

INSECTS OF MICRONESIA

Acarina: Ixodoidea¹

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INTRODUCTION

This report is based on a survey of all known published records of the occurrence of ticks in Micronesia as well as the study of about 45 collections comprising nearly 125 specimens from these islands. Thirty-five collections are from the Mariana Islands, four from the Palau Islands, three from Ponape, three from Kusaie, and one from the Gilbert Islands. Most of the collections were made by personnel of Chicago Natural History Museum, U. S. National Museum, U. S. Naval Medical Research Unit No. 2 (NAMRU) during 1944-1945, California Academy of Sciences, and Bernice P. Bishop Museum. In addition, a few specimens belonging to the Trust Territory of the Pacific Islands and to Kyushu University, Fukuoka, Japan, have been examined. Much of the material was made available to me by R. L. Wenzel of Chicago Natural History Museum and by J. L. Gressitt of Bishop Museum, to whom I wish to express my appreciation. Individual collectors are acknowledged in the body of this report, and further data on them may be found in volume 1 of this series.

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Only the six species listed in the table are known from Micronesia. Reports in the literature concerning the presence of *Ixodes ornithorhynchi* Lucas and *Boophilus annulatus* (Say) are, in all probability, erroneous and should be discounted. The former, recorded by Neumann (1899, Soc. Zool.

¹ This represents, in part, Results of Professor T. Esaki's Micronesian Expeditions (1936-1940), No. 95.

Distributional List of Micronesian Ixodoidea

	MICRONESIAN ISLAND GROUPS										Other Localities	
	N. Mariana	S. Mariana	Caroline							Gilbert		
			Palau	Yap	Caroline Atolls	Truk	Ponape	Kusaie	Marshall			
1. <i>Ornithodoros capensis</i>		×										certain oceanic islands in Atlantic, Pacific, and Indian oceans
2. <i>Ixodes mindanensis</i>			×									Mindanao
3. <i>Amblyomma cyprium cyprium</i>		×	×					×	×			Indonesia, New Guinea, New Hebrides, Santa Cruz Is.
4. <i>A. squamosum</i>		×										
5. <i>Boophilus microplus</i>	×	×	×					×				Florida; Neotropical, Ethiopian, Oriental, and Australian Regions
6. <i>Rhipicephalus sanguineus sanguineus</i>		×									×	nearly cosmopolitan

France, Mém. 12:144) from one of the Mariana Islands on the basis of a female, host unspecified, is a parasite of the platypus, *Ornithorhynchus anatinus*, which occurs only in Australia and Tasmania. The cattle ticks, *Boophilus annulatus* and *B. microplus* (= *Margaropus annulatus australis* syn.) were both recorded in early reports of the Guam Agricultural Experiment Station as occurring in Guam. Later, Barber (1916, Guam Agric. Exper. Sta., Rept. for 1915, 25) stated that these ticks were considered by B. H. Ransom to be indistinguishable from *Margaropus caudatus* Neumann, a species I regard as a synonym of *Boophilus microplus*. Only *B. microplus* was present in the collections of cattle ticks I examined from Guam and other islands of western Micronesia.

Four of the six species known to occur in Micronesia can be regarded as native. These are *Ornithodoros capensis*, *Ixodes mindanensis*, *Amblyomma cyprium cyprium*, and *A. squamosum*. Of these *A. squamosum* is the only one which is restricted to Micronesia; the only records thus far of its occurrence are from Guam. The two introduced species, *Boophilus microplus* and *Rhipicephalus sanguineus sanguineus*, have been found in only a few of the Micronesian islands, but they appear to be well established. The former owes

its presence to the introduction of livestock, particularly cattle; the latter, to the introduction of dogs. Both species are widely distributed throughout the warmer parts of the world.

It is interesting that with the exception of *Ixodes mindanensis*, which is here first reported for Micronesia (Peleliu), all of the species thus far known to occur in Micronesia are represented in Guam (Kohls, 1953, Jour. Parasitology 39 : 264).

SYSTEMATICS

Ticks belong to the superfamily Ixodoidea which is composed of the families Argasidae, Ixodidae, and Nuttalliellidae. Representatives of only the first two of these occur in Micronesia; the last is African and includes but a single peculiar, very rare, species, *Nuttalliella namaqua* Bedford, regarded as a connecting link between the other two families.

KEY TO MICRONESIAN FAMILIES AND GENERA OF TICKS (Males, Females, Nymphs)

1. Scutum lacking in all stages. Sexual dimorphism slight. Mouth parts ventral. Spiracles small and anterior to coxa IV. "Soft ticks" (Argasidae)....**Ornithodoros**
Scutum present, covering most of the dorsal surface of the body of the male but only the anterior part of the body in female, nymphs, and larvae. Mouth parts anterior. Spiracular plate large and posterior to coxa IV. "Hard ticks" (Ixodidae)..... 2
2. Anal groove distinct and contouring the anus anteriorly. Venter of male mostly covered by seven hardened nonsalient plates. Eyes and festoons absent.....**Ixodes**
Anal groove distinct or indistinct but contouring the anus posteriorly. Venter of male with or without salient plates. Eyes present. Festoons present or absent..... 3
3. Palpi long and slender, longer than the basis capituli. Venter of male without plates. Festoons present.....**Amblyomma**
Palpi short, not longer than the basis capituli. Basis capituli hexagonal. Venter of male with adanal and accessory plates. Festoons present or absent..... 4
4. Festoons absent. Palpi very short and ridged dorsally and laterally. Coxa I with two very short spurs. Anal groove obsolete in female and nymphs, indistinct in male. Male very small and with a caudal appendage.....**Boophilus**
Festoons present. Palpi not unusually short, not ridged. Coxa I with two long spurs. Anal groove distinct. Male moderate in size and without a caudal appendage**Rhipicephalus**

Genus **Ornithodoros** Koch

Ornithodoros Koch, 1844, Archiv Naturgesch. 10:219 [type: *O. savignyi* (Audouin); Africa].

Alectorobius Pocock, 1907, Allbutt's Syst. Med. 2:189 [type: *O. talaje* (Guérin-Méneville); Guatemala].

This genus, some members of which are vectors of relapsing fever spirochetes, occurs on all of the continental areas of the world but is poorly represented on oceanic islands. Only the following species is known from Micronesia.

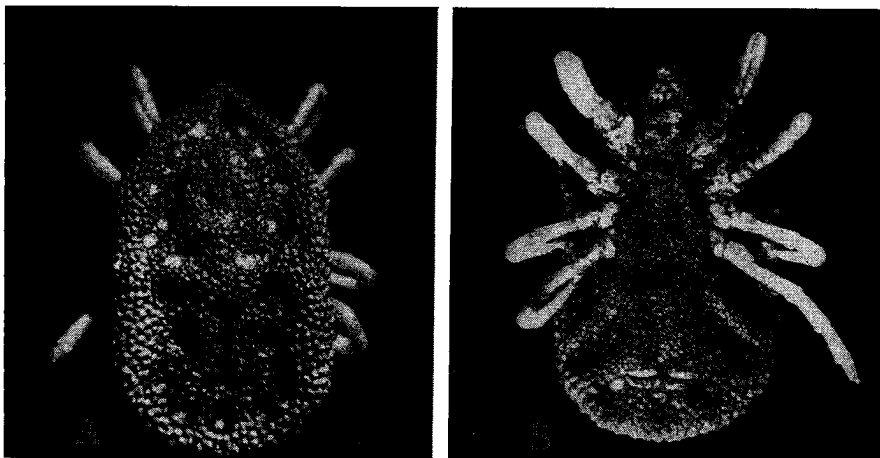


FIGURE 1.—*Ornithodoros capensis*, male, from Japan: A, dorsal view; B, ventral view (N. J. Kramis, photograph).

1. *Ornithodoros capensis* Neumann (fig. 1).

