia, ventral (sternites 9 removed). 47, 53, ♂ sternites 9, dorsal; top right of fig. 53 showing shape of anterolateral process when flattened. 48, ♀ terminalia, ventral (sternite 7 removed). 49, ♀ sternite 7. 50, sternite 9 of a ♂ nymph (presumably of stadium ii). *grdl*, gradulus; *prpt*, paraproct; *st*, sternite; *t*, tergite.

labeled "TANZANIA: Mamba, 15.I.1966, C. A. Hubbard, B.M. 1972-66", "from ***Beamys hindei***", "***Hemimerus morrisi*** Hanney, det. J. A. Meadow, 1966" and "Beamys. 3122". The first 2 labels are apparently written by BMNH personnel, while the 4th one (in pencil, on thin paper), is by the collector. According to the collector Dr Hubbard (in litt., 25.IV.1972), the nymph was collected on 14.I.1966 with his log number 3122 and the adult, on 15.I.1966, log number 3132; the precise type-locality is Saseni River Bridge, ca 1830 m, S Pare Mts, between Sugi and Mamba and between the Tanga-Moshi railroad

track and highway, S of Same, and is 160 km or less from Kenya: Taveta Forest, i.e. the type-locality of *B. hindei*; 10 other *Beamys* were taken at the same locality but without earwigs; altogether he collected 15 *Beamys* in Tanzania and from these, over 100 of this interesting rat have been raised in the U. S. A.

DISTRIBUTION. NE Tanzania.

HOST. *Beamys hindei* Thomas, 1909 which was previously known only from Kenya.

AFFINITIES. This species is closely related to *A. morrisi*. Basing on morphology of the adult ♂, *A. hubbardi* is probably more specialized, particularly in the curvature of the posterior margin of sternite 9, and in the shape of the paraproct. It is interesting that *A. hubbardi* is smaller than *A. morrisi* and coincidentally their respective hosts, *B. hindei* and *B. major*, show a similar difference in body size.

DESCRIPTION. Adult ♂. Length of body 9.5 mm, thoracic dorsum 2.9 mm; width of pronotum 2.2 mm. Prosternum relatively shorter, wider than in *morrisi*. Pleural sutures, in ventral view of prothorax, with anterior sections weakly diverging cephalad and with posterior sections parallel. Tergite 9 with shallowly concave posterior margin; tergite 10 with anterior sections of lateral margins weakly converging cephalad. Paraproct with short anteromedial lobe. Sternite 9 with stout manubrial bars; its anterolateral process long, slender, apically subacute (narrowly rounded in flattened specimen); left section of posterior margin subangulate to median lobe which is long, rather well-defined and lined with fine spines. Ventral surface of pygidium with anterior (inner) margin subparallel to anterior section of lateral margin, and with posterior margin laterally subangulate to lateral margins. Left paramere more slender than in *morrisi*; further details of genitalia as in fig. 51. Other characters similar to those of *morrisi* as described by Hanney and supplemented above.

Adult ♀ unknown.

Nymph ♂ (probably of stadium ii). Tergite 10 with evenly convex posterior margin. Pygidium strongly narrowed apicad, in dorsal view about 1/2 as long as wide at base, lateral margins running arcuately onto posterior margin, not subangulate to latter; ventral surface slightly more than 1/2 as long as wide at base, with fine sparse setae, posterior margin lined with 4 or 5 short, moderately heavy setae. Sternite 7 with posterior margin parallel to that of sternite 8; sternite 9 as figured. Body about 5.5 mm long, 1.7 mm wide; thoracic dorsum 2.2 mm long.

Genus **Hemimerus** Walker, 1871: 2

TYPE-SPECIES. *Hemimerus talpoides* Wk., 1871.

DISTRIBUTION. Same as for the suborder. Confined to and widespread in the W and E African subregions.

HOSTS. Murid rats of the genus *Cricetomys* Waterhouse, 1840 which are endemic to the W and E African subregions, north to the Sudan, west to Gambia, east to Kenya and Zanzibar, south to Zululand.

AFFINITIES. These are discussed under *Araeomerus* and are not repeated here. The generic name is derived from Greek *hemisys* (half) and *meros, meris* (part, portion) and probably refers to the peculiar tibiotarsal articulation.

DEFINITION. The latest and most comprehensive definition of the genus was given by Rehn & Rehn (1936). A few discrepancies therein contained may be noted. The pronotum was said to be about 2× as long as broad, this should be about 2× as wide as long, or about 1/2 as long as wide; the posterior margin of the metanotum was said to be more weakly concave than those of the pro- and mesonota, but in fact, the concave

curvatures in the meso- and metanota are almost similar and are stronger than in the pronotum. The prosternum (fig. 44), actually about as long as the mesosternum, was said to be the longest of all thoracic sterna, but most probably the Rehns mistook the posterior ventral cervical sclerite as a part of the prosternum. Many of the characters enumerated by the Rehns for *Hemimerus* are shared by the then unknown genus *Araeomerus*. A revised definition, in comparison with the latter genus, is given below.

Body fairly robust, with rather numerous setae arranged mainly along posterior margins of sclerites. *Head* about 1/2 as long as wide, in dorsal view strongly produced posterolaterally. Antenna with apex reaching level of anterior margins of coxae 1, segment 2 about 3× as long as wide, segments 3 and 4 squarish, segments 5 – 10 each about 2× as long as wide and each not widened apicad. *Thorax* about 1.47× as wide as head, narrowest at metathorax. Pronotum distinctly wider than metanotum and scarcely narrower than mesonotum, widest behind middle; mesonotum with convex lateral margins, not parallel-sided; metanotum distinctly shorter and narrower than mesonotum; lateral explanate areas of nota broad, ventrally deeply concave mesiad. Prosternum pigmented throughout, about as long as mesosternum, of which the middle sections of lateral margins are virtually straight; metasternum relatively short, with sternal pits situated at anterior 1/3. Tibiae 2 and 3 distinctly longer than their corresponding femora. ♀ *Terminalia:* Sternite 7 with submedian foveae and well-defined median (subgenital) and lateral lobes, gradulus situated near midlength, median lobe posteriorly often with submarginal carina; halves of sternite 9 largely unpigmented and submembranous. Ventral surface of pygidium with strongly concave anterior margin which is often carinate and/or with a shallow membranous infolded flange. ♂ *Terminalia:* Sternite 9 triangularly produced at middle into a digitiform or spur-like subgenital process. Paraproct well separated from ventrolateral extension of tergite 10. Right paramere conical, not hook-like at extreme apex.

SPECIFIC CHARACTERS. The members of the genus are so similar to each other in size, color and most structures that very few characters prove to be helpful to their separation. Carpenter (1909) employed the shape of the thoracic sterna and of the pygidium, width of the abdomen, and the relative length of the terminal tarsomeres for distinguishing *H. talpoides* from *H. hanseni* while Chopard (1934a, 1935) found the relative length-width of the apical antennal segments and the shape of the terminalia useful for discriminating *H. talpoides* and *H. chevalieri*. Rehn & Rehn (1936) strongly criticized those earlier authors. They stressed that the only structures of diagnostic importance for the *Hemimerus* species were the terminalia in both sexes and that the method of preservation of material, whether dry or in alcohol, was largely responsible for the supposed specific characters in other parts of the body. The Rehns seem to have over-relied on undissected adult specimens and in certain respects, on excessive details of several rather variable characters. This probably explains why they should have partly misidentified *vosseleri* as *hanseni* and *sessor* (see listing of specimens under *vosseleri*) and why A. B. Gurney misidentified *sessor* as *vosseleri* (see listing of specimens under *sessor*). To adequately define the various species, we found it is essential to dissect and examine some concealed but diagnostically important structures and to incorporate the adult with the nymphal characters. The new descriptive terms introduced in this paper and labeled in fig. 65, 70 and 71 need little explanation. Some of them are, for simplicity and uniformity, modified from those suggested by the Rehns, as follows: of the ♀ sternite 7, marginal strip = interspace between actual margin and "submarginal sulciform impression" (note: for the marginal strip in ♂, see fig. 80–87); subgenital lobe = "median production", submedian foveae = "proximolateral sulciform impressions"; and of the ♂ sternite 9, subgenital process = "production." Comments on some of the characters used by the Rehns, together with some other notes, are given below.

The Rehns extensively used relative measurements for describing structures but we strongly doubt the accuracy and meaningfulness of certain measurements they presented. For example, in *vicinus* ♀, tergite 10 was said to have "greatest *visible length* equal to approximately one-third the greatest *visible* (proximal) *width*, or equal to slightly more than one-half of *caudal width*; lateral portions of distal margin gradually arcuato-convergent distad to a *point* where the distance between them is slighly less than twice the greatest length of the tergite; median portion of this margin .... evenly arcuate" [*italics* ours]. The above description is evidently based on an undissected specimen of which the anterior part of tergite 10 was overlapped by tergite 9. Even by referring to the Rehns' drawing, we are still quite uncertain what the "visible length" and "visible width" mean, how the "caudal width" was measured and where the turning "point" is between the lateral and median portions of the distal margin.

The Rehns described the curvature of margins of tergites and sternites in excessive detail and by employing complicated terms (such as subarcuato-truncate, subobtusely arcuate, subobtusely angulate). They nevertheless remarked that the curvature might show considerable individual variation (p. 479) and might be misleading in improperly prepared/

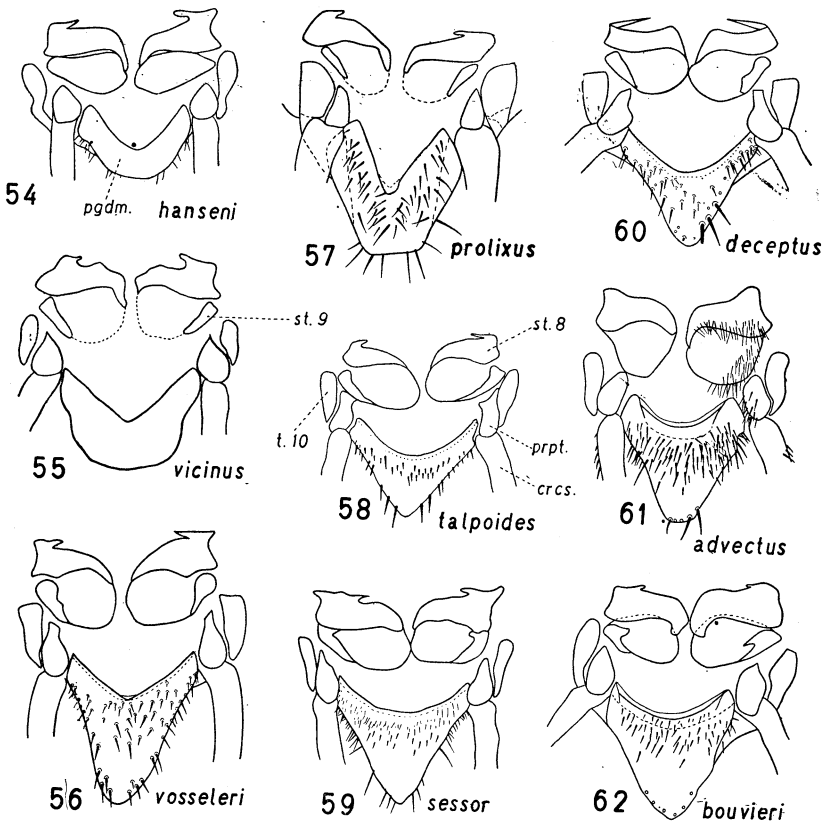


Fig. 54 – 62. *Hemimerus* species, ♀ terminalia, ventral (sternites 7 removed). Except in fig. 61, setae on sternites 8 and 9, paraproct and cerci omitted. Fig. 57 was based on a shrivelled specimen. *crcs* cercus; *pgdm*, pygidium; *prpt*, paraproct; *st*, sternite; *t*, tergite.

preserved specimens (p. 482 & 490, footnotes). In fact the same margin of the same specimen may have a different curvature when viewed from different directions. Furthermore, while the marginal strip of the ♀ subgenital lobe varies with different species in the relative width, the free margin of this lobe in a given species may, as a consequence of mating, be worn away, and the relative width in such specimens may show marked differences from that with a perfect free margin.

