

ACAROLOGY LABORATORY
THE OHIO STATE UNIVERSITY

THE SCUTATE TICKS, OR IXODIDAE,
OF INDONESIA

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off cow; Palembang, off cow; Benkoelen, off cow; Lahat, off buffalo and cow; Tandjoengkarang, off cow and dog), Nias Island (Goenongsitoli, off cow), Java (Serang, off cow; Batavia, off buffalo and cow; Buitenzorg, off cow; Poerwokerto, off cow; Tegal, off cow; Magelang, off cow; Semarang, off cow; Toeban, off cow; Ponorogo, off buffalo and cow; Madioen, off cow and dog; Bodjonegoro, off cow; Blitar, off buffalo and cow; Malang, off cow; Pasoeroean, off cow; Probolinggo, off cow; Djember, off cow and pig), Madoera (Pamekasan, off cow and dog), Bali (Singaradja, off cow), Soemba (Waingapoe, off cow), Flores (Roeteng, off buffalo, cow and horse), Timor (Koepang, off cow and dog), Celebes (Makassar, off cow and pig; Watampone, off horse; Singkang, off goat; Parepare, off cow; Makale, off horse; Gorontalo, off cow and horse; Manado, off cow, horse and dog).

Biology. All the stages in the life cycle are known. *B. microplus* is a one-host tick; the larvae attach to the host and remain thereon till mature. They molt on the host, and many adults were found in the Kraneveld collection still within the nymphal skin. They also mate on the host, and many males and females were found in the copulatory condition. Though it is customary for the female to oviposit on the ground after dropping from the host, many vials contained gravid females and hundreds of eggs; whether or not these were ovipositing on the host when collected, can not be said for certain.

Judging from the number of specimens collected in these islands from domestic animals, the species is very abundant and must be a serious pest of livestock. *B. microplus* is known to transmit several diseases in other parts of the world and must, therefore, be regarded as a possible vector in the East Indies. It is known to transmit *Babesia bigemina* (Smith and Kilbourne). This organism is the causal agent of the disease known under several names, Texas cattle fever, red water, splenic fever, bloody murrain, Mexican fever, tick fever, etc. It is also known to transmit bovine anaplasmosis which is caused by *Anaplasma marginale* Theiler.

Genus *Amblyomma* C. L. Koch, 1844

Key to Species of *Amblyomma*

Males⁴

1. Coxa II with two spurs; internal very small. Scutum broad-oval, chocolate-brown with extensive pale markings. Punc-

⁴ Males of *A. cordiferum* and *A. geoemydae* are unknown.

- tations numerous and unequal. Hypostome with 4:4 dentition *A. robinsoni*
- Coxa II with one spur 2
2. Hypostome with 3:3 dentition. Marginal groove present or absent 3
- Hypostome with 4:4 dentition. Marginal groove absent 5
3. Coxae II-IV with single, short, triangular spur. Coxa I with two spurs; external nearly three times as long as internal. Marginal groove absent. Scutum ornate, small and sub-quadrangular. Punctations numerous, unequal and often absent in median area. Eyes small, yellow and often indistinct *A. helvolum*
- Coxae II-III with single, broad and flat spur. Medium to large ticks 4
4. Medium-sized. Inornate. Marginal groove obsolete or completely absent. Eyes indistinct. Coxa IV with single, broad and flat spur. Coxa I with two short, broad, equal and separated spurs. Punctations unequal and sparsely distributed in periphery; nearly absent in anterior and median areas *A. javanense*
- Large. Ornate. Marginal groove distinct. Eyes large and slightly bulging. Coxa IV with long, stout spur. Coxa I with two spurs; external pointed and about twice as long as internal. Punctations unequal and more or less uniformly distributed. Legs very long *A. crenatum*
5. Coxae II-III with single, broad, ridge-like spur. Coxa IV with single, stout spur nearly twice as long as broad. Coxa I with two spurs; external much longer than internal. Eyes small and flat. Punctations unequal, numerous and uniformly distributed *A. testudinarium*
- Coxae II-III with spine-like spur as long as broad or not much longer than broad 6
6. Coxa I with two short, blunt, nearly equal spurs. Pseudo-scutum well defined. Scutum nearly circular. Eyes very small. Spiracle large and sub-rectangular *A. malayanum*
- Coxa I with two spurs; external longer than internal. Scutum broad-oval, narrowed anteriorly. Eyes large, conspicuous. Spiracle much longer than wide and comma-shaped 7
7. Coxa I with two spurs; external slightly longer than internal and not much longer than broad. Pseudoscutum scarcely

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indicated. Basis with numerous punctations. Punctations on scutum small to medium *A. cyprium cyprium*
 Coxa I with two long spurs; external longer than internal and much longer than broad. Pseudoscutum acutely triangular. Basis lacks punctations. Punctations on scutum large. *A. babirussae*

Females

1. Coxa II with two spurs 2
 Coxa II with one spur 3
2. Coxa III with one spur. Scutum ornate. Punctations numerous, unequal and slightly confluent. Enamel markings on distal end of trochanter, femur, tibia and protarsus of leg I. Hypostome with 4:4 dentition *A. robinsoni*
 Coxa III with two spurs. Internal spur very small and scarcely visible. Scutum inornate and brown in color. Punctations unequal and more restricted to anterior half of scutum. Hypostome with 4:4 dentition *A. cordiferum*
3. Coxae II-III with ridge-like spur much broader than long 4
 Coxae II-III with spine-like spur as long as broad or not much broader than long 6
4. Medium-sized tick. Scutum inornate. Punctations numerous, small to medium and shallow. Eyes often indistinct. Hypostome with 3:3 dentition *A. javanense*
 Large-sized tick. Scutum ornate. Eyes large, pale and flat 5
5. Hypostome with 3:3 dentition anteriorly and 4:4 posteriorly. Scutum triangular with pointed scapulae. Eyes bulging beyond scutum. Postero-internal angle of festoons salient making posterior margin serrate. Legs unusually long. *A. crenatum*
 Hypostome with 4:4 dentition throughout length. Scutum cordiform with scapulae less pointed. Eyes large, flat and not bulging. Posterior body margin not serrate. *A. testudinarium*
6. Hypostome with 3:3 dentition. Scutum ornate. Punctations fine to medium, uniformly distributed. Eyes small, pale and often indistinct. Coxa I with two spurs; external nearly three times as long as internal *A. helvolum*
 Hypostome with 4:4 dentition 7
7. Dorsal foveae unusually large, appearing as two adjacent, salient plaques posterior to scutum. Scutum with posterior

angle very broad. Punctations numerous, deep, slightly unequal, partially confluent and uniformly distributed.

A. malayanum

Dorsal foveae small, inconspicuous or absent 8

8. Scutum ornate and triangular, with sides nearly straight. Porose areas large, oval, closely set and divergent anteriorly. Coxa I with two short, flat spurs as wide as long *A. geoemydae*

Porose areas small and widely separated 9

9. Coxa I with two short, blunt, subequal spurs; external slightly longer than internal. Scutum triangular-cordiform, broader than long and with extensive ornamentation. Punctations small to medium. Legs with pale mother-of-pearl marking at distal end of each joint *A. cyprum cyprum*

Coxa I with long, pointed, external spur nearly three times as long as short, blunt internal spur. Scutum triangular, with reduced ornamentation. Large, deep punctations in lateral fields. Legs pale-green, with enamel markings on some segments *A. babirussae*

Amblyomma babirussae Schulze.

Amblyomma babirussae Schulze, 1932, Zeitschr. Morph. Oekol. Tiere, **25**, pts. 2-3, p. 525 [*nomen nudum*; morphological]; 1933, Zool. Anz., **104**, pts. 11-12, pp. 317-320, figs. 1-5 (3 ♂, 7 ♀, 2 n, Boeroe Island or Celebes, off "*Sus babirussa*" = *Babirussa babyrussa*; 3 n, Minahassa, Celebes; type in Zool. Mus. Greifswald, Germany) [validates *nomen nudum* of 1932]; 1936, Zeitschr. Morph. Oekol. Tiere, **31**, pt. 3, pp. 431-432, figs. 1-2 (morphological); 1941, *Op. cit.*, **37**, pt. 3, pp. 514, 515, 517 (morphological); 1943, *Op. cit.*, **39**, pt. 2, p. 324, fig. 3 (n, Celebes).

Amblyomma cyprum Krijgsman and Ponto, 1931, [*nec* Neumann, 1899] Zeitschr. f. Parasitenk., **4**, pt. 1, pp. 141, 143, map 4; 1932, [*nec* Neumann, 1899] Veeartsenijk. Meded., No. **79**, pp. 21-22, figs. 25-26 (♂, ♀, Celebes, off *Sus celebensis*, cow, buffalo). Toumanoff, 1944, [in part: *nec* Neumann, 1899], Les Tiques (Ixodoidea) de l'Indochine, pp. 106-111, Pl. 78, figs. c-d [only the male, after Krijgsman and Ponto; *nec* female].

In 1932 Krijgsman and Ponto erroneously described and illustrated the male and the female of *babirussae* as those of *cyprum*. Toumanoff in 1944 has taken the description and figure of the male

from Krijgsman and Ponto; his female is another species; probably *A. malayanum*.