Ornithodoros talaje var. *capensis* Neumann 1901, Soc. Zool. France, Mém. 14 : 258 (in nests of penguins on islands off coast of Cape Colony, South Africa; type in Neumann collection, Toulouse ?).—Speiser, 1905, Deutsche Sudpolar Exped. 10 (Zool. 2) : 600 (Ascension I.).—Neumann, 1907, Linn. Soc. London, Trans. (Zool.) 12 : 193 (Cargados Carajos or Siren I., Indian Ocean).—Nuttall, *et al.*, 1908, Argasidae, I, Ticks: A Monograph of the Ixodoidea, 61-62, pl. 3 (St. Paul Rocks, Atlantic Ocean; in birds' nests).—Howard, 1908, Transvaal Mus., Ann. 1 (2) : 88 (states this tick has been reported from Tristan da Cunha).—Tubb, 1937, Roy. Soc. Victoria, Proc. 49 (2) : 415 (Lady Julia Percy I. off coast of Victoria, Australia; in nests of *Eudyptula minor*); 1938, Roy. Soc. Victoria, Proc. 50 (2) : 346 (English I., Sir Joseph Banks group, Spencer Gulf, S. Australia; one female, host probably *Eudyptula minor*).

Ornithodoros talaje [nec Guérin-Méneville, 1849], Banks, 1924, Zoologica 5 (9) : 95 (Eden I., Galapagos).—Ferguson, 1925, Australian Zool. 4 (1) : 25 (W. Australia; from *Eudyptula minor*).

Argas talaje capensis, Bedford, 1932, Vet. Serv. and Anim. Ind. Union of South Africa, 18th Rept. Director, 280 (islands off Cape Province;

in nests of jackass penguin, *Spheniscus demersus*. "Attacks both man and fowls when opportunities offer." ; 1934, Onderstepoort Jour. Vet. Sci. and Anim. Ind. 2 : 74, figs. 23-26 (St. Croix I. off Port Elizabeth; in nests of *Spheniscus demersus*).

(?) *Alectorobius talaje sancti-pauli* Schulze, 1941, Zeitschr. Morph. Ökol. 37 : 544 (established for form occurring on St. Paul Rocks in Atlantic Ocean east of Brazil).—Zumpt, 1952, Australian Nat. Antarctic Res. Exped. Rept. B, 1 : 12-20 (two nymphs, Ascension I., no hosts).

Ornithodoros capensis, Kohls, 1953, Jour. Parasitology 39 : 264 (Guam; off noddy tern, *Anous stolidus*).—Hoogstraal, 1954, Ent. Soc. Washington, Proc. 56 : 274 (Benfi I. in Lake Nyasa, Africa; one female from leg of soldier).

Unpublished records in the collection of the Rocky Mountain Laboratory: RML 33405, San Benedicto I., Revillagigedo Archipelago, off west coast of Mexico, Apr. 30, 1955, W. A. McDonald; adults, nymphs, under stones near nests of blue-faced booby, *Sula dactylatra californica*. RML 33406, Clarion I., as above, May 7-8, 1955; several larvae, probably this species, ex legs of burrowing owl, *Speotyto cunicularia rostrata*. RML 22326, Vivionne Bay, Kangaroo I., S. Australia, Jan. 24, 1946, H. Womersley; adult, nymphs, near penguin nests. RML 30721, Fire I., off Point Kembla, New South Wales, Australia, Mar. 11, 1946, H. C. Davis; adults, nymphs, under stones. RML 33494, Kyo Jima, Shimane Pref., Honshu, Japan, Sept. 16, 1955, H. L. Keegan; numerous adults and nymphs from crevice near nests of black-tailed gull, *Larus crassirostris*. RML 30757 and 30709, Tern I., French Frigate Shoal, Hawaiian chain, July 25 and Sept. 29, 1952, C. R. Joyce; numerous adults and nymphs near nests of sooty tern, *Sterna fuscata*; also several larvae, probably this species, off terns on islands near Oahu, Hawaiian Islands.

Adults variable in size, females ranging from about 3.0 to 6.5 mm. in length by 1.70 to 3.5 mm. in width. Males, 2.5 to 5 mm. in length by 1.4 to 3 mm. in width. Sides nearly straight and parallel, a little pointed anteriorly, bluntly rounded posteriorly. Mammillae on the dorsum and venter large, hemispherical and glossy, larger dorsally at the sides and at the posterior border; smaller and less elevated on the venter and supracoxal folds. Discs on the dorsum large and in a symmetrical arrangement. On the venter the discs are present in lineal arrangement in the preanal, transverse postanal and the median postanal grooves and in three depressions posterior to the postanal groove. Legs small and with the surface micromammulated. All tarsi without humps, but tarsus I with a mild subapical dorsal protuberance. Coxa I and II well separated, all others contiguous. Capitulum lying in a deep camerostome bordered anteriorly by the hood and laterally by the large subrectangular cheeks which partially overlap the mouth parts. Hypostome notched apically. Principal denticles arranged 2/2 with about four large teeth in each file. Post-hypostomal hairs reach to about three-fourths the length of the hypostome. Eyes absent.

DISTRIBUTION: Islands off coast of South Africa; St. Paul Rocks, Ascension I., Tristan da Cunha, Atlantic Ocean; Revillagigedo Archipelago, Galapagos, Hawaiian Is., Pacific Ocean; Fire Is. off New South Wales,

Kangaroo I., and English and Lady Julia Percy Is., off southern Australia; western Australia; Kyo Jima off Honshu, Japan; Guam, western Micronesia; Cargados Carajos, Indian Ocean.

GUAM: One female reared from larvae off *Anous stolidus*, Ypao Pt., June 1945; several larvae, same host, locality unspecified, May-June 1945. NAMRU No. 2 coll.

HOSTS: Marine birds including *Spheniscus demersus*, *Eudyptula minor*, *Sterna fuscata*, *Anous stolidus*, *Sula dactylatra californica*, *Larus crassirostris*, *Speotyto canicularia rostrata* (?). Man, when opportunity offers.

Zumpt (1952) wrote that the Argasidae have contributed two forms to the fauna of sea birds, *Ornithodoros talaje capensis* Neumann on penguins and *O. talaje sancti-pauli* Schulze on terns. He failed to mention a third species, *O. amblus* Chamberlin, which is recorded as extremely abundant on all of the Peruvian guano islands and that larvae at least were found on the penguin, *Spheniscus humboldti* (Chamberlin, 1920, Brooklyn Mus. Sci., Bull. 3: 35-44). Zumpt postulates "that the sea bird infesting *talaje* forms have evolved from continental *talaje talaje* which infests a wide range of animals, especially rodents." Whether or not this hypothesis is correct, *O. capensis* appears to be distinct enough to warrant full specific status. In addition to its markedly different host relationship and distribution, it is readily distinguished from *O. talaje* by its glossy hemispherical mammillae, relatively smaller cheeks, and longer and more numerous hairs on the movable leg segments.

The subspecies *O. talaje sancti-pauli* Schulze, described as a small (largest female 4 mm. long), light yellow form of *talaje capensis* with Haller's organ as in *talaje talaje*, is of doubtful validity. Size and color can vary considerably and the importance of the structure of Haller's organ as a taxonomic character is still to be evaluated. Specimens from Tern Island in the Rocky Mountain Laboratory collection are considerably smaller than others I have seen and may be referable to *sancti-pauli* if the latter is shown to be valid.

O. capensis resembles *O. amblus* of the Peruvian guano islands, but the latter species is not so pointed anteriorly, has smaller and narrower cheeks which do not overlap the mouth parts, and has more numerous and more pointed denticles on the hypostome, as well as other characters which readily distinguish it from *O. capensis*.

Genus *Ixodes* Latreille

Ixodes Latreille, 1795, Mag. Encyclopéd. 4: 18 (type: *Acarus ricinus* Linn. = *Acarus reduvius* Linn.; Europe).

Cynorhaestes Hermann, 1804, Mém. Apterologique 12: 65 [type: *Cynorhaestes ricinus* Linn. = *Ixodes ricinus* (Linn.)].

Crotonus Dumeril, 1829, Dict. Sci. Nat. 54: 401 [type: *Crotonus ricinus* = *Ixodes ricinus* (Linn.)].