The extent, depth, width, color and splitting of the submedian foveae (="proximolateral sulciform impressions") of the ♀ sternite 7 were also described in detail by the Rehns for the various *Hemimerus* species. In fact the difference in these respects is significant only in the right vs left fovea rather than in one vs another species. The Rehns often described one or both foveae in a given species as extending to the "evident" or "exposed" base of the sternite. In all species except *talpoides*, both foveae extend basad almost to the gradulus. The right fovea differs from the left one in being always deeper, wider, generally darker and with a thinner bottom wall, and apparently as a result of mating with the ♂, often splitting at its posterior section (the left fovea does not split). Both foveae, particularly the left one, may become inconspicuous in cleared specimens. This probably explains why Deoras (1941b) found the right and left foveae in his *ovatus* [=*vosseleri*] showing no apparent difference.

For most species, the Rehns described the presence of some heavy "chaetae" on the ♀ pygidial margins or surface. The setae on the free margin of the pygidium in both sexes do not show significant interspecific differences. Those on the ventral surface of the ♀ pygidium are of diagnostic importance and may be arbitrarily classified into 3 kinds: (a) spine-like setae, about as heavy as those on posterior margins (lateral sections) of neighboring tergites, found in all species except *hanseni* and *vicinus*; (b) dark fine setae, found in all species except *hanseni*, *vicinus* and *vosseleri*; (c) pale, very fine and short, soft hairs, found only in *hanseni* and *vicinus*.

Under each species, the Rehns described and sometimes tabulated the individual variation regarding (a) the length/width of the entire body and thorax, (b) the relative length/width of antennal segments, (c) the relative convexity/concavity of the ♀ ventral pygidial surface, (d) the curvature of posterior margins of terminal sclerites, (e) the apical direction of the ♂ subgenital process, (f) the profile outline of the ♀ pygidium, ♀ subgenital lobe and ♂ subgenital process, (g) the number of setae on the ventral surface and lateral margins of the ♀ pygidium. To the first 4 points, we may add the following. (a) The length of the body and thorax may be affected by the telescoping of the segments and the width of the same may be affected by the decurving of the lateral thoracic ampliation in the specimens measured; there is little interspecific difference in these measurements and within a species, the body is generally a little longer/wider in the ♀ than in the ♂, and in the flattened or alcohol-preserved than in dry specimens. (b) The antennal segments do show constant interspecific differences in the relative length/width if the intersegmental membranes are not included in the measurements; however, this difference is too slight to be considered a good or useful diagnostic character. (c) The convexity /concavity of the ♀ ventral pygidial surface may vary with the state of preservation of the specimens involved. In short, while the above-mentioned characters are more or less diagnostic, they may either be intraspecifically variable or show only slight interspecific difference. They are best observed in consistently the same direction from properly preserved/prepared specimens. The discrepancy in some of the Rehns' illustrations is evidently because they

were based on specimens placed on different planes. For instance, the posterior pygidial margin in the allotype ♂ of *sessor* was described as "weakly rounded" (1937: 334) and was shown to be so in the dorsal view (1937: fig. 1); the same margin was shown to be virtually straight in ventral view (1937: fig. 2). In their (1936) fig. 42 – 47, the parameres are seemingly quite distinctive in the relative width of basal portions and the relative curvature and acuteness of apices. As shown in our figures accompanying this paper, the interspecific differences in the ♂ genitalia are very slight. This is also true for the posterior marginal strip of the ♂ sternite 9 in the caudal view. The differences in this strip become very evident only when the sternite is dissected out, placed on a horizontal plane (with the ventral surface of the sternite facing downward) and viewed from above. This is due to the fact that the different length and erectness of the subgenital process in the various species may, in this way, result in a different slope of the entire sternite.

Generally the most important specific characters in the genus are in the ultimate visible sternite of both sexes and the pygidium of the ♀, which should be examined in the entirety, and not only the exposed portions. The males are without exception less distinctive than the females, and the nymphs are less distinctive than the adults. Without the association with later stadia (iii, iv) and/or adults, or without a direct comparison with verified specimens, the nymphs of stadia i and ii cannot positively be determined to species. Therefore only those of *hanseni* are herein described and illustrated.

SPECIES-GROUPS. Rehn & Rehn (1936) recognized 4 species-groups for the genus. They considered the most generalized one to be the *hanseni*-group and that from this group or closely related forms there had evolved 2 branches, the 1st included the *vicinus*- and *talpoides*-groups while the 2nd was solely represented by the *advectus*-group. The last of these groups was thought to have apparently been derived from a more ancestral stock than the present-day *hanseni*-group, to have pursued its own line of development and to have little in common with most of the remaining *Hemimerus* species. For simplicity, only 3 species-groups are herein accepted, and the *vicinus*-group is incorporated into the *hanseni*-group particularly because the females of these 2 groups share with each other all essential characters except the presence/absence of the ventral submarginal carina on sternite 7 and because the ♂ provides much fewer characters than does the ♀ (the ♂ of *vicinus* is unknown). Should the *vicinus*-group be kept independent, it seems necessary either to enlarge it for the inclusion of *vosseleri* and *prolixus* or to erect a 5th group solely for the 2 latter species (cf. discussion under *vicinus*). We agree with the Rehns that the *talpoides*- and *advectus*-groups have evolved side by side from the neighborhood of the *hanseni*-group, but we cannot agree that the *advectus*-group has little in common with other *Hemimerus* species. The *advectus*-group is, in the ♀ sex, similar to the *talpoides*-group in the relative size of the paraprocts and the locking mechanism of the abdominal apex, while in the ♂ sex, it is similar to the *hanseni*-group in the dextral direction of the median process of sternite 9. For brevity, characters of species-groups are not repeated in descriptions of the species included therein.

Hanseni-Group

Adult. Prosternum slightly longer than wide (ca 28: 25). Femur 3 in profile relatively short and wide; tibia 2 with numerous strong setae covering apical 1/3 of dorsal surface. ♀ Terminalia: Tergite 10 posteriorly truncate or weakly convexly curved, sometimes produced at middle into a small inconspicuous triangular lobe; lateral surface with distinct transverse groove shortly before cercal

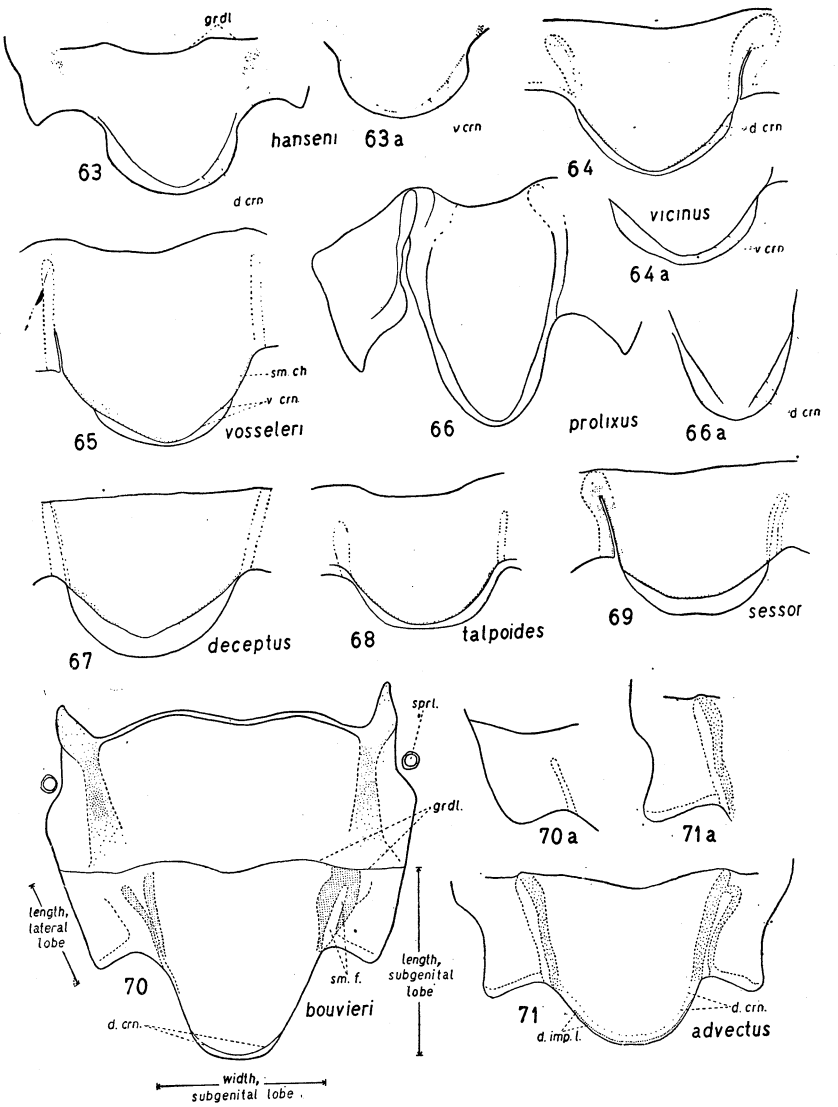


Fig. 63 – 71. *Hemimerus* species, ♀ sternites 7, dorsal (63, 64, 66a, 70, 71) and ventral (63a, 64a, 65 – 69). Fig. 70a and 71a showing shape of left lateral lobes when flattened; 70 showing the method used in measuring lateral and subgenital lobes. *d.crn.*, dorsal carina; *d.imp.l.*, dorsal impressed line; *grdl*, gradulus; *sm.ch.*, submarginal channel; *sm.f.*, submedian fovea; *sprl*, spiracle; *v.crn.*, ventral carina.

base. Pygidium exceedingly short, dorsal surface medially only about 1/2 as long as wide at apex; ventral surface virtually bare, concave mesiad, its anterior (inner) margin deeply V-shaped, mesial section of that margin either reflexed or not, always with infolded membranous flange. Subgenital lobe dorsally with weak submarginal carina and ventrally with either a faint submarginal impressed line (in *hanseni*), or a strong submarginal carina (in *vicinus*). Halves of sternite 9 each al-

most 1/2 as long as wide. Paraproct either hardly longer than wide or as long as wide. ♂ Terminalia (in *hanseni* only, that of *vicinus* unknown): Posterior margin of tergite 10 with small triangular lobe at middle. Pygidium very short. Subgenital process short, with prominent angulate "shoulder" in profile, with apex strongly deflexed and in ventral view directed mainly to right side although extreme apex directed slightly to left side.

This group is evidently the most generalized of the genus and includes but 2 species, *H. hanseni* Shp. and *H. vicinus* R. & R.

3. **Hemimerus hanseni** Sharp, 1895 Fig. 54, 63, 72, 80, 90, 98.

Hemimerus talpoides (misidentification): Hansen 1894: 65, pl. 2, 3, ♀♂.
Hemimerus hanseni Sharp 1895: 218, fig. 114 – 116. — Rehn & Rehn 1936: 475, fig. 1, 9, 10, 18, 24, 30, 36, 42, ♀♂; 1937: 332.