Male (Fig. 17A-F). Two specimens respectively 3.2 and 3.0 mm. long by 2.8 and 2.8 mm. wide, exclusive of capitulum. Scutum nearly circular, but narrowed in region of eyes; brown-black, with ornamentation apparently limited to posterior angle of triangular pseudoscutum; punctations large, very coarse, deep and partially confluent; all raised surfaces without punctations; cervical grooves deep and short; eyes dark and not very conspicuous; festoons distinct and punctate; no marginal groove. Body ventrally wrinkled, lighter and with short, white hairs; genital opening opposite coxa II; anal opening opposite spiracle; spiracles comma-shaped. Legs long, slender and pale green; tarsus I with hump, tapering abruptly; tarsus IV tapering gradually, with two ventral spurs; claws about twice as long as pulvillus; coxa I with two unequal, separated spurs, external long, narrow and pointed, internal short and blunt; coxae II-III with a single, moderately long, external, pointed spur; coxa IV with a single, long, pointed spur mesially placed. Capitulum 0.8 mm. long; basis rectangular; cornua slight; palpal articles relatively short, rugose and hirsute; article two about twice as long as article three; hypostome short; dentition 4:4, with six to eight teeth per file.

Female. (Fig. 17G-L). Engorged specimen 7.2 mm. long by 6.0 mm. wide, exclusive of capitulum; partially engorged specimen 4.05 mm. long by 2.7 mm. wide, exclusive of capitulum. Scutum respectively 1.5 and 1.62 mm. long by 1.8 and 1.95 mm. wide, triangular, lateral margin nearly straight, and posterior angle not very broad, light-brown to reddish-brown, with metallic orange and greenish-yellow markings; punctations large, coarse, deep and restricted mainly to lateral regions, but smaller ones in scapular and median areas; cervical grooves short and deep anteriorly, continuing posteriorly as wide, shallow grooves, but not reaching posterior margin of scutum; no hairs on scutum. Abdomen reddish-brown, finely striate, with numerous, large punctations from each of which arises a long, stout, white, appressed hair; postero-median and two postero-lateral grooves present; marginal groove absent; festoons longer than wide, and grooves separating them narrow and deep. Ventral body surface with short, white hairs on posterior half; genital opening opposite coxa II; anal opening opposite spiracular plate; spiracular plate triangular, with rounded sides; genital grooves diverging widely at level of anal opening; anal groove

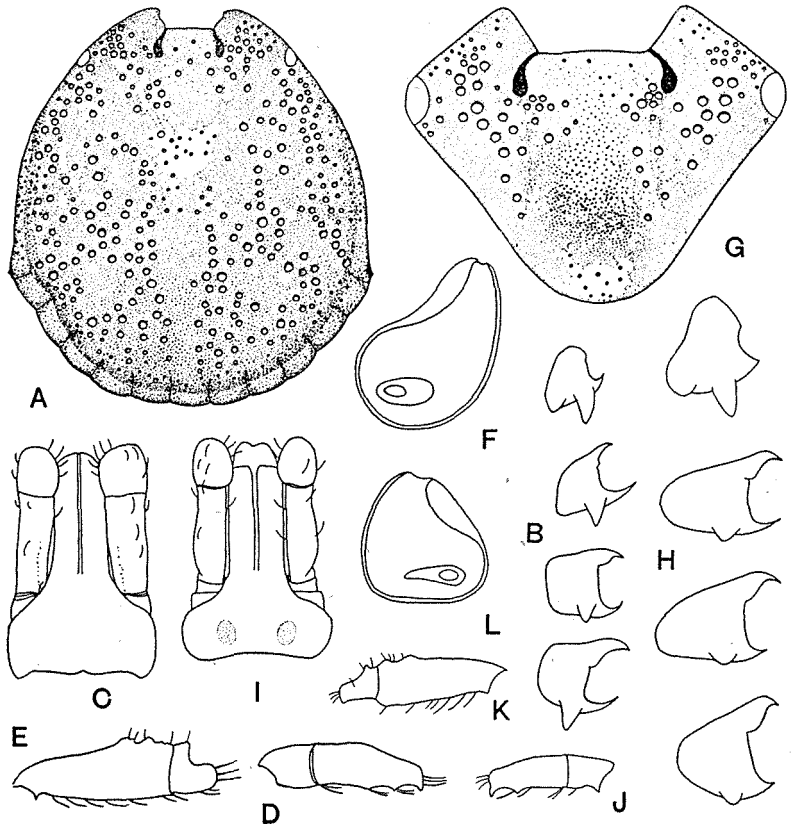


Fig. 17. *Amblyomma babirussae* Schulze. A-F, male: A, scutum; B, coxae I-IV; C, capitulum in dorsal view; D, tarsus IV; E, tarsus I; F, spiracle. G-L, female: G, scutum; H, coxae I-IV; I, capitulum in dorsal view; J, tarsus IV; K, tarsus I; L, spiracle.

semi-circular, not touching genital groove. Legs long and fairly slender; tarsus I with three dorsal humps, tapering abruptly from third hump, and not terminating in a ventral spur; tarsi II-IV without humps, tapering gradually, but with a terminal and a sub-terminal spur; pulvillus about one-half as long as claws; coxa I with a long, pointed, external spur and a short, blunt, internal spur; coxae II-IV with a single, short, blunt spur wider than long. Capitulum 1.15 mm. long; palpal article two slightly over twice as long as article three; palps with long, white hairs; basis very broad, with lateral margins rounded and with posterior margin slightly concave; cornua very short, blunt, and insignificant; porose areas small, oval and widely separated; hypostome dentition 4:4, with approximately ten large teeth per file.

Distribution and hosts. This species appears to be restricted to Celebes. Specimens were seen from the following localities in Celebes: Makale, two females, off horse and buffalo, in Kraneveld collection; Lindoe Lake, Central Celebes, one female, off man, in Museum of Comparative Zoölogy; and Manado, fifteen males, six females, eighteen nymphs and one larva, off deer and wild pig, in de Boer collection.

Biology. Schulze referred to this species several nymphs unusual in that the scutum is ornate. The nymphs seen in the de Boer collection are also ornate.

Amblyomma cordiferum Neumann.

Amblyomma cordiferum Neumann, 1899, Mém. Soc. Zool. France, **12**, pp. 204, 218-219 (1 ♀, Banda Island; doubtfully 6 n, Ternate; type in Hamburg M.). Salmon and Stiles, 1902, 17th Ann. Rept. Bur. Anim. Industry, U. S. Dept. Agric., (1901), p. 474. Blanchard, 1909, L'Insecte et l'Infection, Fasc. 1, Acariens, p. 128. Neumann, 1911, Das Tierreich, Lief. **26**, Acarina, Ixodidae, pp. 58, 67, 84. Robinson, 1926, Ticks, **2**, pt. 4, *Amblyomma*, pp. 25, 188-190, fig. 90 (description and figure from type). Krijgsman and Ponto, 1931, Zeitschr. f. Parasitenk., **4**, pt. 1, pp. 141, 144, Map 4; 1932, Veeartsenijk. Meded., No. **79**, pp. 23, 35, fig. 33, Map 4 (♀, Krakatau Island, off python). Toumanoff, 1944, Les Tiques (Ixodoidea) de l'Indochine, pp. 117, 120.

Since no specimen was seen from the East Indies, a female from Siam was used for the following description.

Female (Fig. 18A-F). Partially engorged specimen 8.22 mm. long by 6.18 mm. wide, exclusive of capitulum. Body nearly rectangular, with sides sub-rectilinear. Scutum inornate, cordiform, broader than long, 3.0 mm. long by 3.78 mm. wide, sides rounded, with posterior angle broad; outlined by a narrow, dark brown border extending around eyes; punctations large, shallow, and only in anterior half of scutum; cervical grooves anteriorly short and deep, prolonged posteriorly as shallow depressions; eyes large and outlined by small punctations. Abdomen with numerous, large, sparsely scattered punctations and with very short, white hairs; dorsal foveae conspicuous; median groove extending from middle festoon anteriorly two-thirds distance to scutum; oblique grooves

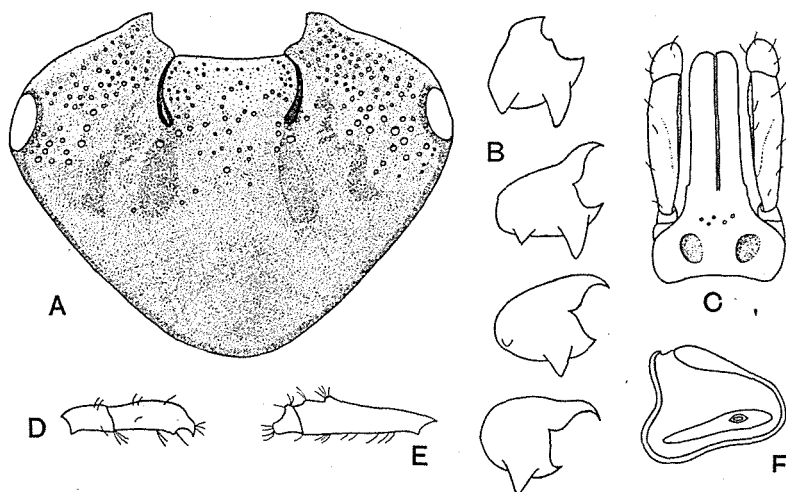


Fig. 18. *Amblyomma cordiferum* Neumann. Female: A, scutum; B, coxae I-IV; C, capitulum in dorsal view; D, tarsus IV; E, tarsus I; F, spiracle.

from second and third festoons, interrupted along their length, but continuing almost to scutum; three lateral depressions on each side; no marginal groove; festoons prominent and about as long as wide; abdomen ventrally lighter, with large punctations on lower third and with large, white hairs; genital opening opposite coxa II; anal opening opposite posterior border of spiracular plate; groove behind anal opening distinct and deep; brown, triangular, spiracular plates, with rounded angles and a dorsal prolongation. Coxae

small and finely punctate; coxa I with two unequal, conical, pointed and widely separated spurs; coxae II and III with two spurs; internal spur on coxa II distinct, but on coxa III very small, scarcely visible; coxae II-IV with external spur triangular, well developed and nearly equal; legs light and medium; femur, tibia and protarsus with pale markings on dorsal, distal portion; tarsi II-IV tapering gradually and ventrally with a distinct, terminal and subterminal spur; pulvillus about two-thirds length of claws. Basis rectangular and about twice as wide as long, with posterior margin slightly concave, and posterior angles slightly salient; porose areas fairly large, far apart, elliptical, and divergent anteriorly; few, small punctations anterior to porose areas; palps fairly long and slender; article two slightly over twice as long as article three; hypostome long and narrow, with 4:4 dentition.