- Eschatocephalus* Frauenfeld, 1853, Zool. Bot. Ver., Verhandl. 3:57 (type: *Eschatocephalus gracilipes* Frauenfeld = *Ixodes vespertilionis* Koch).
Ceratixodes Neumann, 1902, Archiv. Parasitol. 6:115 (type: *Hyalomma puta* Pickard-Cambridge = *Ixodes uriae* White).
Coxixodes Schulze, 1941, Zeitschr. Morph. Ökol. 37:507 (type: *Ixodes ornithorhynchi* Lucas); new syn.
Xiphixodes Schulze, 1941, Zeitschr. Morph. Ökol. 37:507 (type: *Ixodes collocaliae* Schulze); new syn.
Scaphixodes Schulze, 1941, Zeitschr. Morph. Ökol. 37:508 (type: *Ixodes unicavatus* Neumann); new syn.

I see little reason for recognizing *Coxixodes*, *Xiphixodes*, and *Scaphixodes*. The type and only contained species of each of these exhibit unusual morphological patterns, but I do not regard these species as sufficiently distinct to require the splitting up of the old and well-established parent genus.

The genus *Ixodes* is almost cosmopolitan in distribution. Few species are known from oceanic islands and only one has been discovered in Micronesia.

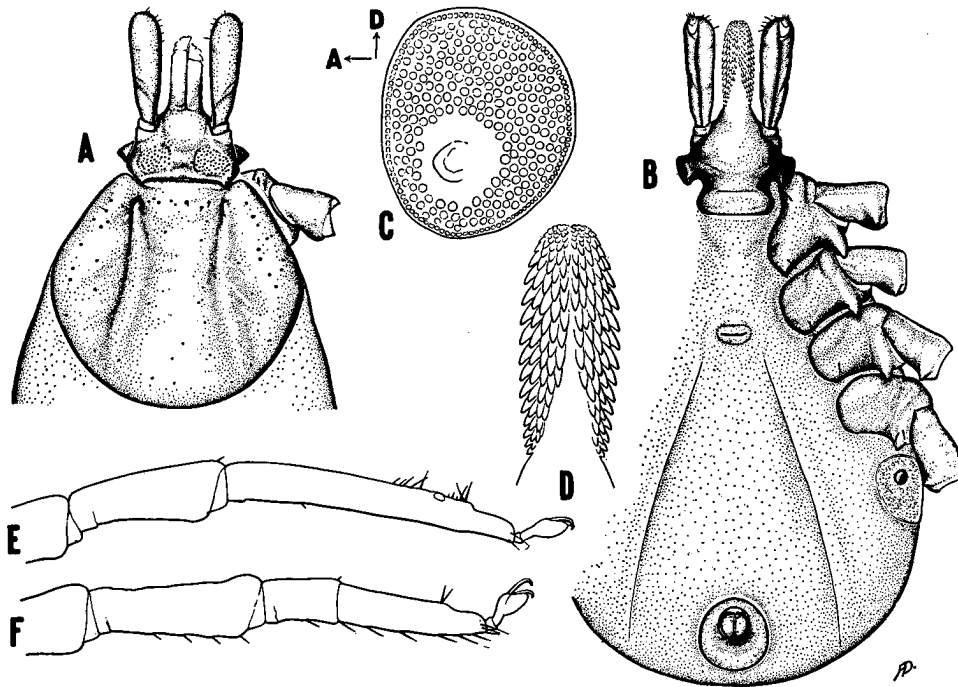


FIGURE 2.—*Ixodes mindanensis*, female: A, capitulum and scutum, dorsum; B, capitulum, coxae and body, venter; C, spiracular plate (A = anterior, D = dorsal); D, hypostome; E, metatarsus and tarsus, leg I; F, metatarsus and tarsus, leg IV. (From Kohls, 1950.)

2. *Ixodes mindanensis* Kohls (fig. 2).

Ixodes mindanensis Kohls, 1950, National Inst. of Health, Bull. 192 : 5
(one female, Mindanao, Philippine Is., off *Turdus poliocephalus*; type
in Chicago Natural History Museum).

Female: Color of capitulum and lateral areas of the scutum blackish; legs, median area of scutum, and postscutal area yellow brown. Capitulum length, tips of palpi to tips of cornua, 0.88 mm.; width of basis capituli, 0.58 mm.; widest at the rounded, salient posterolateral angles. Cornua short and pointed, distance between the tips about 0.34 mm. Posterior margin of basis between the cornua nearly straight. Porose areas large, slightly depressed, and separated by a distance of less than the diameter of one. Palpi stout, broad, and rounded apically, surface smooth. Palpal segments 2 and 3 fused, leaving no visible suture; combined length 0.56 mm. Ventrally the basis is sharply constricted behind the large flattened auriculae which project laterally beyond the margin of the basis and are thus visible in part from above; surface smooth, slightly convex, posterior margin nearly straight, transverse sutural line present. Palpi flattened on their inner faces, plate absent on segment 1. Hypostome large, broad, bluntly rounded, and notched apically. Median denticles smaller than the laterals. Denticles arranged 5/6 apically, then successively 5/5, 4/4, and 3/3 to the base. Length of toothed portion about 0.44 mm. Scutum length, 1.26 mm.; width, 1.39 mm.; evenly rounded posteriorly. Emargination broad and shallow, scapulae bluntly rounded. Lateral carinae absent. Cervical grooves as broad depressions, deeper anteriorly, extending almost to the posterolateral margins. Punctations few, small, and scattered, but somewhat more numerous in anterior and lateral fields. Hairs few, short, and inconspicuous. Legs long and slender. Tarsi long, narrowed abruptly subapically, and without distinct subapical dorsal humps. Length of tarsus 1, 1.13 mm.; metatarsus 0.63 mm. Length of tarsus 4, 0.86 mm.; metatarsus, 0.67 mm. Coxae I to IV each with a stout, flattened, external spur, that on coxa I the largest. Internal spur on coxa I present as a projected flattened corner; on II, III, and IV the internal spurs are suggested by marginal saliences. Trochantal spurs present, equal in size on trochanters I, II, and III, smaller on IV. Spiracular plate short oval, longer axis transverse, length 0.49 mm.; width 0.39 mm. Goblets numerous. Genital aperture situated at about the level of the interval between coxae II and III. Anal groove circular, with the anus nearer the anterior rim of the circle.

Male and immature stages unknown.

The combination of the fused palpal articles 2 and 3, the large conspicuous auriculae, the markedly elongate tarsus of leg I, and the circular anal groove distinguish this tick at once from all described species of *Ixodes*.

DISTRIBUTION: Mindanao, western Caroline Is.

PALAU. PELELIU: Eastern peninsula, one female ex *Gallus gallus*, Sept. 1945, NAMRU No. 2 coll.

HOSTS: *Turdus poliocephalus*, *Gallus gallus*.

Genus *Amblyomma* Koch

Amblyomma Koch, 1844, Archiv Naturgesch. 10:226 [type: *Amblyomma cajennense* (Fabricius); Guiana].

Haemalaster Koch, 1844, Archiv Naturgesch. 10:223 (type: *Haemalaster longirostris* Koch; Brazil).

Euthesius Gistel, 1848, Naturgesch. Thierr., 158 (type: *Ixodes americanus*; America).

Adenopleura Macalister, 1872, Quarterly Jour. Microscop. Sci. (n.s.) 12: 287 (type *Adenopleura compressum* Macalister; West Africa).

Xiphiaster Murray, 1877, Econ. Ent., Aptera 1: 201 (type: *Xiphiaster rostratum* Murray; West Africa).

This large genus is limited essentially to the warmer regions of the world. Two species have been reported from Micronesia.

Schulze in 1933 divided *Amblyomma cyprium* Neumann into two subspecies: *A. cyprium cyprium* Neumann and *A. cyprium aeratipes* Schulze. The former is widely distributed; the latter is known only from the Philippine Islands.

3. *Amblyomma cyprium cyprium* Neumann (fig. 3).