PREVIOUS RECORDS. The lectotype ♀ (København Mus.) is from the "Cameroons" collected by Y. Sjöstedt in 1891. The more precise type-locality is either Kitta (Cameroons) or Rio del Rey (Old Calabar District, i.e. in the extreme SE part of the present-day Nigeria). This species was heretofore known from Nigeria (Rio del Rey), Cameroons (Batanga, Buea, Lolodorf, Victoria Lake[9]), Zaire (Burunga, Ile Bertha, Ituri, Kotili, Lulenga, Mambaka, Mayumbe, Pilipili, Uele), Uganda (Entebbe, Jinja, Kampala, Mt Elgon) and Kenya (Kaimosi, Mt Elgon). The hosts recorded are *C. emini emini*, *C. emini proparator*, *C. gambianus* and *C. gambianus elgonis*. For details, see Bequaert (1930: 824), Carpenter (1909: 256), Chopard (1934b: 120, 1935: 444), Jordan (1909b: 327, as *H. talpoides*), Hansen (1894: 65, as *H. talpoides*), Kock (1973: 7), Meijere (1920: lxiii), Rehn (1924: 352), Rehn & Rehn (1936: 475, 1937: 332), Schouteden (1919: 36, as *H. talpoides*). The record from "Uganda" by Delany & Neal (1966: 354, as *H. talpoides*) pertains to either *H. hanseni* or *H. sessor*.

MATERIAL EXAMINED. 88 adults (31 ♂, 57 ♀), 99 nymphs (43 i, 9 ii ♂, 20 ii ♀, 5 iii ♂, 9 iii ♀, 9 iv ♂, 4 iv ♀).

CAMEROONS: Buenga im Molime-Gebiete, XII.1907, E. Conrad (ZMB); D'Ja Posten (3°15'N, 13°30'E), VII.1936, F. G. Merfield (BMNH 1936-654); O. Sanga Uham, Buala, 1200 m, I.1914, Dr Elbert (ZMB); Sasse nr Buea, Mt Cameroon, 1100 m, II.1951, S. Tita (CAS); Sasse, Sappo, III.1952, S. Tita (CAS); Yaoundé, ex *C. gambianus*, III. 1952, J. Rageau (MCZ).

SPANISH GUINEA: Hinterland Alen, VII.1906–I.1907, Jessmann (ZMB).

CENTRAL AFRICA: Kissenji, XI.1908, v. Hegmann (ZMB).

ZAIRE: Burungo, nr Lake Kivu, ex *C. gambianus*, III.1927, J. Bequaert (MCZ).

UGANDA: Bwamba, Bundibugyo, ex *C. gambianus proparator*, XI.1938, A. Loveridge (MCZ); Bwanda, Hakitengya, IX.1951, R. C. Percy (BMNH 1952-434); Entebbe, ex *C. gambianus*, IX.1960, F. Zumpt (BMNH 1961-138); Mabira (? Matura) Forest, ex *C. gambianus*, XI.1938, A. Loveridge (MCZ).

KENYA: Kirai, S Mt Elgon, ex *C. gambianus elgonis*, I.1934, A. Loveridge (MCZ); 30 km SW, Kitale, ex *C. gambianus*, VII.1963, R. E. Mumford (NAW); Nyanza Prov., Kaimosi, ex *C. gambianus elgonis*, II.1934, A. Loveridge (MCZ).

DISTRIBUTION. Nigeria, Cameroons, Spanish Guinea, Zaire, Central Africa, Uganda, Kenya. This is one of the most widespread species of the genus, and much of its distri-

[9] Not to be confused with the Lake Victoria (which is very large) in E Africa.

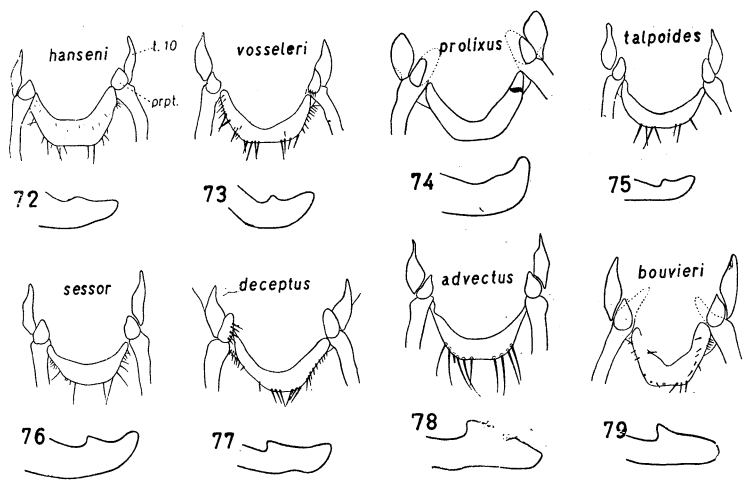


Fig 72 – 79. *Hemimerus* species, ♂ terminalia, ventral (sternites 9 removed), and subgenital processes, viewed from right side. Fig. 79 drawn from a shrivelled specimen. *prpt*, paraproct; *t*, tergite.

butional range overlaps that of *H. sessor*. The westernmost record was from extreme SE Nigeria (Rio del Rey, Old Calabar); the easternmost, extreme W Kenya (Mt Elgon area); the northernmost, extreme SE Nigeria and extreme N Zaire (Uele R.); the southernmost, extreme E Zaire (Maniema District).

HOSTS. *"C. e. emini, C. gambianus, C. g. elgonis."* The *"C. emini"* as recorded by Rehn & Rehn (1936) from Kenya: Kaimosi is a misidentification for *C. g. elgonis* (see Rehn & Rehn 1937) and the *"C. g. proparator"* as recorded by Rehn & Rehn (1937) from Uganda is a synonym of *C. e. emini* (see Kock 1973). Kock (1973) believed *hanseni* and *sessor* to be sympatric on *C. g. elgonis* in the Mt Elgon area.

AFFINITIES. This species is a typical member of the *hanseni*-group (as hereby redefined) and is obviously the most generalized one within the entire genus. In Rehn & Rehn's (1936) key to *Hemimerus* species, the ♀ of *H. hanseni* was compared with that of *vicinus* and the ♂, with that of *bouvieri*; and in Hanney's (1963) description of *Araeomerus morrisi*, the closest relative of that species was said to be *hanseni*. In fact *hanseni* is rather isolated and is unique in the genus in having, in the ♀ sex, a medially very short and ventrally narrowly V-shaped pygidium and in the ♂, a short, vomeriform and weakly dextrally directed subgenital process. This species is similar, in the ♀, to *vicinus* in having a distinct transverse groove on the lateral surface (or lateral extension) of the posteriorly truncate tergite 10, a virtually bare ventral pygidial surface and a pair of very short paraprocts. To *vosseleri* of the *talpoides*-group, *hanseni* is similar in the ventrally concave ♀ pygidium and in the strongly deflexed ♂ subgenital process. The species is also similar to members of the *advectus*-group in the presence of a dorsal (but not ventral) submarginal carina on the ♀ subgenital lobe and in the dextral direction of the ♂ subgenital process. In the Rehns' fig. 10, which shows the ventral view of the abdominal apex of a ♀ from the Cameroons: Lolodorf, the posterior margin of tergite 10 was drawn as if evenly weakly arcuate onto the lateral margins, and the pygidium evenly strongly arcuate, also onto the lateral margins. In these respects, this

figure differs markedly from those 2 authors' fig. 9 and was obviously based on an apically decurved pinned specimen and cannot be taken as representing individual variation.

DESCRIPTION. Adult ♀. Tergite 10 medially 3× as long (15: 5) as pygidium, its lateral margins in dorsal or ventral view parallel, posterior margin very broadly rounded, often produced at middle into a small inconspicuous triangular lobe. Pygidium strongly narrowed apicad, lateral margin oblique, straight or very weakly concave, posterior margin very weakly convex; dorsal surface generally with pair of weak roundish swellings near anterior margin; ventral surface with a few pale fine short hairs on anterolateral corners, anterior margin virtually parallel to lateral margins, not reflexed but its lateral sections each with infolded membranous flange. Sternite 7 with short anterolateral processes; pregradular area shorter (18: 24) than postgradular area; submedian foveae long, diverging cephalad; lateral lobe about as long as wide. Free portion of subgenital lobe semicircular, dorsally with very weak submarginal carina and ventrally with hardly perceptible submarginal impressed line which is formed by a series of minute punctures each bearing a pale, very fine and short hair, is weakly convergent mesiad to actual margin and is parallel to and situated slightly behind dorsal submarginal carina. Body about 3.4 – 3.8 mm wide.

Adult ♂. Pygidium about 1/3 as long as tergite 10, relatively wider than in ♀; ventral surface very weakly concave mesiad, with fine sparse setae. Sternite 9 with slender anterolateral processes and manubrial bars; posterior marginal strip in dorsal view with right 1/2 gently and left 1/2 very strongly narrowed mesiad. Genitalia as figured. Body about 3.3 – 3.6 mm wide.

Nymph iv ♀. Tergite 10 with posterior margin slightly angulately produced at middle. Pygidium short, apex subtruncate, comparatively wider than in *vicinus*; ventral surface with very fine setae, with anterior margin deeply concave. Sternite 7 about 2.6× as long as sternite 8; subgenital lobe short, strongly narrowed posteriorly; sternite 8 with posterior margin weakly angulately incised at middle; sternite 9 slightly shorter than 8, posterior margin shallowly incised at middle. Body about 3.0 – 3.2 mm wide.

Nymph iv ♂. Tergite 10 with posterior margin slightly produced at middle. Pygidium trapezoidal, posteriorly subtruncate. Median process of sternite 9 distinctly directed to right side. Body about 2.8 – 3.0 mm wide.

Nymph iii ♀. Pygidium broadly rounded posteriorly. Sternite 9 with posterior margin distinctly incised at middle. Body about 2.5 – 2.7 mm wide.

Nymph iii ♂. Pygidium similar to that in ♀. Body about 2.5 mm wide.

Nymph ii. Body about 2.1 –2.3 mm wide in ♀, 2.0 –2.1 mm in ♂.

Nymph i. Body about 1.8 – 1.9 mm wide.

The accompanying drawings for this widespread species are based on specimens from Kenya: Kiroi (fig. 63) and from the Cameroons: Buenga (remaining figures).

4. **Hemimerus vicinus** Rehn & Rehn, 1936 Fig. 55, 64, 99.

Hemimerus vicinus Rehn & Rehn 1936: 481, fig. 2, 11, 19, ♀; 1937: 333.

PREVIOUS RECORD. This species was solely known from the ♀ sex and from Nigeria: Lagos Distr., Ife, ex *C. emini*. The type is in the USNM.

MATERIAL EXAMINED. 1 adult (♀), 5 nymphs (3 i, 1 ii ♀, 1 iv ♀).

NIGERIA: Western Region, Ife, ex *C. emini* (#439), X.1926, A. S. Pearse (USNM, det. Rehn & Rehn). Western Reg., 6 km S Ilashe, ex *C. emini* (#435), XI.1966, J. C. Geest (USNM). Ilashe is only a few km NE of Ife, the type-locality of *vicinus*.

DISTRIBUTION. W Nigeria (Ife, Ilashe).

HOST. *C. emini* is the only recorded host.