Distribution and Hosts. Known from Banda Island (Neumann, 1899) and Krakatau Island (Krijgsman and Ponto, 1932). In the Museum of Comparative Zoölogy was seen one female collected by C. J. Aagaard at Bangkok, Siam, off *Ophiophagus hannah*.

Amblyomma crenatum Neumann.

Amblyomma crenatum Neumann, 1899, Mém. Soc. Zool. France, **12**, pp. 203, 214-215, fig. 52 (1 ♀, Cape of Good Hope, off *Rhinoceros*; type in Paris M.); 1901, *Op. cit.*, **14**, pp. 297-298 (2 ♂, 2 ♀, Sumatra?). Salmon and Stiles, 1902, 17th Ann. Rept. Bur. Anim. Industry, U. S. Dept. Agric., (1901), p. 473. Howard, 1908, Ann. Transvaal Mus., **1**, pt. 2, p. 145, Pl. 12, fig. i. Blanchard, 1909, L'Insecte et l'Infection, Fasc. **1**, Acariens, p. 128. Neumann, 1911, Das Tierreich, Lief. **26**, Acarina, Ixodidae, pp. 54, 57, 62, 66, 77-78, fig. 34 (♂, ♀, Cape of Good Hope, Liberia, Sumatra (?), off *Rhinoceros bicornis*); 1913, Voyage de Ch. Alluaud et R. Jeannel en Afrique Orientale (1911-1912), Résultats Scientifiques, Arachnides, 2, Ixodidae, p. 29 (1 ♀, Mbuyuni, Pori de Sérenghéti, Kenya Colony). Robinson, 1926, Ticks, **2**, pt. 4, *Amblyomma*, pp. 12, 21, 75-79, figs. 32-33 (1 ♂, from Imp. Bur. Ent.). Bequaert, 1933, Psyche, **40**, 4, pp. 137-140 (24 ♂, 12 ♀, Sungei Lampan, Lower Perak, Federated Malay States, off *Rhinoceros sondaicus*).

Amblyomma subluteum Neumann, 1899, Mém. Soc. Zool. France, **12**, pp. 201, 263 (2 ♂, one locality unknown, one

off African rhinoceros; cotypes in Paris M.); 1901, *Op. cit.*, 14, p. 309. Salmon and Stiles, 1902, 17th Ann. Rept. Bur. Anim. Industry, U. S. Dept. Agric., (1901), p. 472.

There is still uncertainty as to the exact range of *A. crenatum*. It has been recorded from Africa and from the Indo-Malayan region. In 1899 Neumann described the species from a single female from the Cape of Good Hope, South Africa. In the same year he also described *A. subluteum* from two males; the locality of one was unknown, and the other was from Africa. In 1901 Neumann saw in the Berlin Museum two dried males and two dried females collected in Sumatra by Mösch. On the basis of these four specimens he associated the males and females in his collection as one species, and he regarded *A. subluteum* as a synonym of *A. crenatum*. Neumann was doubtful that a species could be so widely separated, and he attempted to explain this unusual distribution by regarding the specimens from Sumatra as having been incorrectly labeled. In 1911 he added Liberia without indication of specimens. In 1913 Neumann recorded another female specimen from Mbuyuni (Pori de Sérenghéti), Kenya Colony, East Africa. This specimen was taken March 13, 1912, without indication of host. Robinson in 1926 also regarded *A. crenatum* as an African species and thought that the Sumatran material was incorrectly labeled. Bequaert in 1933 determined this species in Lower Perak, Federated Malay States. A portion of the twenty-four males and twelve females of this lot is in the Museum of Comparative Zoölogy, as well as two males collected in Java by Palmer and Bryant in 1910, with no indication of host. Bequaert, who had not seen Neumann's 1913 paper, regarded the African records as doubtful; he thought that they might have been taken off animals kept in captivity in Europe. It would be a simple matter to so disregard Neumann's two records from Africa, since they are vague as to the specific locality; however, the record of the one female from Mbuyuni is complete in this respect. The occurrence of this species in the Indo-Malayan region is now positively established, and the possibility that this species is also found in Africa can not be overlooked. Before final judgement can be made as to the complete range of this species, it is necessary that this one African specimen recorded by Neumann be re-examined. If it is not *A. crenatum* then Bequaert may be correct in assuming that the Indo-Malayan region is the only true origin of this species.

Male (Fig. 19A-F). Two Java specimens and fourteen Malayan specimens show a comparatively wide range of variation in

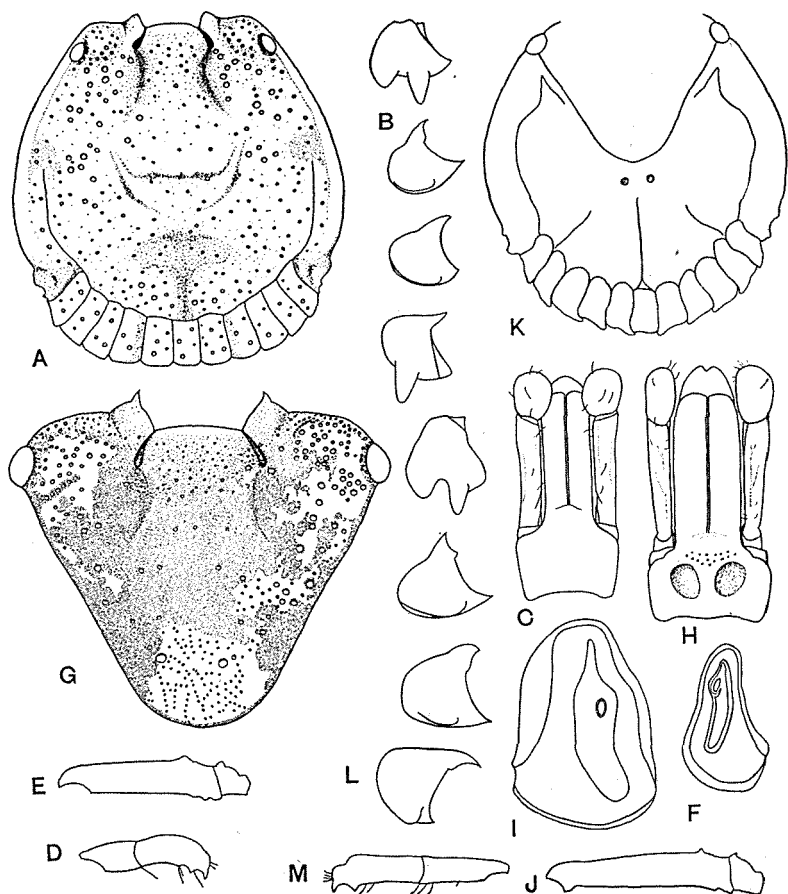


Fig. 19. *Amblyomma crenatum* Neumann. A-F, male: A, scutum; B, coxae I-IV; C, capitulum in dorsal view; D, tarsus IV; E, tarsus I; F, spiracle. G-M, female: G, scutum; H, capitulum in dorsal view; I, spiracle; J, tarsus I; K, body in dorsal view; L, coxae I-IV; M, tarsus IV.

size, from 8.1 to 5.1 mm. long by 8.1 to 5.2 mm. wide, exclusive of capitulum; average 6.98 mm. long by 7.05 mm. wide. Scutum almost orbicular, narrowed slightly behind region of spiracular plate, yellow-orange and with a few, scattered, dark-brown markings, a pale, metallic marking in region of each cervical groove and in area anterior to each eye; punctations large to small; larger ones slightly confluent in posterior portion; cervical grooves short, deep and well defined; yellow, flat eyes very far anteriorly; marginal groove extending only a short distance anteriorly from festoons; spiracular plate large and triangular; festoons very long, with graceful curves on inner margins. Legs very long, yellow-orange, with occasional dark bandings; tarsus I long, slender and with two dorsal humps; tarsus IV ventrally with a terminal and sub-terminal spur; coxa I with two spurs, external pointed and about twice as long as internal; coxae II and III with a broad and ridge-like spur; coxa IV with a single, moderately long spur, about twice as long as wide. Capitulum 3.0 mm. long; basis rectangular, slightly narrower in posterior portion; palps very long and slender; article two about three times as long as article three; hypostome dentition 3:3, with seven to eight teeth per file.