Amblyomma cyprium Neumann, 1899, Soc. Zool. France, Mém. 12: 219 [in part; not one male from Philippine Is.] (three males, five females, Mariana Is.; one female without locality; cotypes in Paris Museum);

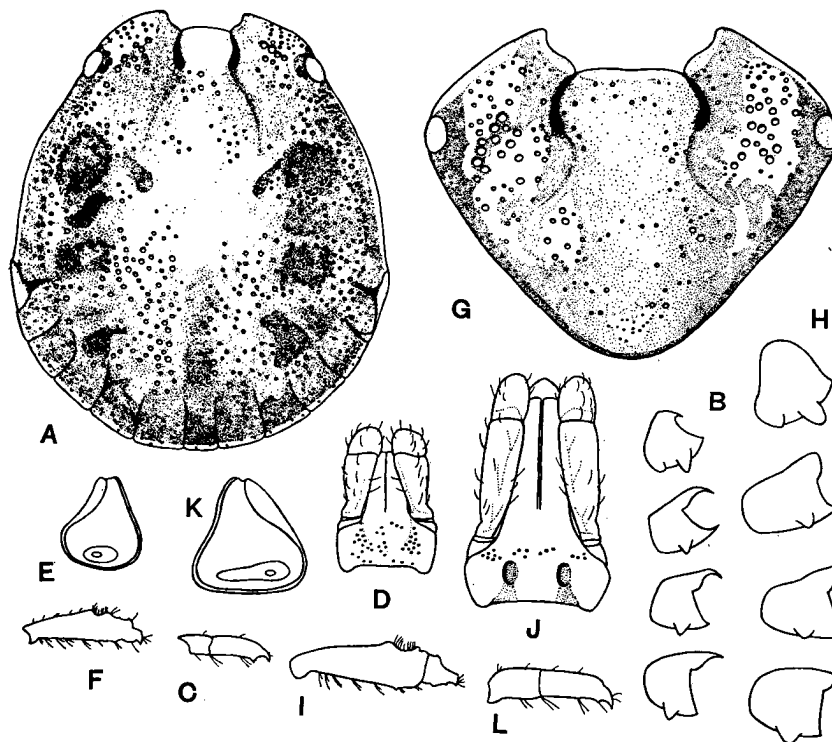


FIGURE 3.—*Amblyomma cyprium cyprium*. A-F, male: A, scutum; B, coxae I-IV; C, tarsus 4; D, capitulum, dorsum; E, spiracular plate; F, tarsus 1. G-L, female: G, scutum; H, coxae I-IV; I, tarsus 1; J, capitulum, dorsum; K, spiracular plate; L, tarsus 4. (From Anastos, 1950.)

and 1.84 by 1.90 mm. for paratype; ornate with an irregular pale spot in the anterolateral fields and a much smaller spot in the posterior angle; posterior angle broad and the apex broadly rounded, posterolateral margins nearly straight; cervical grooves deep anteriorly, continuing posteriorly as broad shallow depressions to near the margin of the scutum; punctations numerous, unequal in size, rather evenly distributed. Dorsum of body exclusive of scutum densely clothed with conspicuous, pale, ovate scales; venter posterior to spiracles

1911, Das Tierreich, Acarina, Ixodidae 26: 87 [Mariana Is., New Guinea, Malay Peninsula (not Philippines); off *Chelonia*].—Jepson, 1911, Dept. Agric. Fiji, Council Paper 25: 32 (Fiji Is., off bush pig and cattle).—Robinson, 1926, Amblyomma, IV, Ticks: A Monograph of the Ixodoidea, 233 [in part, description of male, not female] (Celebes, male off *Sus celebensis*).—Krijgsman and Ponto, 1932, Veeartsenijk. Meded. 79: 21, figs. 25, 26 (Celebes, off *Sus celebensis*, cows, buffalo) [fig. 26, female is of *A. babirussae* Schulze, *fide* Anastos, 1950].—Lever, 1943, Agric. Jour. Fiji 14: 40 (Nadarivatu, female, off man).—Non Toumanoff, 1944, Les Tiques (Ixodoidea) de l'Indochine, 106, figs. pl. 78, figs. a-b, pl. 79a, b (central Annam off *Cyclemis mouhoti*) [figs. of female are not of *A. cyprium*; probably *A. geoemyidae* (Cantor)].—Alicata, 1948, Pacific Science 2: 65 (Guam, off bull).—Anastos, 1950, Ent. Americana 30: 89, fig. 20, male, female (Flores, seven adults off buffalo; Mariana Is., female; Fiji, nine adults; New Hebrides, five adults; New Guinea, five adults off *Sus papuensis*, Bulolo, one female off man, Biak or Owi I., one male off clothing of man, Sansapor; one female off wild pig, Vanikoro I., Santa Cruz Islands).—Kohls, 1953, Jour. Parasitology 39: 264 (Guam, Ritidian Pt. and unnamed locality, several nymphs and larvae, probably *Amblyomma cyprium cyprium* off *Rattus rattus* and "rats").

Amblyomma scaevola Oudemans, 1905, Ent. Ber. Nederl. Ent. Ver. 1 (2): 216 (male, Manokwari, type in Zool. Mus. Amsterdam).

Amblyomma quasicyprium Robinson, 1926, Amblyomma, IV, Ticks: A Monograph of the Ixodoidea, 237, fig. 17 (female, Frontera, Tabasco, Mexico, off *Ateles melanochir*; female, Taveuni, Fiji, off cow; cotypes in British Museum).—Schulze, 1933, Zool. Anzeiger 104: 322 (true female of *A. cyprium*; one cotype probably not from Mexico).

Amblyomma dammermani Warburton, 1927, Parasitology 4: 409, pl. 27, fig. 3 (female, Great Kei I. without host; type in Zool. Mus. Bogor).—Krijgsman and Ponto, 1932, Veeartsenijk. Meded. 79: 23, fig. 37.—Anastos, 1950, Ent. Americana 30: 91 (reduced to synonym of *A. cyprium cyprium*).

Male: A medium-sized tick, largest specimens about 6 mm. long, exclusive of capitulum, by 5.5 mm. wide. Body broad oval, widest behind the middle, narrowing anteriorly. Capitulum relatively short; basis rectangular, slightly broader than long, cornua short; palps short, stout, segment 2 nearly twice as long as segment 3; hypostome short, broad, dentition 4/4 with inner row the shortest. Scutum ornate with pale markings more in evidence anterior to eyes; pseudoscutum clearly defined in some specimens but little in evidence or absent in others; punctations large, deep, numerous, sometimes partially confluent in the anterolateral fields, almost completely absent from the dark raised areas; cervical grooves short, deep, prolonged posteriorly as shallow depressions; marginal groove absent. Coxa I with two short flat spurs, the external the longer; other coxae each with a single, short triangular spur; tarsi 2-4 each with a terminal and subterminal ventral spur, tarsus 1 with a terminal ventral spur only.

Female: Size, unfed, about as for male. Capitulum as for male except palps long, segment 2 more than twice as long as segment 3; porose areas small, deep, widely separated; dentition of hypostome 4/4. Scutum triangular-cordiform, wider than long, ranging up to about 3.9 mm. wide by 3.3 mm. long; ornamentation pattern variable but usually with a large spot in the anterolateral field and a smaller spot in the posterior field; punctations larger and more numerous in the anterolateral fields; cervical grooves short, deep anteriorly. Body with numerous punctations and short fine hairs. No marginal groove; foveae small and inconspicuous. Coxa I with two short, subequal spurs, the external slightly longer, a single short, broad spur on each of the other coxae; tarsal spurs as in male.

DISTRIBUTION: Micronesia, Malay Peninsula (?), New Guinea, Celebes, Flores I., Great Kei I., New Hebrides, Santa Cruz Islands.

S. MARIANA IS. GUAM: Several, Amantes Pt., Fadian (Fadang), Yigo, Oca Pt., Pati Pt., Ritidian Pt., May-June 1945, Dybas; several, Ritidian Pt., May-June 1945, G. Bohart, Gressitt; several, Tarague, Upi trail, May 1936, Usinger; Barrigada, from pig, Aug. 1936, Swezey; Tarague, May 1936, Swezey; Tarague, Ritidian, from belly, Sept. 1949, Kondo; Machanao, Tailalo, Sept. 1949, Anderson; Ritidian, Jan. 1952, O'Lien.

PALAU. BABELTHUAP: East Ngatpang, Dec. 1952, Gressitt; Emertao, Mar. 1938, Hiraishi; Imeliik (Aimeliik), Aug. 1953, Beardsley.