AFFINITIES. Contrary to the connotation of its name *vicinus* (Latin, near, neigh-

Table 3. Comparison of *Hemimerus vicinus* and relatives, ♀

	hanseni	*vicinus*	*vosseleri*	*prolixus*
Tergite 10, posterior margin	nearly straight	straight	convex	convex
Tergite 10, lateral surface, transverse groove	strong	moderately strong	at most weakly perceptible	undefinable
Pygidium, apex	broad, very blunt	broad, very blunt	narrow, subacute	broad, very blunt
Pygidium, ventral surface, median line	very short	rather short	long	short
Pygidium, ventral surface, anterior margin	continuous at middle, parallel to lateral margins	continuous at middle, not parallel to lateral margins	seemingly interrupted at middle, not parallel to lateral margins	seemingly interrupted at middle, not parallel to lateral margins
Pygidium, ventral surface, setae	all exceedingly fine	all exceedingly fine	mostly spine-like	all spine-like
Sternite 7, anterolateral process	short, wide	short, wide	long, narrow	long, narrow
Sternite 7, lateral lobe	as long as wide, 1/2 as wide as subgenital lobe, truncate posteriorly	shorter than wide, 1/2 as wide as subgenital lobe, truncate posteriorly	as long as wide, 1/2 as wide as subgenital lobe, truncate posteriorly	as long as wide, not narrower than subgenital lobe, produced posterolaterally
Sternite 7, postgradular area	long	short	long	long
Sternite 7, submedian foveae	diverging anteriorly	diverging anteriorly	parallel	subparallel, converging at both ends
Subgenital lobe, submarginal carinae	dorsal and ventral, latter very weak	ventral, no dorsal	ventral, no dorsal	dorsal and ventral, latter very weak
Paraproct	short	short	long	long

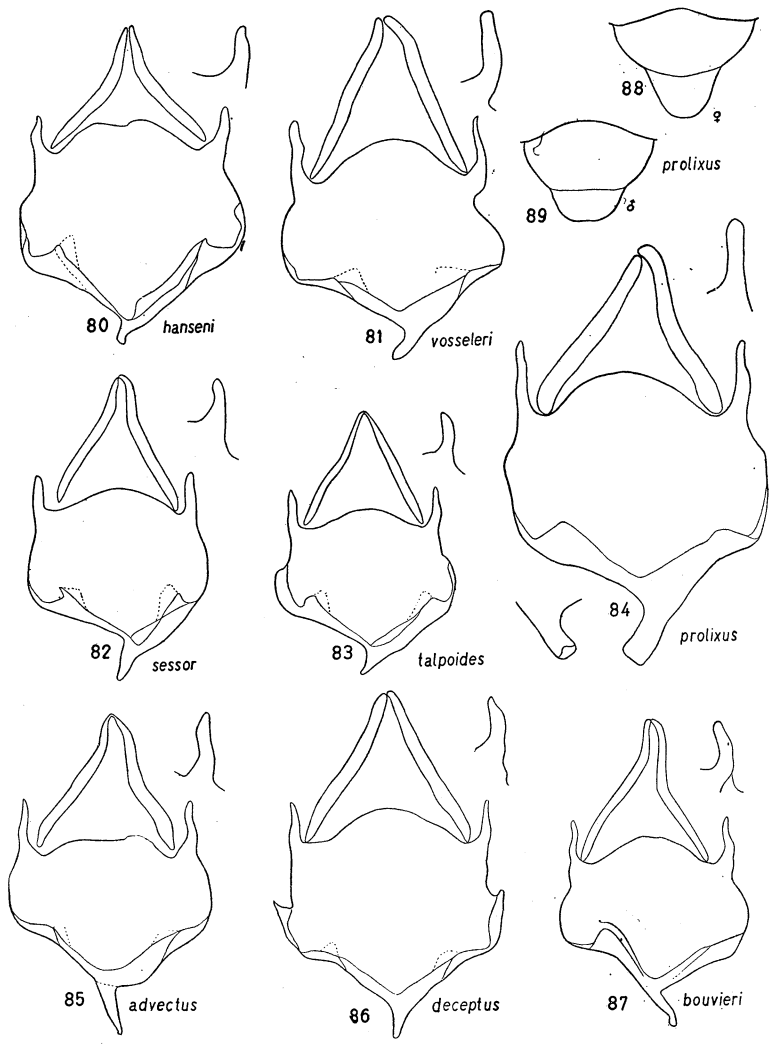


Fig. 80 – 89. *Hemimerus* species, ♂ sternites 9 and ♂ ♀ abdominal apices. 80 – 87, ♂ sternites 9, ventral; top right of each figure showing shape of anterolateral process when flattened; bottom left of fig. 84 showing subgenital process in dorsal view. 88, ***prolixus*** n. sp., ♀ abdominal apex, dorsal; 89, same, ♂ abdominal apex, dorsal. Note: Sternite 9, particularly its posterior marginal strip, is to be compared only after it is dissected out and placed on a horizontal plane, cf. p. 350.

boring),[10] this species is rather isolated within the genus and is, insofar as the adult ♀ is concerned, obviously an intermediate between typical members of the ***hanseni***- and ***talpoides***-groups. A comparison of females of related species is given in Table 3 from which it is clear than ***vicinus*** is closer to ***hanseni*** than to ***vosseleri*** and ***prolixus***. In brief, tergite

[10] Perhaps the Rehns referred the name ***vicinus*** to the close relationship of this earwig and its host.

10 and the pygidium in *vicinus* strongly resemble those of *hanseni*, while sternite 7 resembles, in certain respects, this structure in *vosseleri* and *prolixus*. The ♂ of *vicinus*, when discovered, will most probably show the same tendency. The original description of this species was based on the unique type ♀, which was on a slide-mount and was somewhat flattened. Consequently the posterior margin of tergite 10 was described and illustrated as "slightly notched, evenly arcuate" at its median section while the greatest median length of the pygidium was given as "equal to approximately three-fifths of apical width, or one-third of greatest visible (proximal) width."

DESCRIPTION. Adult ♀. Tergite 10 parallel-sided, medially 1.8× as long (16: 9) as pygidium, truncate posteriorly, transverse groove on lateral surface slightly weaker than in *hanseni*. Pygidium moderately narrowed apicad, lateral margin very weakly concave, posterior margin very weakly convex, dorsal surface, as in *hanseni*, with pair of weak roundish swellings near anterior margin; ventral surface more ample than in *hanseni*, with a few pale fine short soft hairs on anterolateral corners; anterior margin infolded to form a membranous flange, and with median section strongly reflexed (hence thereby forming a distinct submarginal fovea) while lateral sections distinctly divergent caudad to lateral margins. Sternite 7 with short wide anterolateral processes; pregradular area longer (23: 20) than postgradular area; submedian foveae long, diverging cephalad; lateral lobe shorter than wide. Free portion of subgenital lobe semicircular, dorsally with a weak and ventrally with a strong submarginal carina, latter carina close and parallel to submarginal channel whereas marginal strip slightly widened anterolaterad. Body about 3.7 mm wide.

Adult ♂ unknown.

Nymph iv ♀. Tergite 10 with almost straight posterior margin. Pygidium short, apex subtruncate and narrower than in *hanseni*, ventral surface with fine setae and deeply concave anterior margin. Sternite 7 about 3× as long as sternite 8; subgenital lobe fairly long, strongly narrowed apicad. Sternite 8 with evenly concave posterior margin. Sternite 9 much longer than 8, with posterior margin scarcely incised at middle. Body about 3.1 mm wide.

Talpoides-Group

Adult. Prosternum distinctly longer than wide (ca 31: 25). Femur 3 in profile moderately long and narrow in proportion; tibia 2 with numerous strong setae covering about apical 2/5 of dorsal surface. ♀ Terminalia: Tergite 10 triangularly produced posteriorly, lateral surface without transverse groove (frequently with very vague indication of such a groove in *vosseleri*). Pygidium fairly long; dorsal surface generally about as long as wide; ventral surface setose, either concave mesiad, or deplanate (or even very weakly convex), its anterior margin infolded to form a membranous flange, and convergent anteriorly to lateral margins (never parallel to latter), either evenly arcuate and uniformly pigmented-sclerotized throughout, or (in *vosseleri* and *prolixus*) abruptly subangulate and weakly pigmented-sclerotized at middle section. Subgenital lobe with distinct (weak in *prolixus*) submarginal channel and ventral submarginal carina, and except in *prolixus*, with no dorsal submarginal carina. Halves of sternite 9 each slightly shorter than wide. Paraproct generally about 2× as long as wide. ♂ Terminalia: Posterior margin of tergite 10 weakly concave or nearly straight. Pygidium moderately short. Subgenital process long, generally with weakly produced "shoulder" in profile, distinctly directed to left side (sinistrad) in dorsal view, apex either strongly (in *vosseleri* and *prolixus*) or slightly deflexed ventrad.

This group includes 5 species, *H. vosseleri* R. & R., *prolixus* n. sp., *talpoides* Wk., *sessor* R. & R. and *deceptus* R. & R. The first 2 of these species are somewhat atypical in certain respects (Table 3) and approach the *hanseni*-group.

5. **Hemimerus vosseleri** Rehn & Rehn, 1936 Fig. 56, 65, 73, 81, 91, 100, 105.

Hemimerus talpoides (misidentification): Vosseler 1906: 63.

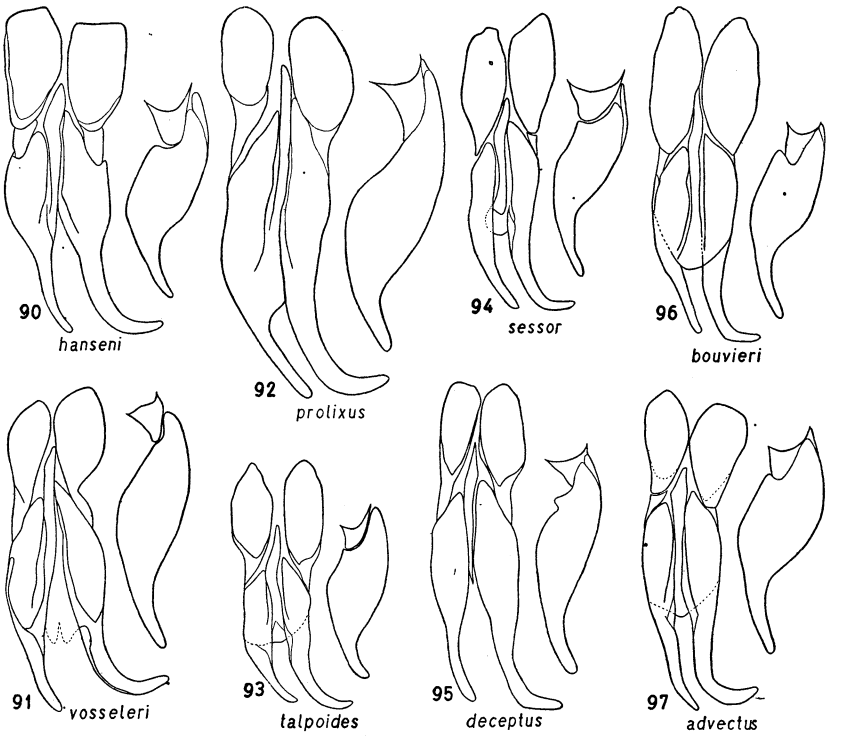


Fig. 90 – 97. *Hemimerus* species, ♂ genitalia, ventral; and right parameres, viewed from right side. Drawn to same scale.

Hemimerus hanseni (misidentification): Gedge 1921: 91.
Hemimerus vosseleri Rehn & Rehn 1936: 483, fig. 6, 15, 21, 27, 33, 39, 45, ♀♂.
Hemimerus deceptus var. *ovatus* Deoras 1940: 201; 1941a: 172–85, fig. 1–29, ♀♂; 1941b: 321–33, fig. 1–30, ♀♂. **New synonym.**

PREVIOUS RECORDS. The type ♀ of *vosseleri* (ANSP) is from Tanzania: Usambara, Amani; paratypes are from the same locality and from Kenya: Mt Mbololo. Vosseler's original series was from Derema nr Amani. The type-series of *ovatus* is from Tanzania: Morrogorro nr Dar-es-Salem. Other published records for this species are from Kenya (Nairobi area; Sokoke Forest at inland of Malindi; Machakos ca 1800 m; Nyeri Forest ca 1900 m) and Tanzania (S Pare Range). Hosts recorded are *C. gambianus* (as *gambiense* in Deoras 1941a), *C. g. ansorgei, C. g. engavi, C. g. kenyensis,* and *Beamys hindei.* For details, see Deoras (1941a: 172, as *H. deceptus* var. *ovatus*), Gedge (1921, as *H. hanseni*), Glover (1968, as *Hemimerus* sp.), Halcrow (1958: 650), Hubbard (1970: 235), Kock (1973: 6, 7), Rehn & Rehn (1936), Spinage (1963: 109, as *H. talpoides*), Vosseler (1906: 63, 1907: 436, as *H. talpoides*) and Zumpt (1966: 4).