Female (Fig. 19G-M). Four unengorged Malayan specimens from 9.4 to 9.1 mm. long by 9.4 to 8.8 mm. wide, exclusive of capitulum; average 9.3 mm. long by 8.9 mm. wide; two fully engorged females respectively from 22 to 23 mm. long by 20 mm. wide by 16 to 17 mm. thick. Scutum triangular, 4.1 mm. long by 4.7 mm. wide; ornamentation variable, but with a spot in each corner; larger punctations slightly confluent and restricted to antero-lateral regions; finer punctations more numerous and more uniformly distributed; cervical grooves short and deep, continuing posteriorly as shallow furrows toward postero-lateral margin; eyes large, flat and yellow, extending beyond lateral margins of scutum. Marginal groove distinct; festoons large and longer at postero-internal angle, making posterior margin of abdomen saw-toothed; abdomen ventrally with numerous, short, white hairs and many punctations; spiracular plates large, triangular and with rounded corners. Legs very long; tarsus I long and slender, with two dorsal humps; tarsus IV ventrally with a terminal and sub-terminal spur; coxa I with two spurs, internal more blunt than that of male; coxae II and III with a broad and ridge-like spur; coxa IV with a single spur, much shorter than that of male. Capitulum 3.3 mm. long; basis nearly rectangular and broader in front; porose areas large, depressed and

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divergent; palps very long and slender; notched hypostome with 3:3 dentition anteriorly, becoming 4:4 in posterior third.

Distribution and Hosts. It has been recorded from Africa (Neumann, 1899, 1911, 1913) and from the Federated Malay States (Bequaert, 1933). Six females and fourteen males were seen in the Museum of Comparative Zoölogy from Lower Perak, Federated Malay States, taken off *Rhinoceros sondaicus*. These are part of the same lot referred to by Bequaert in 1933. Two male specimens seen in the Museum of Comparative Zoölogy were collected by Palmer and Bryant in 1910 at Tamandjaija, Bantam, Java, without indication of host.

Biology. *Amblyomma crenatum* shows a remarkable adaptation to its peculiar host, the rhinoceros. The capitulum is very long, and it is capable of penetrating the thick skin easily; the large articles of the cheliceral digits are well adapted for cutting through the tough hide of this animal; and the very long legs enable the tick to move easily over the large body of its host. The two devices which aid most ticks in the process of attaching to their hosts are the claws and spurs. In this case the claws are very long and are about two and a half times as long as the pulvillus. The ventral terminal and sub-terminal spurs of the tarsus are also large. When the tick is about to attach, the claws hold the tick temporarily in place; the legs are then flexed, and this action pulls the spurs firmly into the hide anchoring the tick securely until the hypostome can be inserted. After it is inserted, the hypostome acts as the main organ of attachment. The sharpness of the spurs can be readily demonstrated when a leg is pulled across the finger, for the spur will easily penetrate the skin.

Amblyomma cyprium Neumann.

This species was divided into two subspecies by P. Schulze in 1933. The typical form has a wider distribution, whereas the subspecies, *A. cyprium aeratipes* Schulze, appears to be restricted to the Philippine Islands.

Amblyomma cyprium cyprium Neumann.

Amblyomma cyprium Neumann, 1899, Mém. Soc. Zool. France, 12, pp. 202, 204, 219-221 [in part; not one male from Philippine Islands] (3 ♂, 5 ♀, Mariana Is.; 1 ♀ without locality; cotypes at Paris M.). Salmon and Stiles, 1902, 17th Ann. Rept. Bur. Anim. Industry, U. S. Dept. Agric., (1901), pp. 473, 474. Blanchard, 1909, L'Insecte et l'In-

- fection, Fasc. 1, Acariens, p. 128. Neumann, 1911, Das Tierreich, Lief. 26, Acarina, Ixodidae, pp. 56, 59, 64, 67, 87-88 [in part: not the Philippine record] (New Guinea, Malay Peninsula, off Chelonia). Jepson, 1911, Council Paper No. 25, Dept. Agric., Fiji, p. 32 (Fiji Is., off bush pig and cattle). Patton and Cragg, 1913, Textbook Medical Ent., p. 616. Turbet, 1924, Ann. Rept. Vet. Officer, Dept. Agric., Fiji (off horses, pigs and cattle in Fiji Islands.) Fielding, 1926, Comm. Austral. Service Publ. (Trop. Div.) No. 9, pp. 82-83. Robinson, 1926, Ticks, 2, pt. 4, *Amblyomma*, pp. 17, 21, 233-236, fig. 115 [in part: description and figure of ♂, nec ♀] (♂, Celebes, off *Sus celebensis*). Schulze, 1936, Meddel. Zool. Mus., Oslo, No. 45, p. 158 (morphological); 1941, Zeitschr. Morph. Oekol. Tiere, 37, pt. 3, pp. 514, 517 (morphological). Lever, 1943, Agric. Journ., Fiji, 14, pt. 2, p. 40 (♀, Nadarivatu, Fiji, off man). Alicata, 1948, Pacific Science, 2, pt. 1, p. 65 (Guam).
- Amblyomma scaevola* Oudemans, 1905, Ent. Ber. Nederl. Ent. Ver., 1, pt. 22, p. 216 (♂, Manokwari, New Guinea; type in Zool. M. Amsterdam); 1906, Nova Guinea, 5, Zool., pt. 1, pp. 105, 130-131, Pl. 3, figs. 51-58. Neumann, 1911, Das Tierreich, Lief. 26, Acarina, Ixodidae, pp. 56, 64, 87. Fielding, 1926, Comm. Australia Service Publ. (Trop. Div.), No. 9, pp. 83-84.
- Amblyomma quasicyprium* Robinson, 1926, Ticks, 2, pt. 4, *Amblyomma*, pp. 21, 237-238, fig. 117 (1 ♀, Frontera, Tabasco, Mexico, off *Ateles melanochir*; 1 ♀, Tavenni, Fiji Is., off cow; cotypes in Brit. Mus.). Schulze, 1933, Zool. Anz., 104, pts. 11-12, p. 322 (true female of *A. cyprium*; Mexico is incorrect locality).
- Amblyomma dammermani* Warburton, 1927, Parasitology, 19, pt. 4, pp. 409-410, Pl. 27, fig. 3 (1 ♀, Goenoeng Daab, Great Kei Id., without host; type in Zool. M. Buitenzorg). Krijgsman and Ponto, 1931, Zeitschr. f. Parasitenk., 4, pt. 1, pp. 141, 144, map 4; 1932, Veeartsenijk. Meded., No. 79, pp. 23, 35, fig. 37, map 4. Schulze, 1936, Meddel. Zool. Mus., Oslo, No. 45, p. 158 (morphological). Toumanoff, 1944, Les Tiques (Ixodoidea) de l'Indochine, pp. 116, 120, Pl. 82.

In 1932 Krijgsman and Ponto recorded males of this species

from Celebes, but their figure of the female is that of another species, *A. babirussae* Schulze. Toumanoff recorded this species from Central Annam in 1944, but his figures *a-b*, plate 78, represent the female of another species closely resembling *A. malayanum* Neumann. Warburton described *A. dammermani* in 1927 from one female collected in the Kei Islands by H. C. Sibers, and he illustrated his description with a dorsal view photograph. In 1932 Krijgsman and Ponto, who also saw this same specimen in the Buitenzorg Museum, made an accurate drawing of it. Since these descriptions and illustrations agree in every respect with females of *A. cyprium* I have from the Flores Islands, Fiji Islands and New Hebrides, I regard *A. dammermani* as a synonym of *A. cyprium cyprium*.

The great confusion present in this species is due to Neumann's failure to illustrate it and to give an adequate description. As a result, females of several closely related species have been confused. I found enough males and females in association to convince me of their relationship.

In 1933 Schulze described the subspecies *A. cyprium aeratipes* from the Philippine Islands. I saw numerous specimens from the same islands, and I agree that they are distinct from the typical form. The males of the two subspecies resemble each other closely, but the females are readily distinguished. All of the earlier records from the Philippine region are included under the synonymy of the subspecies *aeratipes* Schulze. I believe that there is justification for this, for I have seen very many specimens from these islands, and in no case did I see any which could be ascribed to the typical form.