CAROLINE ATOLLS. ANT: In house, Dec. 1955, Marshall.

PONAPE. Sokehs I., Pingelap village, 11 nymphs, 17 larvae, May 3, 1956, William B. Jackson; Colonia (Koronia), Dec. 1930, Uchiyama; Tolotom (Toroton), Feb. 1936, Ono; Mt. Tolenrahkeit, July 1949, Glassman.

KUSAIE. Mt. Fuinkol, Mt. Matante, "Hill 541," Jan.-Mar. 1953, Clarke.

HOSTS: "On man," cattle, *Sus celebensis*, *Sus papuensis*, "pig," buffalo. Micronesian records are from man, cattle, "vegetation," and unstated source.

4. *Amblyomma squamosum* Kohls (fig. 4).

Amblyomma squamosum Kohls, 1953, Jour. Parasitology 39: 264 (females, nymphs, Guam, off water monitor, *Varanus indicus*; type in Rocky Mountain Lab.).

Female: A small tick; length, exclusive of capitulum, and width of least engorged specimen available, 3.3 mm. by 2.2 mm. Basis capituli subrectangular, broader than long, posterior margin between the slightly salient posterolateral angles nearly straight; porose areas small, depressed, subcircular, separated by a distance of a little more than the diameter of one. Palpi slender, about 0.76 mm. in length, segment 2 about twice as long as segment 3. Hypostome mildly notched, the principal denticles arranged 4/4 and limited to the terminal half. Scutum subtriangular, wider than long, 1.67 by 1.77 mm. for holotype and 1.84 by 1.90 mm. for paratype; ornate with an irregular pale spot in the anterolateral fields and a much smaller spot in the posterior angle; posterior angle broad and the apex broadly rounded, posterolateral margins nearly straight; cervical grooves deep anteriorly, continuing posteriorly as broad shallow depressions to near the margin of the scutum; punctations numerous, unequal in size, rather evenly distributed. Dorsum of body exclusive of scutum densely clothed with conspicuous, pale, ovate scales; venter posterior to spiracles similarly clothed and with a band of smaller scales extending forward on each side on the area between the coxae and the genital grooves to about the level of the genital aperture; no marginal grooves; foveae very large and distinct as two salient plaques posterior to scutum. Coxa I with two moderate subequal blunt spurs; II, III, and IV each with

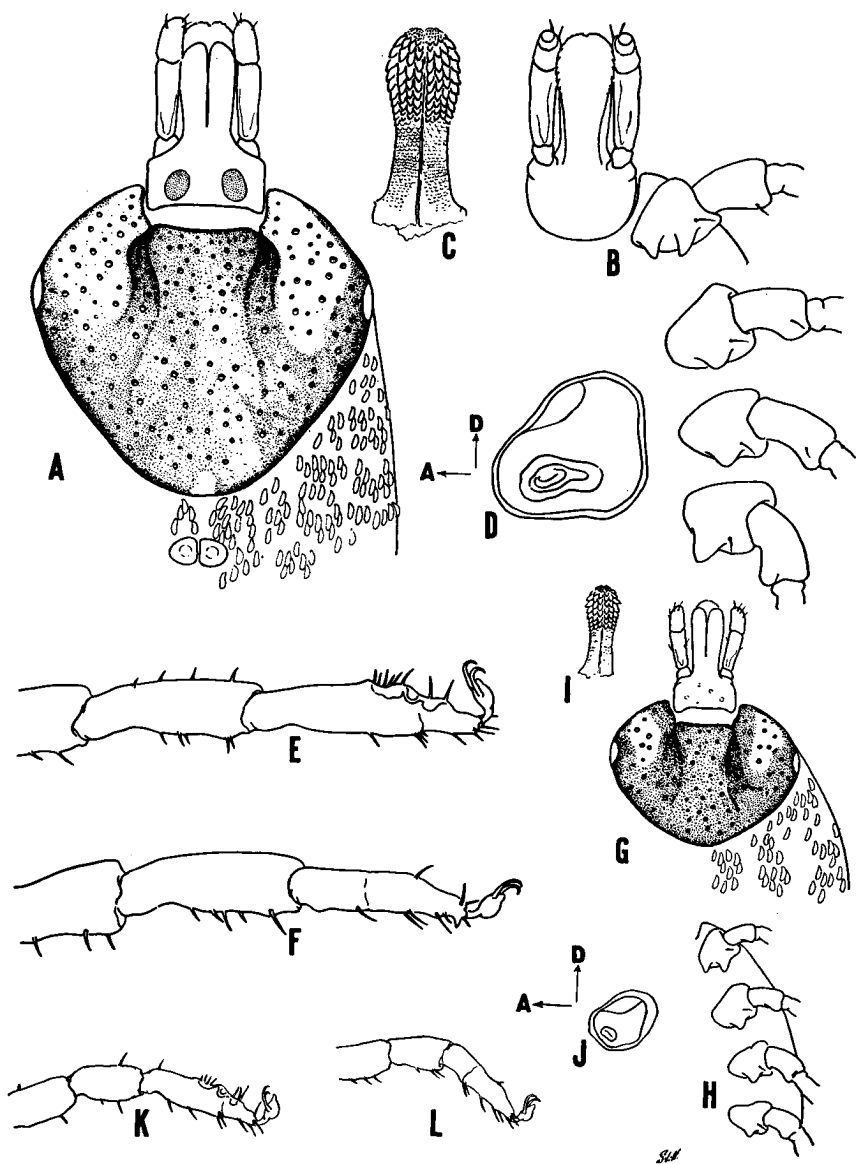


FIGURE 4.—*Amblyomma squamosum*. A-F, female: A, capitulum, scutum, and portion of body showing scales and the foveae; B, capitulum and coxae, venter; C, hypostome; D, spiracular plate (A = anterior, D = dorsal); E, metatarsus and tarsus, leg I; F, metatarsus and tarsus, leg IV. G-L, nymph: G, capitulum, scutum, and portion of body showing scales; H, coxae; I, hypostome; J, spiracular plate; K, metatarsus and tarsus, leg I; L, metatarsus and tarsus, leg IV. (From Kohls, 1953.)

a spur similar to those of coxa I. Apical and subapical ventral spurs absent on tarsus 1; apical ventral spur present on 2, 3, and 4.

Nymph: Basis capituli subrectangular, mildly convex dorsally and with a few punctations; posterior margins between the mildly salient posterolateral angles nearly straight. Palpi long, slender, combined length of segments 2 and 3 about 0.40 mm. Hypostome with the principal denticles arranged 3/3. Scutum length 0.75 mm., width 0.95 mm.; shape much as in the female; ornate, with an irregular pale spot in the anterolateral fields; cervical grooves deep anteriorly, extending as broad shallow depressions to near the posterior margin; punctations similar to those in the female. Body clothed with scales as in female except scales absent on the venter anterior to the spiracles. Coxal spurs as in female. Apical and subapical ventral spurs absent on all tarsi.

DISTRIBUTION: GUAM. Four females, three nymphs, Piti Pt., June-July 1945; one female, Piti, June 1945; one nymph, Tarague Pt., July 1945; NAMRU No. 2 coll. Piti, on monitor lizard, June 1945, R. H. Baker.

HOST: *Varanus indicus*.

Genus *Boophilus* Curtice

Boophilus Curtice, 1891, Jour. Compar. Med. and Vet. Archiv. 12: 317 (type: *Ixodes annulatus* Say; Florida).

Subgenus *Boophilus* Curtice, 1891. Minning, 1934, Zeitschr. Parasitenk. 7: 2 [type: *B. annulatus* (Say)].

Subgenus *Palpoboophilus* Minning, 1934, Zeitschr. Parasitenk. 7: 3 [type: *Boophilus decoloratus* (Koch); Africa].

Subgenus *Uroboophilus* Minning, 1934, Zeitschr. Parasitenk. 7: 3 (no type designated, 11 species included).