MATERIAL EXAMINED. 99 adults (23 ♂, 76 ♀), 81 nymphs (22 i, 11 ii ♂, 7 ii ♀, 10 iii ♂, 13 iii ♀, 7 iv ♂, 11 iv ♀).

ZAIRE: Lukolela, ex *C. gambianus,* J. P. Chapin (MCZ, originally labeled as *H. hanseni*).

KENYA: Mt Kenya, VIII–X.1972, A. Insoll (BMNH 1936–275); Kikuyu, ex *Cricetomys,*

III.1936, R. Meinertzhagen (BMNH 1936-542, MCZ); Kikuyu, Magug North, 2100 m, ex *C. gambianus* (#10796), VI.1956, H. Hoogstraal & M. Kaiser (FMNH); Nairobi, ex *C. gambianus* (USNM); Nairobi, Ngong, ex giant rat, I.1949 (BMNH 1949-137); same locality, VI.1941, V. G. van Someren (BMNH 1959-468); "Kenya", J. Roberts (BMNH 1931-521).

TANZANIA: Amani, ex *C. gambianus*, I.1966, C. A. Hubbard (BISHOP); same data, X.1961, C. A. Hubbard & C. G. Osgood (ANSP); Amani, ex *Cricetomys*, VIII.1927, C. B. Williams (USNM); Arusha, Kiranyi, 1600 m, ex *C. gambianus* (#11388), Hoogstraal (FMNH); Arusha, Singisi, 1600 m, ex *C. gambianus* (#11278, 11302), VIII.1956, Hoogstraal (FMNH) (these 3 lots all det. J. W. H. Rehn 1957 as *H. sessor*!); Mt Meru, Muala, ex *Cricetomys* (#11198), VII.1956, Hoogstraal (FMNH); Rungwe Mt, ex *C. gambianus viator*, IV.1930, A. Loveridge (MCZ, nymphs, det. someone as *H. hanseni*!)

DISTRIBUTION. Zaire, Kenya, Tanzania; mountainous areas. Widespread in Tanzania (from Usambara Mt in the NE to Rungwe Mt in the SW), confined to the extreme E in Zaire (Lukolela) and spreading in Kenya northward as far as the Nairobi area.

HOSTS. *"C. gambianus, C. g. ansorgei, C. g. engavi, C. g. kenyensis, C. g. viator, Beamys hindei."* The occurrence on *Beamys* is most probably incidental.

SYNONMY. *H. deceptus* var. *ovatus* Deoras was suggested by Zumpt (1966: 2) to possibly represent a subspecies of *deceptus*. It is hereby suppressed as a synonym of *vosseleri*. As listed in the above bibliography, the name *ovatus* first appeared in a preliminary note by Deoras (1940) and was formally described in the same author's (1941b: 332 - 33, fig. 30) paper dealing mainly with the internal anatomy. The description is in fact a comparison of specimens of *ovatus* with Rehn & Rehn's (1936) description and drawings of *deceptus*. The "many differences" of the 2 taxa were given in 7 points which are analyzed below (characters of *deceptus* as stated by Deoras are in parentheses) [our annotations in square brackets].

(1) Body of ♀ 11.8 mm, of ♂ 11.6 mm long in average (♀ 9.8 - 10.5 mm, ♂ 9.8 - 10.7 mm) [the Rehns gave the lengths for *deceptus* as ♀ 10.2 - 11.5 mm, ♂ 9.8 - 10.3 mm].

(2) Right proximolateral sulciform impression [right submedian fovea] of ♀ [sternite 7] not different from left one in width and depth (former always broader and more deeply excavated than latter).

(3) Marginal [error for submarginal] carina of ♀ last sternum [i.e. sternite 7] ovate (subobtusely angulate).

(4) Distal margin of ♀ "last tergite" [i.e. tergite 10 or the Rehn's penultimate tergite] conical and converging evenly to the midpoint (curved to the subobtusely angulate midpoint) [the Rehns wrote for the type of *deceptus* "evenly curved to the rounded subobtuse-angulate midpoint" but remarked in a footnote on p. 490 "due to drying, the lateral portions of the distal margin in the type have, in part, decurved sufficiently to give to the general outline, in dorsal view, a trigonal form. What has happened is evident from the condition of the type specimen and paratypes"].

(5) Median length of ♂ "ultimate tergum" [i.e. pygidium] 1/2 of "width" [as shown in Deoras' fig. 30c, evidently this refers to the greatest or proximal width] (3/5 of apical width) [the Rehns wrote on p. 475 for *deceptus* "equal to one-half of proximal or three-fifths of apical width"].

(6) Lateral margins of ♂ "penultimate tergite" [i.e. tergite 10] evenly rounded (subtruncate) whereas distal margin having a narrow (wide) concavity [the Rehns wrote for *deceptus* "lateral margins evenly but slightly convergent caudad, passing roundly into the shallowly concave distal margin"].

(7) Body widest at prothorax (mesothorax) in both sexes.

It is difficult to explain why Deoras should have compared *ovatus* with *deceptus* rather than with *vosseleri,* misquoted the Rehns' description (points 1, 2, 3, 4, 6) and employed inconsistent terminology (last vs ultimate, tergum vs tergite, his ♀ last tergite referring to the tergite anterior to pygidium while his ♂ ultimate tergum referring to the pygidium itself). A pair of specimens of *ovatus* was stated by him to have been deposited in the BMNH but none can be located there now. From the above analysis and from Deoras' description and drawings (incl. 1941a: fig. 23 and 26 which were said to have been drawn to scale), *ovatus* is obviously synonymous with *vosseleri.* In all *Hemimerus* specimens (in alcohol) examined, the mesonotum is more or less wider than any other segment of the body and is scarcely wider than the pronotum. This was considered by the Rehns to be one of the generic characters. The correctness of Deoras' statement and drawings (1941a: fig. 1 and 2, also said to have been drawn to scale) is to be questioned, particulary because the pronotum appears to be scarcely wider than the mesonotum (33: 32) in his fig. 1 and very markedly so (39: 33) in his fig. 2. Presumably these 2 figures were based on 2 different slide-mounts and the apparent discrepancy resulted from the degree of flattening of the 2 specimens involved. The excessive convexity of the ♀ sternite 7 in profile, as shown in Deoras' fig. 26, is entirely inconceivable.

AFFINITIES. *H. vosseleri* and *H. prolixus* are related and are atypical within the *talpoides*-group. They stand intermediate between the *hanseni*- and *talpoides*-groups, specialize in different directions and share with each other several important characters (Table 3, cf. key, 1st 1/2 of couplet 6). The concave, medially shortened pygidial venter and the convexly curved posterior margin of tergite 10 in the ♀ and the strongly deflexed subgenital process in the ♂ are similar to those in the *hanseni*-group; the ventral submarginal carina of the subgenital lobe and the spine-like setae on the pygidial venter in the ♀ and the sinistrally directed subgenital process in the ♂ are similar to those in the typical members of the *talpoides*-group; whereas the parallel submedian foveae of sternite 7 and the seemingly medially interrupted anterior margin of the pygidial venter in the ♀, as well as the long anterolateral processes of sternite 9 in the ♂ are unknown in all other *Hemimerus* species. The most obvious characters for the separation of *vosseleri* and *prolixus* are enumerated in couplet 7 of the key. One may note that in *vosseleri* the free portion of the ♀ subgenital lobe is relatively short, normal in width and with a horizontal and fairly thick marginal strip, and the ♂ subgenital process is relatively short and narrow. Coincidentally or consequently the ♀ pygidial venter is medially long and normal in width at base, its anterior margin not parallel to the lateral margins, the lateral lobe of sternite 7 is narrow and truncate posteriorly, the subgenital lobe bears well-developed (though shortened) ventral (not dorsal) submarginal carina, the submarginal channel of the lobe lies intermediate between the dorsum and venter, and the apex of the ♂ subgenital process is narrowly rounded. In *prolixus,* the free portion of the ♀ subgenital lobe is unusually long and narrow, and with very thin and strongly deflexed marginal strip, while the pygidial venter is medially short and narrowed at base, its anterior margin parallel to lateral margins, the lateral lobe of sternite 7 is unusually wide and strongly produced posterolaterally, the subgenital lobe bears well-defined dorsal but scarcely definable ventral submarginal carina, its submarginal channel lies on the venter of the lobe, and the apex of ♂ subgenital process is seemingly truncate.

In Rehn & Rehn's (1936: 474) key to species, ♀ *vosseleri* was said to be distinguishable from other members of the *talpoides*-group in having sternite 7 ("ultimate sternite") apically not definitely locking, by means of a flange, into the ventral surface of the pygidium ("ultimate tergite"). This statement is incorrect and contradictory to their definition of the *talpoides*-group (p. 472) and is not mentioned in their description of the species. In the same key, ♂ *vosseleri* was placed next to and compared with *deceptus*. However, the affinities with the latter species are rather remote. The varietal name *ovatus* is taken from Latin and most probably implies the ovate submarginal carina of the ♀ sternite 7.

DESCRIPTION. Adult ♀. Tergite 10 medially about 1/2 longer (17: 12) than pygidium, with posterior margin generally more weakly arcuate than in *sessor* and *deceptus*, often with hardly perceptible transverse groove on lateral surface. Pygidium obtuse or narrowly rounded posteriorly. Ventral pygidial surface medially concave, fairly long, with rather sparse spine-like setae on anterior 2/3 and with a few fine setae on anterior 1/2; anterior margin V-shaped, convergent anteriorly to lateral margins, with median section roundly edged and very weakly pigmented-sclerotized, hence in constrast to remaining sections and seemingly thereby interrupted. Sternite 7 with long narrow anterolateral processes; pregradular area shorter (22: 25) than postgradular area; lateral lobe nearly as long as wide, 1/2 as wide as subgenital lobe, with transverse, almost straight posterior margin; submedian foveae parallel, often very slightly converging at both ends. Free portion of subgenital lobe semicircular, with ventral submarginal carina only about 1/2 as long as true margin and lying posterior or lateral to level of submarginal channel, both this carina and channel convergent mesiad to true margin and, in lateral view of apex of the lobe, almost reaching level of true margin. Paraproct narrowed and obliquely truncate at anterior end. Body about 3.4 – 3.7 mm wide.

Adult ♂. Tergite 10 medially about 2.5× as long (15: 6) as pygidium, with posterior margin generally weakly concave. Pygidium more broadly rounded posteriorly than in *sessor* and *deceptus*, ventral surface medially shorter than in *sessor*. Sternite 9 including subgenital process longer (53: 43) than manubrial bar which is stouter than in *talpoides* and *sessor*; anterolateral process unusually long (about 2/5 as long as manubrial bar), broadly rounded at apex; posterior marginal strip in dorsal view distinctly narrowed laterad at right 1/2, and evenly narrow at left 1/2. Subgenital process in profile as in fig. 73; in ventral view distinctly narrowed apicad, shorter in proportion than in all other *Hemimerus* species except *hanseni* (and ? *vicinus*), with apex strongly deflexed ventrad and narrowly rounded; inner surface of that deflexed area facing dextrad. Paraproct about 1/2 longer than wide. Genitalia (fig. 91) with apex of left paramere in ventral view slightly blunter and less curved than in *prolixus*. Body about 3.2 – 3.4 mm wide.

Nymph iv ♀. Tergite 10 with posterior margin very slightly angulately produced at middle. Pygidium dorsally moderately long, apex narrowly rounded; ventral surface with shallowly concave anterior margin and with some fine and a few moderately heavy setae. Sternite 7 about 3× as long as sternite 8; subgenital lobe fairly long, strongly narrowed apicad; posterior margin of sternite 8 evenly concave; sternite 9 much longer than 8, posteriorly deeply incised at middle. Body about 2.9 mm wide.

Nymph iv ♂. Tergite 10 with almost straight posterior margin. Pygidium broadly rounded at apex. Subgenital process of sternite 9 directed distinctly to left side. Body about 2.8 mm wide.

6. **Hemimerus prolixus** Maa, new species Fig. 57, 66, 74, 84, 88, 89, 92.