Male (Fig. 20A-F). Two unengorged specimens from Roeteng, Flores, respectively 5.85 and 5.8 mm. long by 5.4 and 5.1 mm. wide, exclusive of capitulum. Body broad-oval, narrowed anteriorly in front of eyes and widest in front of posterior third. Scutum slightly convex, reddish-brown, with some copper-colored markings anterior to eyes or on pseudo-scutum; pseudo-scutum very pronounced; punctations large, numerous and deep at periphery, but almost completely lacking in semi-lateral and median regions; partially confluent in region of lateral margins; cervical grooves short, deep and prolonged posteriorly as shallow depressions; eyes large, flat and yellow-orange; no lateral groove; festoons longer than wide. Ventral, abdominal surface yellow, finely punctate and finely wrinkled; numerous, small, white hairs posteriorly; genital

opening opposite coxa II; spiracles large and comma-shaped; anal opening opposite posterior border of spiracle. Legs long, stout and reddish-brown, with many, long, white hairs; coxa I with two short, flat spurs; external spur longer than internal spur; other coxae with a single, strong, triangular spur; tarsi long, tapering gradually; tarsi of second, third and fourth pair of legs ending in a strong, terminal and sub-terminal spur; claws about twice the

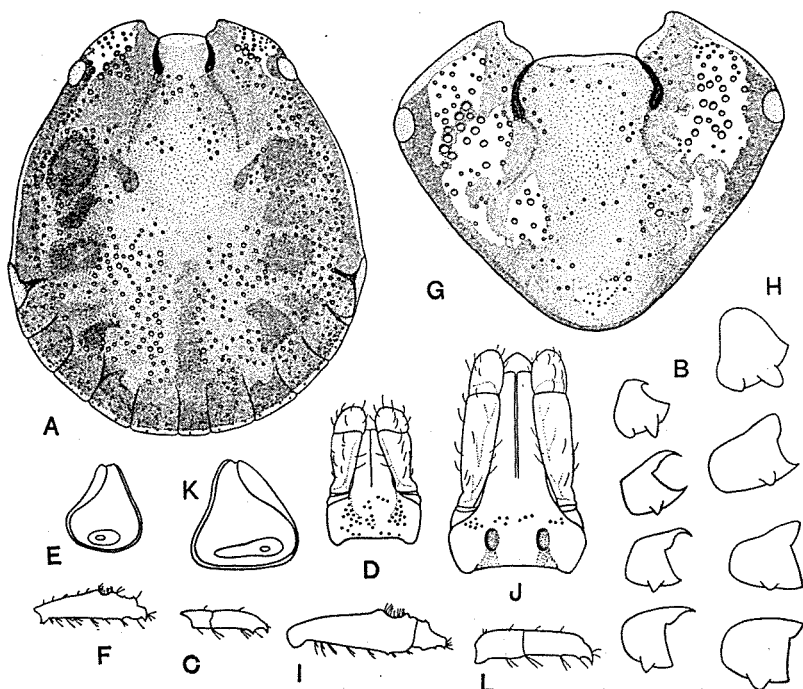


Fig. 20. *Amblyomma cyprum cyprum* Neumann. A-F, male; A, scutum; B, coxae I-IV; C, tarsus IV; D, capitulum in dorsal view; E, spiracle; F, tarsus I. G-L, female: G, scutum; H, coxae I-IV; I, tarsus I; J, capitulum in dorsal view; K, spiracle; L, tarsus IV.

length of small pulvillus. Capitulum comparatively short; rectangular basis slightly broader than long, with short cornua; posterior portion of basis with many punctations, some slightly confluent; short palps wrinkled and with numerous, long, white hairs; second article about twice the length of third article; hypostome

shorter than palps; dentition 4:4, with inner row shorter than others.

Female (Fig. 20G-L). One partially engorged specimen from Roeteng, Flores, 10.02 mm. long by 8.4 mm. wide, exclusive of capitulum. Scutum from 3.3 to 3.12 mm. long by 3.9 to 3.6 mm. wide in five specimens; average 3.19 mm. long by 3.7 mm. wide; triangular-cordiform, wider than long, posterior angle broad, reddish-yellow with a complete, dark brown border extending posteriorly from eyes; pattern of enamel markings variable; large spots in antero-lateral regions and a small spot in posterior angle; markings in median area present or absent; punctations in antero-lateral areas larger and more numerous; those in remainder of scutum smaller and more sparsely distributed; cervical grooves deep and wide anteriorly; large, conspicuous, yellow eyes set off by dark eye spots. Abdomen yellow-brown, finely wrinkled and with very numerous punctations; a short, white hair in each punctation; festoons as broad as long; no marginal grooves; abdomen ventrally with hairs less numerous and much smaller; genital opening small and opposite coxa II; anal opening opposite spiracle; triangular spiracle with rounded corners. Brown legs with pale mother-of-pearl markings at distal end of each joint; long, white hairs on all legs; coxa I with two short, sub-equal spurs, external slightly longer than internal spur; other coxae with a single, broad, short spur; tarsus IV small, cylindrical, tapering gradually and with a terminal and sub-terminal spur; pulvilli medium-sized. Capitulum slightly over 2 mm. long, rectangular and broader than long, with sides slightly convex; cornua short and blunt; porose areas small, deep and widely separated; hypostome long and straight, with 4:4 dentition; palps long; article two slightly over twice as long as article three; palps slightly longer than hypostome.

Distribution and Hosts. This subspecies is widely distributed and is known from the Mariana Islands, New Guinea, Malay Peninsula, and the Fiji Islands. In the East Indies it is known from Celebes (Robinson, 1926) and Kai Island (Warburton, 1927; Krijgsman and Ponto, 1931, 1932). Specimens were seen from the following localities in the Oriental Region: Flores (Roeteng, five females and two males, off buffalo, in Kraneveld collection), Mariana Islands (Ladrones Islands, one female, in Museum of Comparative Zoölogy), Fiji Islands (Nagaranabuluti, near Nadarwatu, one female, off man, R. A. Lever coll., in Rocky Mountain Laboratory; Suva, one male, W. M. Mann coll.; Veti levu, Saiaro, one male, W. M. Mann coll.; Fiji, six females, W. M. Mann coll., all in Museum

of Comparative Zoölogy), New Hebrides (Espiritu Santo, one female, one male, G. Banner coll., in Rocky Mountain Laboratory; Erromango, one male, one female; Tanna Island, one male, all in Museum of Comparative Zoölogy), New Guinea (Bululo, one male, four females, off *Sus papuensis*, C. Günther coll.; Biak or Owi Island, one female, off man, R. S. Fitz coll.; Finschafen, one male, E. S. Ross coll.; Sansapor, one male, on clothing of man, G. M. Kohls coll.; all in Rocky Mountain Laboratory), Santa Cruz Group (Vanikoro Island, one female, off wild pig, E. Troughton and A. Livingstone coll., in Rocky Mountain Laboratory).

Biology. The original host of this tick was unknown. In 1911 Neumann gave turtles as such, but without stating on what evidence. Krijgsman and Ponto in 1932 list the same host, apparently repeating Neumann. I doubt that this tick occurs on reptiles, for a study of the many host records shows that only mammals are attacked. There are no definite or authentic records of its ever having been taken off reptiles.

Amblyomma cyprium aeratipes Schulze.

Amblyomma cyprium aeratipes Schulze, 1932, Zeitschr. Morph. Oekol., Tiere, **25**, pts. 2-3, p. 526 [*nomen nudum*; morphological]; 1933, Zool. Anz., **104**, pts. 11-12, pp. 321-322 (1 ♂, Momangan, North Mindanao; 1 ♀, Pt. Banga, Mindanao; type ♂ in Berlin Museum) [validates *nomen nudum* of 1932]; 1936, Meddel. Zool. Mus., Oslo, No. **45**, p. 158 (morphological).

Amblyomma cyprium Neumann, 1899, Mém. Soc. Zool. France, **12**, p. 221 [in part: only the male from Philippine Islands]; 1911, Das Tierreich, Lief. **26**, Acarina, Ixodidae, p. 88 [in part: only Philippine record].

Male. This subspecies is darker than the typical form. The greenish-enamel markings on the legs are very pronounced and give the legs a banded appearance at the joints. In the typical form the markings are more mother-of-pearl and do not show this characteristic banding. The pseudoscutum is markedly set off by ornamentation, but in the typical form ornamentation is usually found on the antero-lateral margins only. Specimens of *A. cyprium aeratipes* studied are uniformly, heavily punctate, and these punctations are confluent in the median and posterior regions. In the typical form the punctations are less numerous in the median area, and they are confluent only slightly in the posterior region.

Female. The Philippine subspecies is generally darker, and the posterior angle of the scutum is more pointed than that of the typical form. The punctations of *aeratipes* are larger, more numerous and slightly confluent. The greenish-enamel markings on the legs are very pronounced, while those of the typical form are mother-of-pearl. The spurs on coxa I are longer than those of the typical form; the external spur is about twice as long as the internal in contrast to the typical form where they are nearly equal.

Distribution and Hosts. Seventeen lots were seen agreeing with Schulze's description of *A. cyprum aeratipes*. These lots include twenty-seven females and eight males, and all are restricted to the Philippine Islands. Where host records are stated they are off man with the exception of one unusual record in the Rocky Mountain Laboratory of a female taken off a bird, *Harpactes ardena rhodiosternum* by H. Hoogstraal in Mindanao.

Amblyomma geoemydae (Cantor).

Ixodes geoemydae Cantor, 1847, Journ. Asiatic Soc. Bengal, **16**, pt. 2, p. 608 (♀, Pinang Hills, Sumatra, off *Geoemyda spinosa*; type in British Museum).

Amblyomma geoemydae Neumann, 1906, Arch. de Parasitol., **10**, pt. 2, pp. 214-216, figs. 15-16 (examined type; 3 ♀, Mt. Kinabalu, Borneo); 1911, Das Tierreich, Lief. **26**, Acarina, Ixodidae, pp. 59, 68, 88. Robinson, 1926, Ticks, **2**, pt. 4, *Amblyomma*, pp. 21, 230-231, fig. 113. Krijgsman and Ponto, 1931, Zeitschr. f. Parasitenk., **4**, pt. 1, pp. 141, 144, map 4; 1932, Veeartsenijk. Meded., No. **79**, pp. 23, 35, fig. 34, map 4. Toumanoff, 1944, Les Tiques (Ixodoidea) de l'Indochine, pp. 116, 120, Pl. 84.