This small genus is restricted to the warmer regions of the world lying between the fortieth parallel north and the forty-fifth parallel south latitude. The three or four currently recognized species, all of veterinary importance, are one-host ticks; the entire life cycle from larva to fully engorged mated adult is spent on a single host. The principal hosts are cattle, although horses and other domestic and certain wild ruminants are also commonly attacked.

5. *Boophilus microplus* (Canestrini). (Figures 5, 6.)

Haemophysalis micropla Canestrini, 1888, Atti Soc. Veneto-Trent Sci. Nat. 11: 104 (Paraguay; type in Genoa Museum).

Rhipicephalus annulatus var. *caudatus* Neumann, 1897, Soc. Zool. France, Mém. 10: 413 (Japan, off horse; Île de France, off cattle; Cayenne; Senegal; Borneo, off deer).

Rhipicephalus australis Fuller, 1899, Queensland Agric. Jour. 4: 389 (Australia; off horses and cattle).

Boophilus (Uroboophilus) krijgsmani Minning, 1934, Zeitschr. Parasitenk. 7: 9, 11, 29 (male, female, Celebes, Soemba, Java, Borneo, Timor, Sumatra, Soela I., Bali, New Guinea, off cattle; type: female in Berlin Museum).

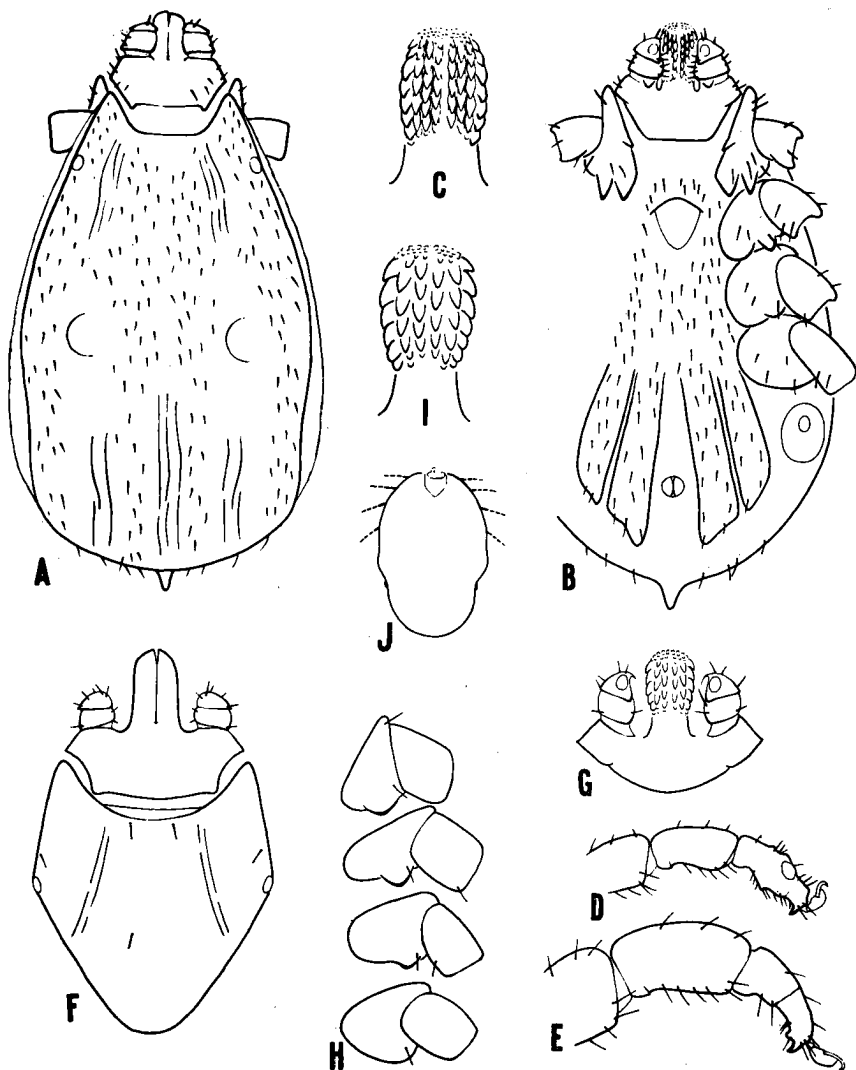


FIGURE 5.—*Boophilus microplus*. A-E, male: A, capitulum and scutum, dorsum; B, capitulum, coxae, and plates, venter; C, hypostome; D, metatarsus and tarsus, leg I; E, metatarsus and tarsus, leg IV. F-J, nymph: F, capitulum and scutum, dorsum; G, capitulum, venter; H, coxae; I, hypostome; J, engorged nymph. (From Cooley, 1946, National Inst. Health, Bull. 187.)

Boophilus (Uroboophilus) rotundiscutatus Minning, 1934, Zeitschr. Parasitenk. 7: 9, 10, 30 (male, female, Celebes, Borneo, Sumatra, Java, Bali, Soemba, Timor, Amboina, off cattle; type: male in Berlin Museum).

Boophilus (Uroboophilus) longiscutatus Minning, 1934, Zeitschr. Parasitenk. 7: 11, 31 (female, New Guinea, Halmahera, Soela I., off cattle; type in Berlin Museum).

Male: A small tick, largest specimens about 2.1 mm. long, exclusive of capitulum and caudal process, by about 1.3 mm. wide. Body elongate oval, widest at about the middle. Scutum not completely covering the body at the sides; exposed parts finely striate and without hairs. Capitulum length from tips of palpi to tips of cornua 0.3 to 0.4 mm., width 0.4 to 0.5 mm.; basis hexagonal; cornua short, blunt; palps very short and blunt, segment I with a short retrograde process of variable shape; hypostome dentition 4/4 with six to eight teeth per file. Scutum mildly excavated at the sides near the spiracular plates; cervical grooves broad, shallow, divergent posteriorly; two shallow circular depressions posterior to the cervical grooves; posterolateral and median grooves present; hairs numerous on elevated areas, absent in grooves and depressions; eyes small, flat, inconspicuous. Genital aperture opposite coxa II. Adanal and accessory plates hirsute, each terminating posteriorly in a short internal spur. Legs short, stout; coxa I with two short distinct, triangular spurs, the internal wider than the external; coxa II with internal and external spurs distinctly rounded, shorter than on I, internal spur the wider; coxa III with a still shorter external spur, internal spur similar to that on II; coxa IV without spurs; tarsus I with a terminal ventral spur, remaining tarsi each with a terminal and a sub-terminal ventral spur.

Female: Size, unengorged, a little larger than that of male. Long oval. Scutum occupying about half the total length. Median and posterolateral grooves present, marginal groove absent; venter with genital and postanal median grooves present. Hairs present on dorsal and ventral surfaces but absent in all grooves. Fully engorged specimens may be as large as 13 by 9 mm. Capitulum wider than long; basis hexagonal; cornua absent; porose areas oval, widely separated, with longer axes diagonal; hypostome with dentition 4/4, five to seven teeth per file. Scutum from about 0.96 to 1.02 mm. long by 0.75 to 0.80 mm. wide; scapulae long, blunt; cervical grooves broad, shallow, terminating at the posterolateral margins; hairs few, long, scattered, absent in the grooves. Coxae I and II each with two broadly rounded, nearly equal spurs; coxae III and IV with external spurs smaller than on II, internal spurs much reduced or absent. Tarsal spurs as in male.

Nymph: Capitulum and scutum with characters similar to those of the female. Hypostome dentition 3/3 with about five teeth per file. Scutum length and width about equal, about 0.45 mm. Coxae small; no internal spurs; coxa I with a short broad, rounded external spur; II and III with spurs as for I but progressively smaller; no spurs on IV.

Larva: Basis capituli transversely elongate, lateral and posterior margins rounded, cornua absent; hypostome dentition 2/2 with about six short broadly rounded teeth per file. Scutum length about 0.31 mm., width 0.42 mm.; hairs and punctations absent. Coxa I with a single short broad spur; no spurs on II and III.

DISTRIBUTION: Florida, Mexico, West Indies, Central and South America, Australia, parts of Africa, Oriental Region, Micronesia.