MATERIAL EXAMINED. Holotype adult ♀, paratypes 1 adult ♂, 4 adult ♀ and 5 nymphs (2 i, 1 iii ♀, 2 iv ♂), MOZAMBIQUE: Namuli Mt, ex forest rat (Mammal No. 46), 28.VII.1932, J. Vincent, BMNH 1933-194. Holotype and 7 paratypes in BMNH, 3 paratypes (2 adult ♀, 1 nymph iv ♂) in Bishop Mus.

DISTRIBUTION. N Mozambique. The type locality Namuli Mt is about 2700 m high and lies E of Lake Chilwa.

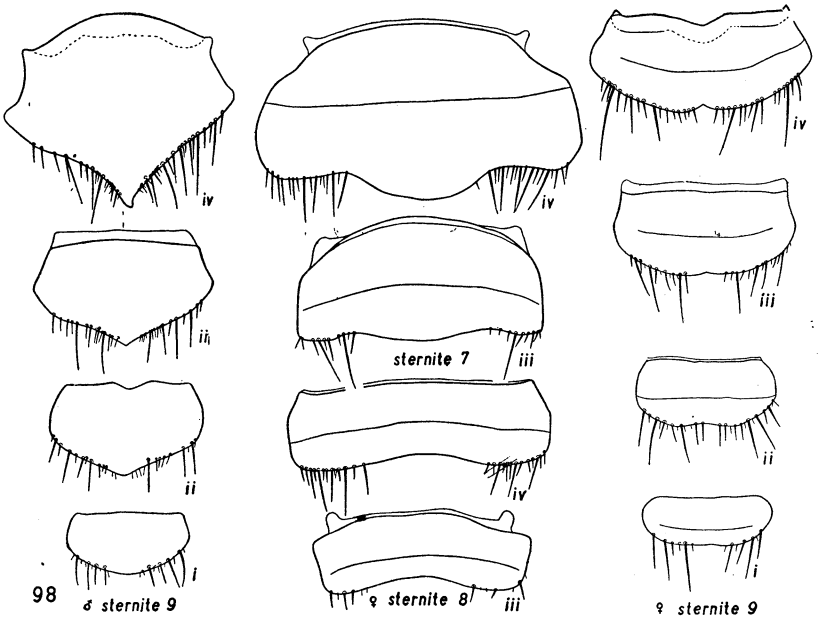


Fig. 98. *Hemimerus hanseni* Shp., sternites 7 – 9 of 4 nymphal stadia, drawn to same scale.

HOST. Unidentified, probably a *Cricetomys* endemic to Mozambique.

AFFINITIES. As suggested by the name, *prolixus* (Latin, stretched out long) may easily be recognized by the long narrow subgenital lobe and the posterolaterally strongly produced lateral lobe of the ♀ sternite 7. Other characters of the species unique within the genus are the thin flexed flap-like marginal strip of the same sternite and the seemingly truncate apex of the ♂ subgenital process. The species is rather isolated, related to but clearly distinctive from *H. vosseleri* (q.v., Table 3). It shares with the latter species, in the ♀, the concave ventral pygidial surface (and its numerous spine-like setae), the virtually parallel submedian foveae; and in the ♂, the strongly deflexed subgenital process, and the long and apically broadly rounded anterolateral processes of sternite 9.

DESCRIPTION. Adult ♀. Tergite 10 medially about 2× as long (20: 9) as pygidium, with almost evenly convex posterior margin. with no definable transverse groove on lateral surface. Pygidium broadly rounded posteriorly. Ventral pygidial surface medially short and concave, with numerous spine-like setae (no fine ones) on anterior 3/4; anteroir margin V-shaped, convergent anteriorly to lateral margins (seemingly parallel to latter in fig. 57, the pygidial venter in which is shrivelled and deeply concave mesiad), with median section roundly edged and very weakly pigmented-sclerotized, hence in contrast to remaining sections, and seemingly interrupted at middle. Sternite 7 with narrow, moderately long anterolateral processes; pregradular area shorter (23.5: 28) than postgradular area; lateral lobe about as long as wide, scarcely narrower than subgenital lobe, with oblique posterior margin and strongly produced posterolaterally; submedian foveae subparallel, weakly converging at both ends. Free portion of subgenital lobe scarcely shorter than wide at base, gently, evenly narrowed apicad; apex in profile simple, entire (not bilobed) and obliquely truncate; marginal strip semitransparent, exceedingly thin along true margin and distinctly deflexed ventrad, hence forming on dorsal surface a pair of weak submarginal carinae (which almost meet each other at their apices) and on ventral surface a distinct, nearly complete submarginal channel; ventral

submarginal carina hardly discernible and lying immediately next to submarginal channel. Paraproct triangular, strongly narrowed cephalad. Body about 3.9 – 4.1 mm wide.

Adult ♂. Tergite 10 medially about 2.3× as long (16: 7) as pygidium, with virtually straight posterior margin. Pygidium less broadly rounded posteriorly than in *vosseleri*. Sternite 9 including subgenital process much longer (70: 47) than manubrial bar which is about as stout as in *vosseleri* and is about 3× as long as anterolateral process; apex of anterolateral process broadly rounded; posterior marginal strip in dorsal view distinctly narrowed laterad at right 1/2 and distinctly narrowed mesiad at left 1/2. Subgenital process in profile as in fig. 74, in ventral view evenly broad, longer and much wider than in *vosseleri*, with apex very strongly deflexed ventrad and seemingly truncate; inner surface of this deflexed area facing anterodextrad (in ventral view, facing anterosinistrad). Paraproct about 1/2 longer than wide. Genitalia (fig. 92) with apex of left paramere slightly sharper and more curved than in *vosseleri*. Body about 3.6 mm wide.

Nymph iv ♂. Posterior margin of tergite 10 almost straight. Pygidium broadly rounded posteriorly. Sternite 9 with posterolateral margins symmetrical and more concave than in *vosseleri*; apex of subgenital process directed caudad. Body about 3.1 – 3.2 mm wide. Nymph iv ♀ unknown.

Nymph iii ♀. Posterior margin of tergite 10 angulately produced at middle. Pygidium with more numerous strong setae on posterolateral surface than in *vosseleri*; ventral surface weakly concave mesiad, with a number of fine setae on disc. Sternite 7 with subgenital lobe much narrower but slightly more produced than in *vosseleri*. Body about 2.7 mm wide.

7. **Hemimerus talpoides** Walker, 1871 Fig. 43, 44, 58, 68, 75, 83, 93, 101, 106.

Hemimerus talpoides Walker 1871: 2, "♂". — Rehn & Rehn 1936: 493, fig. 5, 14, 20, 26, 32, 38, 44, ♀♂; 1937: 335. — Hagan 1951: 261 – 74, fig. 80 – 86, viviparity.
Hemimerus chevalieri Chopard 1934a: 242, ♂♀.

PREVIOUS RECORDS. The lectotype ♀ of *talpoides* (BMNH) is from Sierra Leone, whereas the type ♂ of *chevalieri* (Paris Mus.) is from the Ivory Coast. Other published records for this species are from former French Guinea (Kindia, Lower Casamance, Timbo), Portuguese Guinea, Liberia, Ghana and Nigeria (nr Lagos). Recorded hosts are *C. emini* and *C. g. gambianus*. For details, see Bouvier (1905: 174), Carpenter (1909: 256), Chopard (1934a: 242, 1935: 444), Cook (1901: 53, as *Hemimerus* sp.), Kock (1973: 7), Rehn & Rehn (1936: 493, 1937: 335), Saussure (1879: 414) and Walker (1871: 2).

MATERIAL EXAMINED. 38 adults (9 ♂, 24 ♀), 28 nymphs (7 i, 5 ii ♂, 1 ii ♀, 5 iii ♂, 5 iii ♀, 2 iv ♂, 3 iv ♀).

LIBERIA: Grand Gedah Ranch, Tar's Town, 25 km N of Zwedru, ex *C. emini* (#1505, 1546, 1575, 1617, 1619), VII.1971, D. A. Schlitter (USNM); Mt Coffee, 1895–1897, Mrs Sharp (USNM).

GHANA: Boankra, 27 km from Kumasi, ex *C. gambianus*, VI.1971, I.K.B. Acheampong (NAW); Oda, ex *C. gambianus*, G. S. Cansdale (MCZ).

DISTRIBUTION. Portuguese Guinea, Guinea, Sierra Leone, Liberia, Ivory Coast, Ghana, Nigeria (nr Lagos); in lowland forests and adjoining savanna.

HOSTS. *"C. g. gambianus, C. emini."*

AFFINITIES. This species is closely related to *H. sessor* and *H. deceptus*. Its characters unique within the genus are the long narrow marginal strip and the short submedian foveae of the ♀ sternite 7. In these characters and in the setal density of the ♀ ventral pygidial surface, the outline of the ♂ pygidium, and the relative width of parameres, *talpoides* shows its affinities with or similarities to *vosseleri*. The species is therefore herein placed between *vosseleri* and *sessor* (Rehn & Rehn 1936 placed it at the top

of the *talpoides*-group). The specific name *talpoides* is derived from Latin, *talpa* (a mole) and Greek, *-oides* (like, resembling), in allusion to the tibiotarsal structure.

DESCRIPTION. Adult ♀. Tergite 10 medially slightly more than 2× as long (15: 6.5) as pygidium, posterior margin generally angulately produced at middle. Pygidium also posteriorly angulate at middle, ventral surface deplanate, with sparse, largely fine setae on anterior 1/2 and with U-shaped anterior margin. Sternite 7 with long narrow anterolateral processes; pregradular area longer (20: 17) than postgradular area; submedian foveae short, diverging anteriorly; lateral lobe about as long as wide; subgenital lobe somewhat flattened mesiad, with free portion semi-elliptical, marginal strip very narrow at middle, submarginal carina as long as and parallel to submarginal channel. Paraproct widened and with a mesial lobe at anterior end. Body about 3.1 – 3.4 mm wide.

Adult ♂. Tergite 10 medially about 2.5× as long (12: 5) as pygidium, truncate posteriorly. Pygidium with posterior margin less broadly rounded (but not so narrowly rounded as shown in the Rehns' fig. 26 & 32) than in *vosseleri*, with ventral surface about as short as in latter species. Sternite 9 including subgenital process longer (42: 30) than manubrial bar which is slender and about 4× as long as anterolateral process; posterior marginal strip in dorsal view evenly broad at right 1/2, distinctly narrowed mesiad at left 1/2. Subgenital process in profile as in fig. 75. Paraproct 2× as long as wide. Genitalia as in fig. 93. Body about 2.9 – 3.2 mm wide.

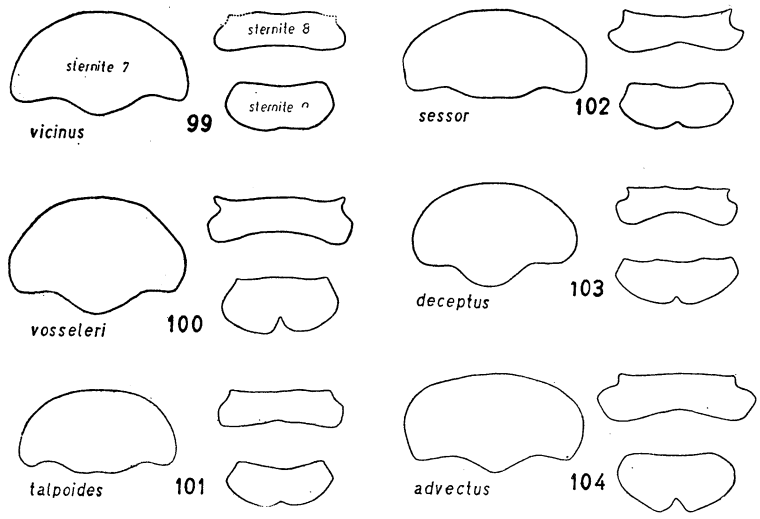


Fig. 99 – 104. *Hemimerus* species other than *hanseni* Shp., sternites 7 – 9 of nymphs iv ♀, drawn to same scale. Compare with fig. 98.