Amblyomma geomydae Schulze, 1932, Zeitschr. f. Parasitenk., **4**, pt. 3, pp. 470-471, fig. 7 (1 ♀, n, Soekaranda, Sumatra); 1932, Zeitschr. Morph. Oekol. Tiere, **25**, pt. 2-3, p. 525 (morphological).

Haemalastor geoemydae Oudemans, 1936, Krit. Histor. Overzicht Aëcarologie, **3**, Bd. B, pp. 487-488.

This species was not seen and the following description of the female, taken from Neumann, 1906, and from Robinson, 1926, gives the main diagnostic characters. Scutum triangular, with sides nearly straight and with posterior angle narrow; ornate, with three yellow spots on maroon-brown background; cervical grooves long, distinct and concave externally; punctations numerous, large, unequal and deep. Spiracular plate large and sub-triangular. Cor-

nua absent; large, oval porose areas divergent anteriorly and close together; hypostome with 4:4 dentition. Coxa I with two flat, short, separated spurs as wide as long; coxae II-IV each with a single spur; tarsi long and terminating in talus; each ends in two small, consecutive spurs. The male is as yet unknown. The nymph, described and figured by Schulze (1932), is unusual in having pale enamel spots on the scutum.

Distribution and Hosts. The species is known thus far only from Sumatra and Borneo. It is probably restricted to land tortoises.

Amblyomma helvolum Koch.

Amblyomma helvolum C. L. Koch, 1844, Arch. f. Naturgesch., 10, pt. 1, p. 230, No. 39 (♀, Manila; type in Berlin Museum); 1847, Uebersicht des Arachnidensystems, 4, pp. 19, 93-94, Pl. 18, fig. 66. Neumann, 1899, Mém. Soc. Zool. France, 12, pp. 278-279; 1901, *Op cit.*, 14, p. 312 (corrects Neumann, 1899). Blanchard, 1909, L'Insecte et l'Infection, Fasc. 1, Acariens, p. 130. Neumann, 1911, Das Tierreich, Lief. 26, Acarina, Ixodidae, p. 90 (uncertain species). Warburton, 1926, Treubia, 8, pts. 3-4, p. 279 (4 ♀, Sinabang and Busung, Simeuloeë Island, Babi Island, off *Varanus salvator*, *Mabuya multifasciata*, "*Naja bungarus*" = *Ophiophagus hannah*). Robinson, 1926, Ticks, 2, pt. 4, *Amblyomma*, pp. 16, 20, 216-219, fig. 106 (extensive host and distribution lists). Oudemans, 1928, Ent. Ber. Nederl. Ent. Ver., 7, pt. 164, p. 376 (12 ♂, 2 ♀, Berhala Island, off "*Dipsadomorphus dendrophilus*" = *Boiga dendrophila*; 1 ♂, from pisang stem). Sharif, 1928, Records Indian Mus., 30, pt. 3, pp. 325-326 (2 ♀, Singora, Siam, off *Coluber radiatus*; 2 ♀, off *Varanus nebulosus*). Oudemans, 1929, Tijdschr. Ent., 72, Suppl., p. 208 (the "Goudachtig gevlekte teek" Wurm, 1781, Verh. Bataviaasch. Gen., 3, p. 400; "op de groote adder," python (?), Java). Vitzthum, 1931, Résultats Scientif. Voyage Indes Orient. Néerland. Prince Léopold, 3, pt. 5, pp. 28-29 (♀, Tandjoeng Keling, Sumatra). Krijgsman and Ponto, 1931, Zeitschr. f. Parasitenk., 4, pt. 1, pp. 141, 143, map 4 (♂, ♀, Java, off *Varanus salvator* and *Mabuya multifasciata*); 1932, Veeartsenijk. Meded., No. 79, pp. 23, 34, 35, figs. 29-30 (♂, ♀, Java). Schulze, 1933, Arch. f. Hydrobiol., Suppl.-Bd. 12,

pp. 495-496, 497, 498, figs. 3-4 (figures from type; 1 ♀, Leyte, P. I.; 7 ♂, Komodo, off *Varanus komodoensis*; 1 ♂, Endeh, Flores, off *Varanus salvator*). Toumanoff, 1944, Les Tiques (Ixodoidea) de l'Indochine, pp. 115, 118, 120, Pls. 82, 84.

Amblyomma decoratum C. L. Koch, 1844, Arch. f. Naturgesch., 10, pt. 1, pp. 230-231, No. 40 (♂, Philippine Is.; type in Berlin M.); 1847, Uebersicht des Arachnidensystems, 4, pp. 19, 94-95, Pl. 18, fig. 67. Neumann, 1899, Mém. Soc. Zool. France, 12, pp. 203, 245 (5 ♂, Philippine Is.); 1901, Op. cit., 14, p. 304. Salmon and Stiles, 1902, 17th Ann. Rept. Bur. Anim. Industry, U. S. Dept. Agric., (1901), p. 473. Neumann, 1910, Ann. Sci. Nat. Zool., 9, pp. 175-176 (4 ♂, Manila, Luzon; 1 ♂, off *Varanus salvator*, locality unknown; 1 ♀, Padang, Sumatra, off *Varanus salvator*). Warburton, 1910, Parasitology, 3, pt. 4, p. 396 (Zool. Gardens, Calcutta, off *Geoemyda grandis*; Nicobar Islands, off *Varanus salvator*). Neumann, 1911, Das Tierreich, Lief. 26, Acarina, Ixodidae, pp. 56, 57, 64, 67, 87 (♂, ♀, Philippine Islands, Java, Sumatra, off "*Zamenis mucosus*" = *Ptyas mucosus*, *Varanus salvator*, *Python reticulatus*).

Amblyomma fimbriatum C. L. Koch, 1844, Arch. f. Naturgesch., 10, pt. 1, p. 231, No. 42 (♂, Manila); 1847, Uebersicht des Arachnidensystems, 4, pp. 20, 95, Pl. 18, fig. 68.

Amblyomma quadrimaculatum Neumann, 1899, Mém. Soc. Zool. France, 12, pp. 202, 245-246 (1 ♂, Java, off "*Triglyphedon dendrophilum*" = *Boiga dendrophila*; type described from Oudemans Coll., now at Leiden M.); 1901, Op. cit., 14, p. 304 (4 ♂ and 2 mutilated ♀, Java, off *Python reticulatus*). Salmon and Stiles, 1902, 17th Ann. Rept. Bur. Anim. Industry, U. S. Dept. Agric., (1901), p. 473. Schulze, 1933, Arch. f. Hydrobiol., Suppl.-Bd. 12, pp. 492, 495, 497, 498, figs. 5-6 (5 ♀, Ranau, Sumatra, off *Varanus salvator*; 2 ♂, Java off "*Varanus bivittatus*" = *Varanus salvator*, 1 ♀, Edi, Sumatra; 3 ♂, Java, off "*Dipsadomorphus dendrophilus*" = *Boiga dendrophila*); 1943, Zeitschr. Morph. Oekol. Tiere, 39, pt. 2, p. 355, fig. 38 (Sumatra; morphological). Buitendijk, 1945, Zoolog. Meded. Leiden, 24, pts. 3-4, p. 285 (type; locality here given as Pulau Berhala).

Amblyomma furcosum Neumann, 1901, Mém. Soc. Zool. France,

14, pp. 299-300 (2 ♀, Java, off *Python reticulatus*; type in Berlin M.).

Amblyomma (*Aponomma*) *tenimberense* S. and L. Hirst, 1910, Ann. Mag. Nat. Hist., (8), 6, pp. 307-308, fig. 9 (♂, Tanimbar Island, off *Varanus indicus*; type in Brit. Mus.).

Amblyomma feuerborni Schulze, 1932, Zeitschr. Morph. Oekol. Tiere, 25, pts. 2-3, p. 527 [*nomen nudum*]; 1933, Arch. f. Hydrobiol., Suppl.-Bd. 12, pp. 492-495, 497, 498, figs. 7-9 (4 ♂, 1 ♀, Klakah, Java, off snake, probably *Ptyas mucosus*; 1 ♂, same locality, off *Python reticulatus*; 3 ♂, Berhala Island, off "*Dipsadomorphus dendrophilus*" = *Boiga dendrophila* and undersized male from hollow pisang stem; holotype ♂ from Java, off ?*Ptyas*, in Z. M. Berlin) [validates *nomen nudum* of 1932].

Haemalastor helvolum Oudemans, 1936, Krit. Histor. Overzicht Acarologie, 3, Bd. B, pp. 492-494, figs. 199-200.

So many specific names are involved in the synonymy of this species that it is best to discuss them in chronological order.