N. MARIANA IS. ALAMAGAN: Several, July 1951, R. M. Bohart.

S. MARIANA IS. SAIPAN: Several, near Lake Susupe, Dec. 1944, Dybas; several, near sea level, May 1954, F. Brown. GUAM: Several, ex cattle, bullock, Piti, June, Nov. 1936, Usinger, Swezey.

PALAU: BABELTHUAP: Several, Ngerehelong, Dec. 1952, J. C. Maquodog. KOROR: Several, Nov. 1947, Dybas.

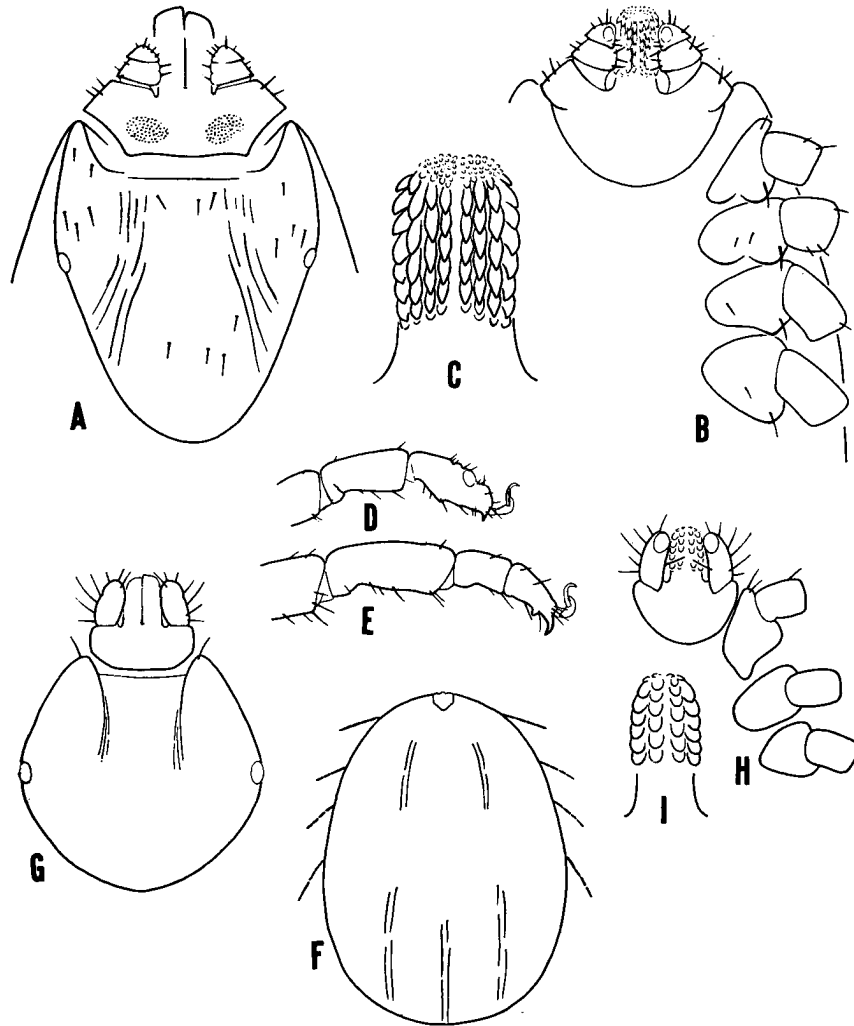


FIGURE 6.—*Boophilus microplus*. A-F, female: A, capitulum and scutum, dorsum; B, capitulum and coxae, venter; C, hypostome; D, metatarsus and tarsus, leg I; E, metatarsus and tarsus, leg IV; F, engorged female. G-I, larva: G, capitulum and scutum, dorsum; H, capitulum and coxae, venter; I, hypostome. (From Cooley, 1946, National Inst. Health, Bull. 187.)

PONAPE. Colonia, two females off captive deer, Mar. 1948, Dybas.

HOSTS: Cattle, deer.

This important cattle tick was reported from Guam as early as 1912 by Fullaway in a report of the Guam Agricultural Experiment Station (Kohls, 1953, Jour. Parasitology 39: 264). The statement in U. S. War Department Technical Bulletin (1944, Techn. Bull., Med. 57) that cattle in Guam are frequently infested with ticks of the family Argasidae is quite likely erroneous and probably refers to *Boophilus microplus*. Gressitt (Introduction, volume 1 of this series, p. 193) states that it occurs on Ponape, where it is known to carry bovine piroplasmiasis.

Genus *Rhipicephalus* Koch

Rhipicephalus Koch, 1844, Archiv Naturgesch. 10: 238 (type: *Ixodes sanguineus* Latreille; France).

Phauloixodes Berlese, 1889, Acari, Mir. Scorp. fasc. 55, 7 and 8 (type: *P. rufus* Berlese, synonym of *R. bursa* Can. and Fanz.; Italy).

This genus is primarily African; a few species occur in Europe and Asia. The following species is almost cosmopolitan and is an introduction.

6. *Rhipicephalus sanguineus sanguineus* (Latreille). (Figures 7, 8.)

Ixodes sanguineus sanguineus Latreille, 1806, Gen. Crust. Ins. 1: 157 (France; no host, no sex).

Rhipicephalus sanguineus, Koch, 1844, Archiv Naturgesch. 10: 238.

Rhipicephalus sanguineus sanguineus, Neumann, 1911, Das Tierreich, Acarina, Ixodidae, 26: 35.—Vandenberg, 1929, Guam Agric. Exper. Sta., Rept. for 1927, 15 (on dogs, Guam).

Because of the wide distribution and great variability of this species, a number of species and subspecies whose status awaits clarification have been described.

Male: A medium-sized species, largest specimens about 2.5 mm. long exclusive of capitulum by about 1.6 mm. wide. Body long oval, widest near the spiracles. Basis capituli hexagonal; posterior margin convex, salient; cornua distinct. Palpal segment I, ventrally, with a distinct plate. Hypostome dentition 3/3 with seven or eight teeth in each file. Scutum inornate, reddish brown; cervical grooves short deep; lateral grooves beginning near the eyes and including one festoon on each side; posteromedian and paramedian grooves distinct; numerous small punctations intermingled with which are larger ones each with a short fine hair. Eyes oval, slightly convex. Adanal plates subtriangular, mildly concave on internal border; accessory plates short, pointed. Legs short, thick; coxa I deeply cleft, the two spurs close together, internal spur broader; II and III each with a short external spur and salient inner corner; IV with a short external and a very small internal spur. Tarsus I without ventral spurs; 2, 3, and 4 each with a terminal and a subterminal ventral spur.

Female: Size, unengorged, a little larger than that of male. Scutum occupying about half the length of body. Median and paramedian grooves usually present and conspicuous. Marginal grooves distinct and including the first three festoon on each side. Fully engorged specimens may become as large as 11.5 mm. long by 7.5 mm. wide. Capitulum as for male