Nymph iv ♀. Tergite 10 with posterior margin very slightly angulately produced at middle. Pygidium dorsally shorter than in other members of *talpoides*-group; apex acute; ventral surface with some fine and a few moderately heavy setae and with shallowly concave anterior margin. Sternite 7 about 3× as long as sternite 8; subgenital lobe short and weakly narrowed apicad; posterior margin of sternite 8 weakly angulately incised at middles; sternite 9 scarcely longer than 8, posteriorly deeply incised at middle. Body about 2.8 mm wide.

Nymph iv ♂. Inseparable from that of *vosseleri* as described above. Body about 2.7 mm wide.

The accompanying drawings for this widespread species are based on specimens from Liberia: Grand Gedah Ranch.

8. **Hemimerus sessor** Rehn & Rehn, 1936 Fig. 59, 69, 76, 82, 94, 102, 107.

Hemimerus sessor Rehn & Rehn 1936: 487, fig. 3, 12, 23, ♀; 1937: 333, fig. 1 – 4, ♂.

PREVIOUS RECORDS. The type ♀ of this species (USNM) is from Kenya: Mt Gargues (= Wargues), Mathews Range. The species was also known from Uganda (Mt Elgon, Gulu). Hosts recorded are *C. emini*, *C. g. gambianus*, *C. g. elgonis*, *C. raineyi*. For details, see Kevan (1954: 75), Kock (1973: 6, 7) and Rehn & Rehn (1936, 1937). The record from "Uganda" by Delany & Neal (1966: 354, as *H. talpoides*) pertains to either *H. hanseni* or *H. sessor*.

MATERIAL EXAMINED. 117 adults (37 ♂, 80 ♀), 139 nymphs (49 i, 18 ii ♂, 18 ii ♀, 15 iii ♂, 12 iii ♀, 17 iv ♂, 10 iv ♀).

TOGO: Pagala, 8°11'N, 0°58'E, ex *C. gambianus* (#2106), V.1968, J.W.L. (USNM).

DAHOMEY: Central Region, Zikonkame, 7°55'N, 2°01'E, ex *C. gambianus* (#3175), IV.1968, C. B. Robbins (USNM).

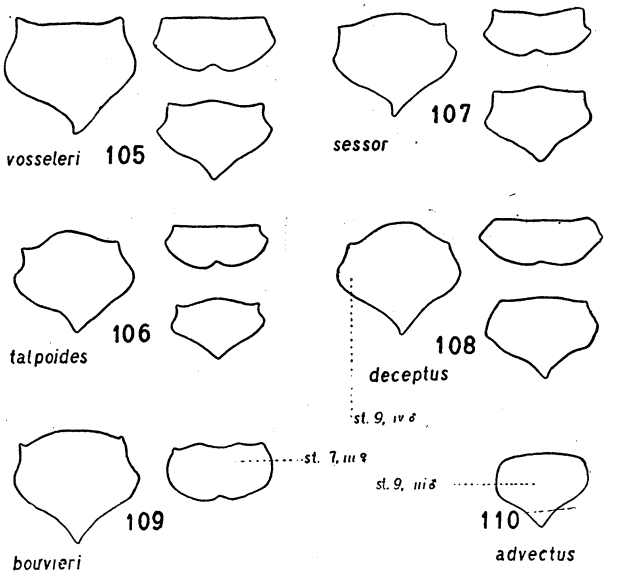


Fig. 105 – 110. *Hemimerus* species other than *hanseni* Shp., sternites 9 of nymphs iv ♂ and iii ♂, and sternites 7 of nymphs iii ♀. All drawn to same scale. Compare with fig. 98.

NIGERIA: Western Region, Upper Ogun Ranch, 20 km N Iseyin, ex *C. gambianus* (#869), XII.1966, J. C. Geest (USNM). North Reg., Felele, 7°51'N, 6°43'E, ex *C. gambianus* (#3175), V.1967, Geest (USNM); Mada R., 8°54'N, 8°17'E, ex *C. gambianus* (#1885, 1886, 1887, 1905, 1910, 1912), III.1967, Geest (USNM), Sakpa, 8°25'N, 2°21'E, ex *C. gambianus* (#6149), III.1967, Geest (USNM); Ugar Jabar, 9°31'N, 8°23'E, ex *C. gambianus* (#2217, 2218, 2345), III.1967, Geest (USNM); 24 km NW Zaria, ex *C. gambianus* (#2281), IV.1966, H. J. Herbert (USNM).

UGANDA: Patiko, 1150 m, 3°N, 32°18'E, ex *C. gambianus*, Oundls Exped. B.E. G.E. 27 (BMNH 1963-747); Sipi, Mt Elgon, ex *C. gambianus elgonis*, XII.1933, A. Loveridge (MCZ).

KENYA: Rift Valley Prov., Nakuru District, Subukia, 2300 m, ex *Cricetomys* (#4249, 4256, 4257, 4258, 4270, 4334), VII.1948, H. Hoogstraal (CAS, FMNH, USNM, det. A. B. Gurney 1957 as *H. vosseleri*).

DISTRIBUTION. Togo, Dahomey, Nigeria, Uganda, Kenya; in mountain forests. The eastern- and southernmost records were from C Kenya (Mathews Range) where the species almost meets *H. vosseleri*; the westernmost record was from Togo (Pagala) where it almost meets *H. talpoides*; the northernment record, from N Nigeria (Ugar Jabar). The distributional range of *H. sessor* extensively overlaps that of *H. hanseni*, from Nigeria to Kenya. The lack of any record of *sessor* from the wide gap between these 2 limits may probably be attributed to insufficient collecting.

HOSTS. "*C. emini, C. g. gambianus, C. g. elgonis, C. g. raineyi.*" As mentioned above, the species was believed by Kock (1973) to be sympatric with *H. hanseni* on *C. gambianus elgonis* in the Mt Elgon area.

AFFINITIES. Coincident with the geographical distributions, *H. sessor* stands intermediate between *H. talpoides* and *H. deceptus*, and appears to be slightly closer to *deceptus* than to *talpoides* in the ♀, and the converse in the ♂. The only outstanding character of *sessor* appears to be the relatively long ♂ ventral pygidial surface. Rehn & Rehn (1936: 488) remarked that the evenly rounded ♀ subgenital lobe in *sessor* made the species distinguishable from other members of the *talpoides*-group. In their key to species, ♀ *sessor* was separated from *talpoides* and *deceptus* by the weakly curved posterior margin of tergite 10, more or less deplanate ventral pygidial surface and practically concentric submarginal carina and true margin of the subgenital lobe. In their (1937) description of ♂ *sessor*, the relatively short pygidium was said to be distinct from that of *deceptus*. We are unable to appreciate these differences. The specific name is taken from Latin, *sessor, -oris* (a sitter, a dweller) and is probably an allusion to the parasitic life of the species.

DESCRIPTION. Adult ♀. Tergite 10 slightly more than 2× as long (18: 8) as pygidium, posteriorly generally less weakly arcuate than in *vosseleri*. Pygidium posteriorly angulate or subangulate at middle; ventral surface deplanate or weakly convex, with dense, largely fine setae on anterior 1/2 and with U-shaped anterior margin. Sternite 7 with long narrow anterolateral processes; pregradular area as long (21: 20) as postgradular area; submedian foveae long, diverging cephalad; lateral lobe as long as wide. Free portion of subgenital lobe semi-elliptical; submarginal carina parallel to submarginal channel, as long as and divergent mesially from true margin; marginal strip very broad at middle; apex of the lobe in profile with submarginal carina clearly surpassed by true margin. Paraproct narrowed anteriorly. Body about 3.3 – 3.7 mm wide.

Adult ♂. Tergite 10 truncate posteriorly, about 2.5× as long (14: 6) as pygidium, the posterior margin of which is less broadly rounded than in *vosseleri* and *talpoides*, and the ventral surface of which is longer than in all other members of the *talpoides*-group. Sternite 9 including subgenital process longer (49: 36) than manubrial bar which is slender and is 4× as long as anterolateral process; posterior marginal strip in dorsal view evenly broad at right 1/2 and distinctly narrowed mesiad at left 1/2; subgenital process in profile as in fig. 76. Paraproct in ventrolateral view scarcely longer than wide. Genitalia as in fig. 94. Body about 2.9 – 3.2 mm wide.

Nymph iv ♀. Tergite 10 and pygidium as in *vosseleri*. Sternite 7 about 3× as long as sternite 8; subgenital lobe short, weakly narrowed apicad; posterior margin of sternite 8 weakly angulately incised at middle; sternite 9 scarcely longer than 8, posteriorly deeply incised at middle. Body about 3.1 mm wide.

Nymph iv ♂. Inseparable from that of *vosseleri* as described above. Body about 2.9 mm wide.

The accompanying drawings for this species are based on specimens from Kenya: Nakuru.

9. **Hemimerus deceptus** Rehn & Rehn, 1936 Fig. 60, 67, 77, 86, 95, 103, 108.

Hemimerus talpoides (misidentification): Bedford 1932: 308.
Hemimerus deceptus Rehn & Rehn 1936: 489, fig. 4, 13, 25, 31, 37, 43, ♀♂.

PREVIOUS RECORDS. The type ♀ of this species (BMNH) is from Transvaal: Pretoria, National Zoological Park. The only other published records are from Transvaal: Zoutpansberg Distr., Gobler's Farm and from Mozambique, and the only host recorded is *C. gambianus haagneri*. For details, see Bedford (1932), Rehn & Rehn (1936) and Tendeiro (1963: 433).

MATERIAL EXAMINED. 24 adults (9 ♂, 15 ♀,) 42 nymphs (12 i, 2 ii ♂, 8 iii ♂, 10 iii ♀, 6 iv ♂, 4 iv ♀), including 1 ♂ 1 ♀ (BMNH) without collection data and det. by H. E. Hinton, and 1 ♂, 2 ♀, 19 nymphs, "without data, in box left behind by Mr. L. Distant" (BMNH 1911-383).

MALAWI: Mt Cholo, ex *C. gambianus viator*, III.1949, A. Loveridge (MCZ); Maiwale, ex *Cricetomys* fur, XI.1932, W.A. Lamborn (BMNH 1950-96).

TRANSVAAL: Paratypes (ANSP, BMNH), Gobler's Farm. "N. Transvaal", ex *C. gambianus*, IX.1958, Louis Trichardt (SAIMR).

DISTRIBUTION. Malawi, Mozambique, NE Transvaal.

HOSTS. "*C. gambianus haagneri, C. g. viator.*"

AFFINITIES. This species, particularly in the ♀ sex, is very closely related to the preceding one. Its characters unique or outstanding within the *talpoides*-group are the very short anterolateral process of the ♀ sternite 7, the laterally abruptly narrowed submarginal channel of the ♀ subgenital lobe and the peculiarly shaped ♂ subgenital process in profile. The marginal strip of the ♀ subgenital lobe is still broader than in *H. sessor*. Rehn & Rehn (1936) distinguished *deceptus* from *vosseleri* by the ventral pygidial surface being deplanate to weakly convex instead of concave, from *talpoides* by the ♀ subgenital lobe being not flattened mesiad, and from *sessor* by the same lobe being not "evenly arcuate, semicircular and with the submarginal impression practically concentric with the actual margin" but semi-ovate and with the submarginal impression not concentric. These 2 authors did not discuss the relative affinities of the 4 species but placed *deceptus* between *talpoides* and *sessor*. The specific name is taken from Latin, *deceptus* (deceiving) and probably implies the parasitic life, or the obscure characters of the species which were overlooked by Bedford (1932).