In 1844 C. L. Koch described three species in the following sequence: *Amblyomma helvolum* based on a female from Manila, *Amblyomma decoratum* based on a male from the Philippine Islands, and *Amblyomma fimbriatum* based on a male from Manila. The types are in the Zoological Museum, Berlin. In 1847 he gave supplementary descriptions and figures for all three species. After examining five males collected by F. Semper in the Philippine Islands, Neumann decided in 1899 that they were *A. decoratum*. These specimens belonging to the Hamburg Museum had been named "*Ixodes aquilae*," an unpublished name. In the same year he described *A. quadrimaculatum* from a male in the Oudemans' collection in Java. In 1899 he also published a short description of *A. helvolum* based upon the same female that Koch had described from Manila. In 1901 Neumann reduced *A. fimbriatum*, known from a single male specimen, to a synonym of *A. decoratum*. He also described *A. furcosum* in 1901 from two females collected in Java and deposited in the Berlin Museum, but in 1910, after seeing Koch's specimens, he reduced it to a synonym of *A. decoratum*. In the same year S. and L. Hirst described a new species, *Amblyomma* (*Aponomma*) *tenimberense*, from a male taken on Tanimbar Island. In 1911 Neumann reduced *A. quadrimaculatum* to a synonym of *A. decoratum*. Up to the time of Robinson in 1926, there were only three remaining names in this complex which were re-

garded as valid: *A. helvolum*, *A. decoratum* and *A. (Aponomma) tenimberense*. Robinson compared the type of *A. helvolum* with numerous females of *A. decoratum*; because he could find no constant characters to distinguish them, he regarded *A. decoratum* as a synonym of *A. helvolum*. Robinson agreed with Neumann in degrading *A. fimbriatum*, *A. quadrimaculatum* and *A. furcosum* to synonyms of *A. decoratum*. Robinson also reduced *A. (Aponomma) tenimberense* to a synonym of *A. helvolum*. In 1933 Schulze claimed that three species had been confused in the *helvolum* group; he revived *A. quadrimaculatum*, and he described *Amblyomma feuerborni* from four males and one female from Java. The characters selected to separate these forms by Schulze are tenuous. I have compared specimens from the Philippine Islands, Java and Sumatra, and though slight differences exist in the males, they are probably due to individual variation. The females can not be separated. Only by rearing these forms in sufficient numbers could the question be settled definitely. For the time being I can only regard *A. feuerborni* and *A. quadrimaculatum* as synonyms of *A. helvolum*.

Male (Fig. 21A-F). Ten partially engorged specimens from 3.15 to 2.7 mm. long by 2.85 to 2.4 mm. wide, exclusive of capitulum; average 2.91 mm. long by 2.54 mm. wide. Body sub-quadangular, posterior border slightly rounded, lateral margins slightly convex, reddish-brown; punctations unequal, numerous and evenly distributed in most specimens, but in some completely absent in median area; cervical grooves short, deep and slightly widened posteriorly; no elevations, depressions or lateral grooves; festoons distinct; eyes small, yellow and frequently indistinct; size, shape and distribution of markings variable; pale ornamentation generally distributed over body as a small marking in each scapular angle, an elongated marking in each lateral field and two adjacent, symmetrical spots in posterior region; some with median markings varying from one to three, but others lacking a median spot. Ventral body surface pale yellow and conspicuously wrinkled; numerous, short, white hairs on posterior third; genital opening opposite posterior border of coxa II; anal opening very far posteriorly and opposite posterior border of spiracular plate; anal groove very distinct; spiracular plates large and comma-shaped. Legs moderately long and stout; coxa I with two spurs, external about twice as long as internal; remaining coxae with a single, triangular spur; tarsi tapering gradually. Capitulum relatively long; basis rectangular

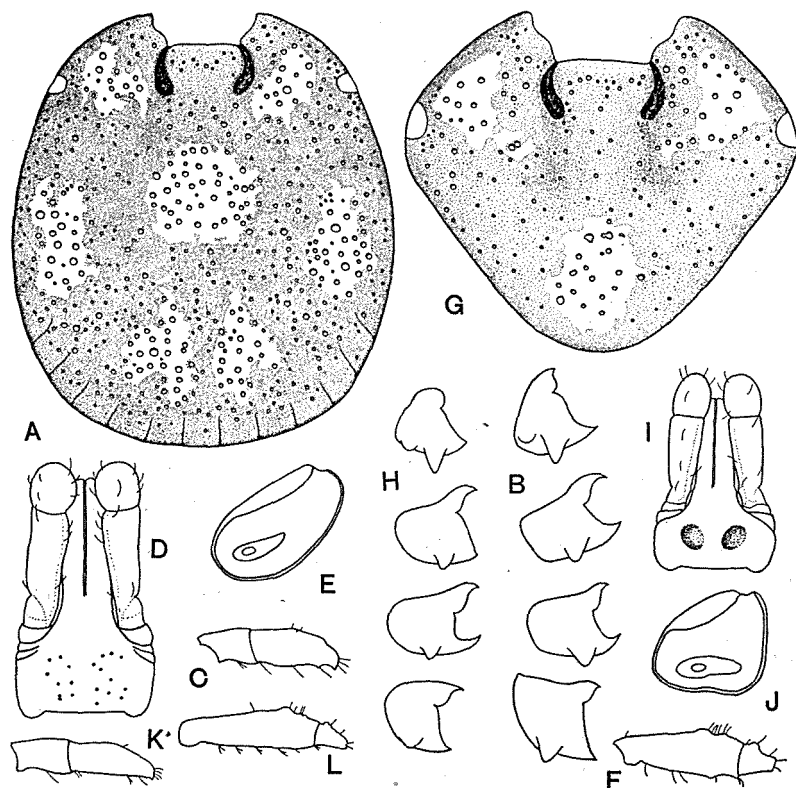


Fig. 21. *Amblyomma helvolum* Koch. A-F, male: A, scutum; B, coxae I-IV; C, tarsus IV; D, capitulum in dorsal view; E, spiracle; F, tarsus I. G-L, female: G, scutum; H, coxae I-IV; I, capitulum in dorsal view; J, spiracle; K, tarsus IV; L, tarsus I.

and slightly wider than long; palps long, with article two over twice as long as article three; hypostome long and spatulate; 3:3 dentition, with relatively large and distinct teeth.

Female (Fig. 21G-L). All partially engorged, and largest 5.4 mm. long by 4.05 mm. wide. Body broad-oval and narrowed anteriorly near scutum. Scutum from 2.1 to 1.8 mm. long by 2.4 to 2.22 mm. wide, average 1.94 mm. long by 2.27 mm. wide, small, sub-triangular, with rounded angles and posterior angle medium broad, postero-lateral margins sinuous to slightly convex, reddish-brown, ornate, with a large marking in each scapular angle and with one in posterior angle; size and shape of markings variable; punctations fine to medium and evenly distributed; cervical grooves short, deep and prolonged posteriorly as a very shallow depression; dorsal foveae well defined; eyes small, pale and often difficult to distinguish; festoons distinct and not widely separated. Ventral body surface similar in color to dorsal surface; numerous, fine punctations on posterior third, with short, white hairs; genital opening opposite coxa II; anal opening opposite posterior third of spiracular plate; spiracular plates broad. Legs moderately long and stout; external spur on coxa I much longer than very small internal spur; coxae II-IV with a single, medium-sized spur. Capitulum long; basis rectangular, broader than long, and with posterior angles slightly salient; porose areas large, deep and divergent; palps long; hypostome with 3:3 dentition.

Distribution and Hosts. This species is very widely distributed and is known from the Philippine Islands, Nicobar Islands, Netherlands East Indies, Federated Malay States, St. John's Island (Singapore), Borneo, New South Wales, India and Siam. In the East Indies it has been recorded from Java (Neumann, 1899, 1901, 1911; Robinson, 1926; Oudemans, 1929; Krijgsman and Ponto, 1931, 1932; Schulze, 1933), Sumatra (Neumann, 1910, 1911; Vitzthum, 1931; Schulze, 1933, 1943), Simeuloeë Island and Babi Island (Warburton, 1926), Berhala Island (Oudemans, 1928; Schulze, 1933), Komodo Island and Flores Island (Schulze, 1933), Tanimbar (S. and L. Hirst, 1910).

Numerous specimens from the Philippine Islands were seen in the Rocky Mountain Laboratory and in the Museum of Comparative Zoölogy. The following additional records from Java and Sumatra are based upon specimens seen in the Museum of Comparative Zoölogy: Java (Buitenzorg, fourteen males, one female, taken off snake by Palmer and Bryant, March 8, 1909; three females, three

males, taken off *Varanus* sp. by Palmer and Bryant, March 28, 1909; two females, one male, collected by Palmer and Bryant, March, 1909. Depok, three males, one female, taken off cobra by Palmer and Bryant, July 7, 1909; one female taken off *Ptyas korros*). Sumatra (Dolok Merangir, E. coast of Sumatra, three females, taken off *Naja naja leucodira* by W. A. Bangham).

Biology. In 1926 Robinson reported finding one nymph with several males taken off "*Iguana*" = *Varanus* from St. John's Island (Singapore, Straits Settlement). Robinson neither figured nor described this nymph. In a lot of three males and three females, which had been taken off *Varanus* sp. by Palmer and Bryant in 1901 at Buitenzorg, Java, March 28, 1909, I found four nymphs which closely resemble the female of *A. helvolum*, and no eyes could be distinguished. These nymphs might possibly belong to the genus *Aponomma*, which lacks eyes, or it is possible that the immature forms of *A. helvolum* might lack eyes. This question can only be settled by breeding experiments.

Amblyomma javanense (Supino).

Rhipicephalus javanensis Supino, 1897, Atti Soc. Veneto-Trent. Sci. Nat., (2) 3, pt. 1, p. 233 (n, Karkecet (Tenasserim), off *Manis javanica*; type in Genoa M.). Neumann, 1897, Mém. Soc. Zool. France, 10, p. 416.

Dermacentor indicus Supino, 1897, Atti Soc. Veneto-Trent. Sci. Nat., (2) 3, pt. 1, p. 236 (♂, ♀, Kokarcet (Tenasserim); Bhamo, Burma, off *Manis javanica*, "*Manis aurita*" = *Manis pentadactyla dolmanni*); 1897, *Op. cit.*, (2) 3, pt. 2, p. 251, Pl. 13, fig. 15. Neumann, 1897, Mém. Soc. Zool. France, 10, pp. 382-383.

Aponomma politum Neumann, 1899, *Op. cit.*, 12, p. 191 (2 ♂, off *Python molurus*, without locality; cotypes probably in Paris M.). Salmon and Stiles, 1902, 17th Ann. Rept. Bur. Anim. Industry, U. S. Dept. Agric., (1901), p. 470.

Amblyomma sublaeve Neumann, 1899, Mém. Soc. Zool. France, 12, p. 204, 221 (2 ♀, Siam; cotypes in Paris M.); 1901, *Op. cit.*, 14, pp. 298-299 (2 ♂, 2 ♀, Canton, China). Salmon and Stiles, 1902, 17th Ann. Rept. Bur. Anim. Industry, U. S. Dept. Agric., (1901), p. 474. Warburton, 1910, Parasitology, 3, pt. 4, p. 396 (many localities in India, off *Manis* spp. and "*Euprepes*" = *Mabuya*). Neumann, 1911, Das Tierreich, Lief. 26, Acarina, Ixodidae,

- pp. 56, 59, 63, 64, 68, 85-86. Nuttall, 1914, Parasitology, **7**, pt. 3, p. 256, fig. 10 (n, Karkecet, Burma, off *Manis javanica*; in lot labeled *R. javanensis* by Supino). Warburton, 1925, Spolia Zeylanica, **13**, pt. 2, p. 256 (Colombo, Ceylon, off pangolin). Robinson, 1926, Ticks, **2**, pt. 4, *Amblyomma*, pp. 17, 23, 244-247, figs. 120-121 (♂, ♀, wide distribution and many hosts). Sharif, 1928, Records Indian Mus., **30**, pt. 3, pp. 328-330, fig. 45 (♂, ♀, Central Prov., off *Manis* sp.; ♂, Bengal, off *Manis pentadactyla* and "*Nicoria tricarinata*" = *Geoemyda tricarinata*; ♀, Punjab, off *Vesperugo abramus*; ♂, Bombay Presidency, without host). Krijgsman and Ponto, 1931, Zeitschr. f. Parasitenk., **4**, pt. 1, pp. 141, 143, map 4; 1932, Veeartsenijk. Meded., No. **79**, pp. 22-23, 34, 36, figs. 27-28, map 4 (♂, ♀, Java, off *Manis javanica*). Toumanoff, 1944, Les Tiques (Ixodoidea) de l'Indochine, pp. 104-105, 118, 120, Pls. 72-74 (♂, ♀, Cambodge and Cochin China, off bear, Sambar deer and wild pig).
- Aponomma latum*, Neumann [nec Koch, 1844] 1901, Mém. Soc. Zool. France, **14**, pp. 291-292, 344 (4 ♂, 1 ♀, India, off serpent) [in part: equals *Aponomma politum* Neumann, 1899, syn.]. Howard, 1908, Ann. Transvaal Mus., **1**, pt. 2, p. 153 (after Neumann, 1901). Neumann, 1911, Das Tierreich, Lief. **26**, Acarina, Ixodidae, p. 97 (uncertain species, Port Natal (Natal), India, off *Python molurus*) [in part: equals *Aponomma politum* Neumann, 1899, syn., *ex errore*, *fide* G. Theiler, 1945, The Onderstepoort Journ. Vet. Sci., **20**, pt. 2, p. 182].
- Amblyomma badium* Neumann, 1901, Mém. Soc. Zool. France, **14**, pp. 300-301 (3 ♂, Sumatra; 6 ♂, off *Manis* sp. without locality; 19 ♂, 6 ♀, 6 n, Java, off *Manis javanica*; cotypes in Z. M. Berlin and in Oudemans Coll. now in Leiden M.).
- Aponomma javanense* Cooper and Robinson, 1908, Proc. Cambridge Philos. Soc., **14**, pp. 464-466, figs. 15-17 (3 ♀, Biserat, Siam, off *Varanus salvator*).
- Amblyomma javanense* Schulze, 1934, Zeitschr. f. Parasitenk., **7**, pt. 2, p. 167 (6 ♂, 1 ♀, 1 n, Pangrango, Java, off *Manis javanica*); 1936, Zeitschr. Morph. Oekol. Tiere, **32**, pt. 2, p. 206, fig. 23c (morphological); 1938, *Op. cit.*, **34**, pt. 1, p. 139, figs. 3, 7 (♀, Hainan); 1939, Zeitschr. f. Parasitenk., **10**, pt. 6, p. 728 (Burma).

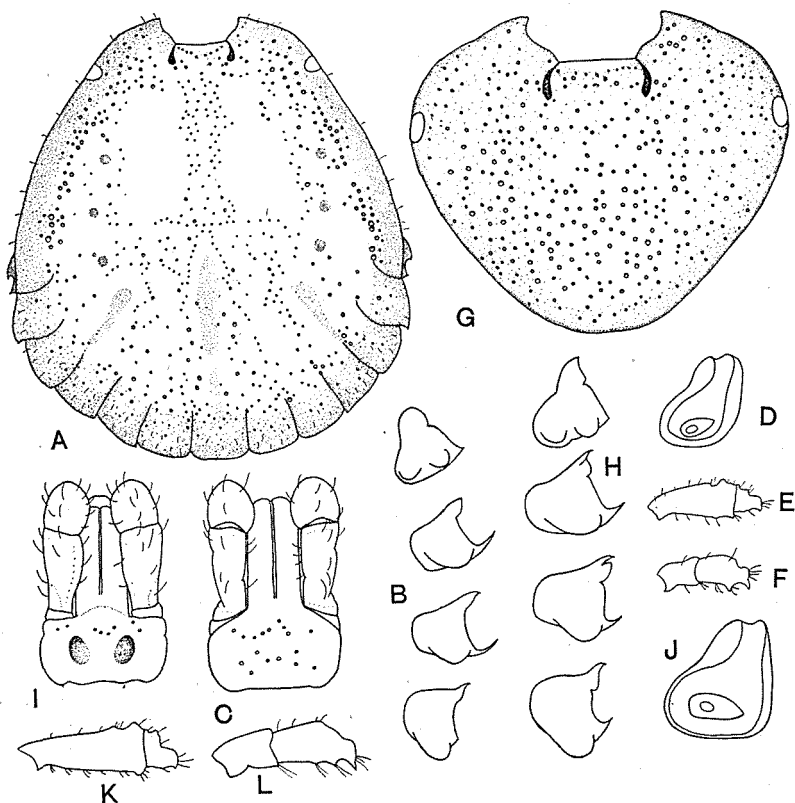


Fig. 22. *Amblyomma javanense* (Supino). A-F, male: A, scutum B, coxae I-IV; C, capitulum; D, spiracle; E, tarsus I; F, tarsus IV. G-L, female: G, scutum; H, coxae I-IV; I, capitulum in dorsal view; J, spiracle; K, tarsus I; L, tarsus IV.

Amblyomma javanense javanense Schulze, 1937, *Op. cit.*, 9, pt. 6, pp. 690-692, fig. 2.

Amblyomma compressum javanense Schulze, 1941, *Zeitschr. Morph. Oekol. Tiere*, 37, pt. 3, p. 514 (morphological).

In 1937 Schulze believed that a relationship existed between the ticks found on the ant-eaters of Africa and of South Asia, and he regarded them as subspecies. *Amblyomma javanense* is the tick found on the Asiatic ant-eaters and *Amblyomma cuneatum* occurs on African ant-eaters. Schulze used the name *A. javanense javanense* (Supino) for the Asiatic form and *A. javanense cuneatum* Neumann for the African form. In 1941 to further complicate matters he decided that *A. compressum* (Macalister) was an older name for *A. cuneatum* Neumann. In giving the former name priority he changed *A. javanense javanense* to *A. compressum javanense*. I examined specimens of *A. cuneatum* in the Museum of Comparative Zoölogy from the Gold Coast, West Africa; it is probable that *cuneatum* and *javanense* had a common origin, but they are so distinct now that they must be regarded as separate species.

Since no specimens are available from Indonesia, specimens from the Philippine Islands are used for the description of the male and the female.

Male (Fig. 22A-F). Seven specimens from 5.4 to 4.8 mm. long to 4.8 to 4.05 mm. wide, exclusive of capitulum; average 5.2 mm. long by 4.52 mm. wide. Scutum inornate, maroon-brown in peripheral regions and yellow-brown in central region; punctations unequal, sparsely distributed in periphery and almost entirely absent in anterior and median portion; lateral groove as linearly arranged punctations extending two-thirds distance to eyes; cervical grooves very small and inverted comma-shaped; few, short, white hairs in region of festoons; eyes small and indistinct; festoons large and distinct. Ventral body surface yellow, finely wrinkled, with numerous, fine punctations, and very short, indistinct hairs; genital opening opposite coxa two; anal opening opposite posterior border of spiracle; anal groove very distinct; spiracular plate long and comma-shaped. Legs brown-maroon, strong and relatively short; coxa I with two short, broad and widely separated spurs; coxae II-IV with a single very broad and flat spur; tarsi short, terminating abruptly and with prominent terminal and sub-terminal spurs; claws very long, nearly three times as long as pulvillus. Capitulum relatively short; basis rectangular, with lateral edge slightly convex; palps short and club-shaped; article two about one and a half