DESCRIPTION. Adult ♀. Tergite 10 about 2× as long (18: 9) as pygidium, generally a little more strongly arcuate posteriorly than in *vosseleri*. Pygidium posteriorly subangulate (but not distinctly angulate as shown in the Rehns' fig. 4 & 13 which were based on a dry shrivelled specimen; see discussion on the synonymy of *ovatus*, p. 359); ventral surface deplanate or weakly convex, with U-shaped anterior margin and with dense, largely fine setae on anterior 2/3. Sternite 7 with short broad anterolateral processes; pregradular area as long (21: 22) as postgradular area; submedian foveae long, diverging anteriorly; lateral lobe as long as wide. Free portion of subgenital lobe semicircular, its marginal strip exceedingly broad, strongly narrowed anterolaterad; submarginal carina as long as true margin and strongly convergent anterolaterally to latter; submarginal channel coincidental at middle with submarginal carina and thus seemingly broadly interrupted thereby.

Paraproct narrowed anteriorly. Body about 3.3 – 3.5 mm wide.

Adult ♂. Tergite 10 truncate posteriorly, about 2.5× as long (16: 6) as pygidium. Pygidium with posterior margin less broadly rounded than in *vosseleri* and *talpoides* whereas ventral surface shorter than in *sessor*. Sternite 9 including subgenital process longer (56: 41) than manubrial bar which is stout and 4× as long as anterolateral process; posterior marginal strip in dorsal view slightly narrowed laterad at right 1/2 and evenly broad at left 1/2; subgenital process in profile as in fig. 77. Genitalia as in fig. 95. Body about 2.8 – 3.2 mm wide.

Nymph iv ♀. Posterior margin of tergite 10 evenly convex. Pygidium moderately long, narrowly rounded at apex; ventral surface with fine and a few moderately heavy setae, and with shallowly concave anterior margin. Sternites 7 – 9 as in *vosseleri*. Body about 2.9 mm wide.

Nymph iv ♂. Sternite 9 symmetrical posteriorly, subgenital process apically directed caudad, otherwise inseparable from nymph iv ♂ of *vosseleri*. Body about 2.7 mm wide.

Advectus-Group

Adult. Prosternum slightly longer than wide (ca 31: 27). Femur 3 in profile relatively long and narrow; tibia 2 with numerous strong setae covering apical 1/2 of dorsal surface. ♀ Terminalia: Tergite 10 truncate or very weakly convexly curved posteriorly, lateral surface without transverse groove. Pygidium fairly long; dorsal surface about as long as wide; ventral surface setose, weakly convex, its anterior margin very weakly carinate, evenly arcuate, never parallel to lateral margins, but with infolded membranous flange and weak submarginal groove, and flanked by pair of short oblique carinae. Subgenital lobe without submarginal channel but dorsally (not ventrally) with weak submarginal carina or impressed line. Halves of sternite 9 each as long as or slightly shorter than wide. Paraproct about 2× as long as wide. ♂ Terminalia: Tergite 10 posteriorly truncate or slightly produced angulately at middle. Pygidium long. Subgenital process long, with prominent angulate "shoulder" and with apex scarcely deflexed in profile; apex in dorsal view distinctly directed to right side (dextrad).

This group includes 2 species, *H. advectus* R. & R. and *bouvieri* Chpd., and was placed by Rehn & Rehn (1936) at the top of the genus.

10. **Hemimerus advectus** Rehn & Rehn, 1936 Fig. 61, 71, 78, 85, 97, 104, 110.

Hemimerus advectus Rehn & Rehn, 1936: 501, fig. 8, 17, 29, 35, 41, 47, ♀♂.

PREVIOUS RECORDS. The type ♀ of this species (BMNH) is from Angola: Loanda Distr., Pungo Andongo. Other published records are from Angola: Benguela Distr., Caconda; Cuanza Norte Prov., Dembos, Piri, Roca Nova Douro. The only recorded host is *C. gambianus ansorgei*. For details, see Kock (1973: 7), Rehn & Rehn (1936) and Weidner (1955: 175).

MATERIAL EXAMINED. 8 adults (3 ♂, 5 ♀), 9 nymphs (2 i, 1 ii ♀, 5 iii ♂, 1 iv ♀).

ANGOLA: Huila, ex *C. gambianus* (#83989), XII.1954, G. Heinrich (FMNH); Benguela Prov., 30 km S of Gabela, ex *C. gambianus* (#83988), VIII.1954, G. Heinrich (FMNH).

DISTRIBUTION. Angola (Benguela, Huila, Loanda, Cuanza Norte).

HOSTS. "*C. gambianus*, *C. g. ansorgei*."

AFFINITIES. This species is a close relative of *H. bouvieri* (q.v.). The ♂ was compared by Rehn & Rehn (1936) with that of the latter species and *hanseni* only because the posterior margin of tergite 10 and the subgenital process in these 3 species are superficially alike. The specific name is taken from Latin, *advectus* (carrying, conveying) and possibly implies the parasitic life of the species.

DESCRIPTION. Adult ♀. Ventral extension of tergite 10 with weakly convex mesial margins. Pygidium rather broadly rounded posteriorly; ventral surface scarcely carinate along anterior margin, anteromedian area less convex than in *bouvieri*, posterior margin lined with some spine-like setae; superior margin in profile not deflexed, but lying on same plane with that of tergite 10. Sternite 7 with pre- and postgradular areas subequal in length (22: 21), lateral lobe about 1/2 longer than wide and with distinctly concave lateral margin. Free portion of subgenital lobe about 1/2 as long as wide, dorsally with faint submarginal impressed line. Halves of sternite 8 subtriangular, that of sternite 9 each as long as wide. Body about 3.4 – 3.7 mm wide.

Adult ♂. Tergite 10 truncate posteriorly, 2× as long as pygidium, with lateral margins before cercal bases weakly converging at both ends. Pygidium about 2/5 as long as wide, posterior margin longer than in *bouvieri*, ventral surface scarcely concave mesiad, superior margin in profile on same plane as that of tergite 10, not deflexed. Manubrial bar comparatively shorter and more robust than in *bouvieri*. Sternite 9 with subgenital process less strongly directed to right side and its preapical "shoulder" in profile less prominent than in *bouvieri;* right 1/2 of posterior margin distinctly sigmoid when viewed vertically to general plane of the sternite. Genitalia as in fig. 97. Other characters similar to those of *bouvieri*. Body about 3.3 – 3.4 mm wide.

Nymph iv ♀. Tergite 10 with posterior margin very slightly angulately produced at middle. Pygidium dorsally longer than in *bouvieri*, apex narrowly rounded; ventral surface with shallowly concave anterior margin and with some fine and a few moderately heavy setae. Sternite 7 about 3× as long as sternite 8; subgenital lobe fairly long, strongly narrowed apicad; sternite 8 with posterior margin weakly angulately incised at middle; sternite 9 much longer than 8, with posterior margin very deeply incised at middle. Body about 3.2 mm wide.

11. **Hemimerus bouvieri** Chopard, 1934 Fig. 62, 70, 79, 87, 96, 109.

Hemimerus talpoides (misidentification): Bouvier 1906: 170.
Hemimerus bouvieri Chopard 1934a: 242, ♂. — Rehn & Rehn 1936: 497, fig. 7, 16, 22, 28, 34, 40, 46, ♀♂.

PREVIOUS RECORDS. The type ♂ of this species (Paris Mus.) is from Mozambique: Valley of Pungwe (Pongué) River, Cuengère (Guengère). Other records are from Zaire, Urundi, Tanzania and Rhodesia. The only recorded host is *C. emini*. For details, see Bouvier 1906: 170, as *H. talpoides*), Chopard (1934a: 242, 1934b: 121, 1935: 444) and Rehn & Rehn (1936: 497).

MATERIAL EXAMINED. 49 adults (22 ♂, 27 ♀), 14 nymphs (3 i, 1 ii ♀, 1 iii ♀, 1 iv ♂, 8 iv ♀), including 1 ♀ without data (BMNH), and 1 ♂, 1 ♀, 1 nymph iv ♀, labeled "From Gambian pouched rat *Cricetomys gambianus*. Presented by R. E. Rewell, Zool. Soc. Lond. BM. 1949-460."

TANZANIA: Bukoba, on W shore of Lake Victoria, ex *C. gambianus*, 1921, N.C.E. Miller (BMNH, det. Rehn & Rehn).

MALAWI: Lilongwe Distr., Lilongwe, ex *C. gambianus* ssp. (? *viator*), V.1945 (ANSP).

DISTRIBUTION. Zaire (W to the Upper Kasai R.), Urundi, Tanzania (W shore of Lake Victoria), Mozambique (Pungwe R. valley), Malawi (Lilongwe), Rhodesia (Umtali).

HOSTS. "*C. emini, C. gambianus, C. gambianus* ssp. (? *viator*)."

AFFINITIES. This species is closely related to *H. advectus* (cf. key). The ♀ was separated by Rehn & Rehn (1936) from that of the latter species by the 3 following characters: posterior margin of tergite 10 slightly produced at middle (not straight), pygidium narrowly rounded (not subtruncate) and lateral margin of subgenital lobe weakly

sigmoid (not straight). We can hardly accept the significance of these 3 characters, nor did the Rehns' fig. 7 vs 8 show any marked difference in the lateral margins and subgenital lobes. The ♂ of *bouvieri* was compared with that of *hanseni* by Chopard (1934a) and the Rehns, but these 2 species do not have close affinities. It may be noted that in the Rehns' fig. 16, the median length of tergite 10 is seemingly slightly smaller than that of the pygidium. In distended or dissected specimens, the former length is actually about 2× the latter.

DESCRIPTION. Adult ♀. Ventral extension of tergite 10 with strongly convex mesial margin. Pygidium subacute or narrowly rounded posteriorly; ventral surface distinctly carinate along anterior margin, anteromedian area slightly more convex than in *advectus*, posterior section of lateral margin lined with some spine-like setae; superior margin in profile slightly deflexed, not lying on same plane as that of tergite 10. Sternite 7 with pregradular area shorter (21: 25) than postgradular area, lateral lobe slightly longer than wide and nearly straight along lateral margin. Free portion of subgenital lobe about 2/5 as long as wide, dorsally with a weak submarginal carina running along posterior section of free margin. Halves of sternite 9 each slightly shorter than wide. Body about 3.6 – 3.9 mm wide.

Adult ♂. Tergite 10 slightly more than 2× as long as pygidium, virtually parallel-sided anteriorly to level of cercal bases; posterior margin generally very slightly convex at middle. Pygidium about 1/2 as long as wide, with shorter posterior margin than in *advectus*, ventral surface concave mesiad, dorsal margin in profile slightly deflexed ventroposteriorly, distinctly not on same plane as that of tergite 10 (the Rehns said they were on the same plane). Sternite 9 with manubrial bar comparatively longer and more slender than in *advectus*; right 1/2 of posterior margin almost obliquely straight when viewed vertically to plane of sternite (drawn by the Rehns in their fig. 28 as if distinctly sigmoid); subgenital process more strongly directed to right side, and its preapical "shoulder" in profile more prominent than in *advectus*. Genitalia as in fig. 96. Body about 3.2 – 3.6 mm wide.

Nymph iv ♀. Tergite 10 with posterior margin angulately produced at middle. Pygidium as in *advectus* but dorsally shorter. Sternite 7 about 2× as long as sternite 8; subgenital lobe short, strongly narrowed apicad; posterior margin of sternite 8 evenly concave; sternite 9 slightly longer than 8, with posterior margin deeply incised at middle. Body about 2.8 – 3.0 mm wide.

Nymph iv ♂. Tergite 10 posteriorly subtruncate. Pygidium broadly rounded at apex. Subgenital process directed caudad. Body about 3 mm wide.

The accompanying drawings for this widespread species are based on specimens from Tanzania: Bukoba.

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BIBLIOGRAPHY

This Bibliography is intended to include as many works (whether cited in the text or not) as possible bearing on the parasitic earwigs. For purpose of comparison and discussion, citation is sometimes made in the text for works which do not deal with these insects. Bibliographical reference for such works is given in the context but not in this Bibliography.

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