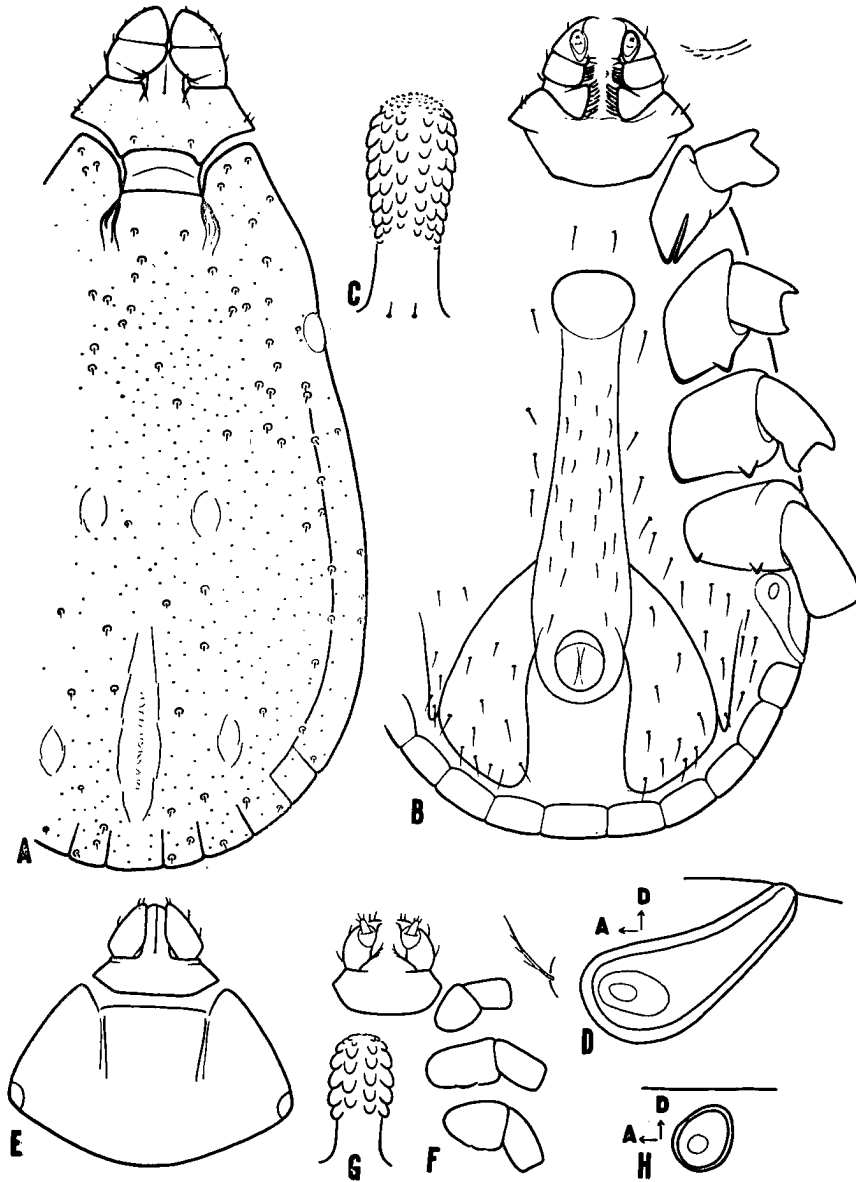


FIGURE 7.—*Rhipicephalus sanguineus sanguineus*. A-D, male: A, capitulum and scutum, dorsum; B, capitulum, coxae, and plates, venter, and palpal hair enlarged; C, hypostome; D, spiracular plate (A = anterior, D = dorsal). E-G, larva: E, capitulum and scutum; F, capitulum and coxae, venter, and palpal hair enlarged; G, hypostome. H, nymph, spiracular plate (A = anterior, D = dorsal). (From Cooley, 1946, National Inst. Health, Bull. 187.)

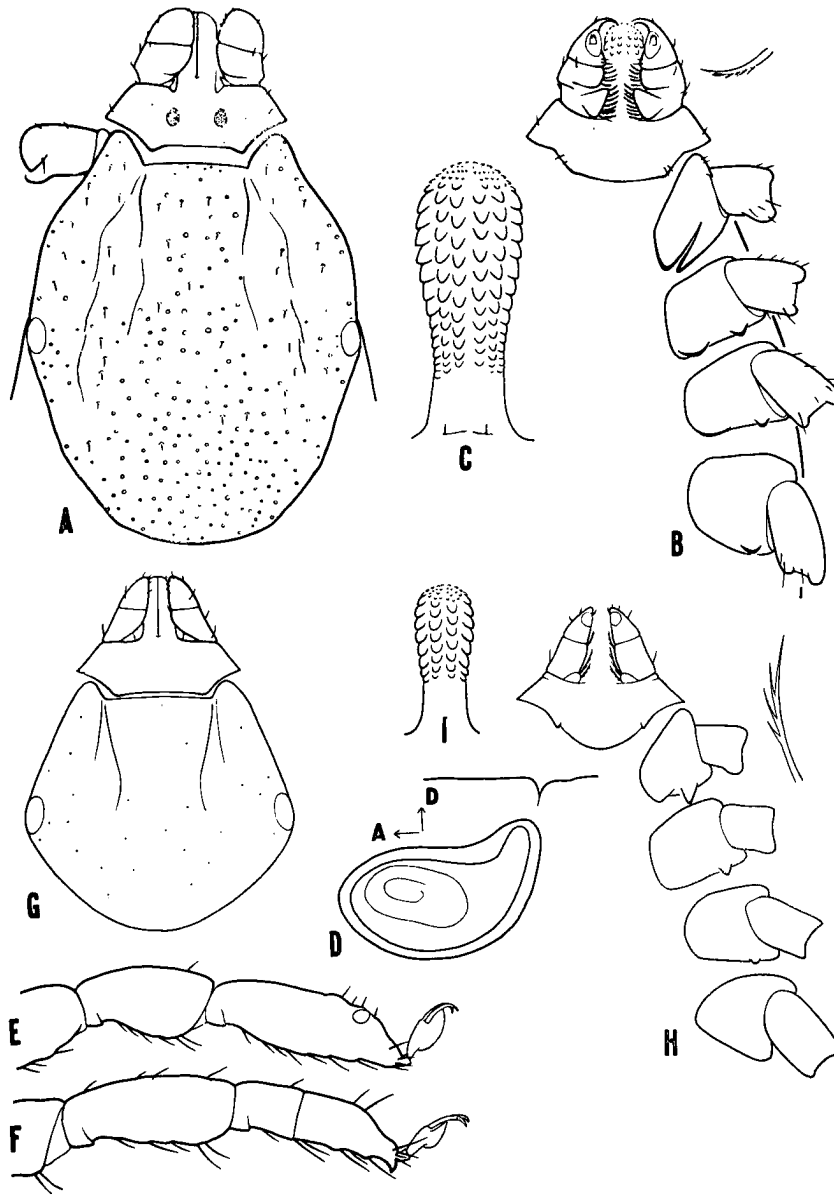


FIGURE 8.—*Rhipicephalus sanguineus sanguineus*. A-F, female: A, capitulum and scutum, dorsum; B, capitulum and coxae, venter, and palpal hair enlarged; C, hypostome; D, spiracular plate (A = anterior, D = dorsal); E, metatarsus and tarsus, leg I; F, metatarsus and tarsus, leg IV. G-I, nymph: G, capitulum and scutum, dorsum; H, capitulum and coxae, venter; I, hypostome. (From Cooley, 1946, National Inst. Health, Bull. 187.)

except basis broader; porose areas small, oval, with their longer axes longitudinal; hypostome as for male but larger and with about 10 teeth per file. Scutum suboval; cervical grooves deep anteriorly becoming broad and shallow posteriorly; punctations variable in size and number, some with short whitish hairs. Legs essentially as in male but longer and more slender.

Nymph: Length and width of unfed specimens, capitulum excluded, up to about 1.30 by 0.6 mm. Oval, widest at about middle. Scutum occupying about half body length. Fully engorged nymphs broad oval, about 3.5 by 2.1 mm. Capitulum and scutum with characters similar to those of female. Hypostome dentition 2/2 with six or seven teeth in each file. Scutum length and width about equal, about 0.5 mm.; cervical grooves deep, short; punctations absent; hairs very few and short. Legs much as in adults; all tarsi without ventral spurs; coxa I with two short, widely separated spurs, external the larger; II and III with very short, rounded external spurs; no spurs on IV.

Larva: Total length about 0.54 mm. width about 0.40 mm. Scutum occupying about one-third of body length. Capitulum much as in the nymph; basis pointed at the sides; hypostome dentition 2/2 with four or five teeth in each file. Scutum broader than long, about 0.21 by 0.33 mm.; cervical grooves shallow, nearly parallel; a few faint punctations present; hairs absent.

DISTRIBUTION: Widely distributed between about 50° N. and 30° S. latitude (Leeson, 1951, Ent. Res., Bull. 42: 123).

S. MARIANA IS. SAIPAN: Three males, from dog, June-Aug. 1945, Hagen. **GUAM**: Recorded by Vandenberg (1929).

GILBERT IS. ONOTOA: Buiartun I., eight females, five males, from dog, Aug. 1951, E. T. Moul.

HOSTS: Principally dogs, but also various wild and domestic animals and certain larger ground-feeding birds; rarely, reptiles. Micronesian records are from dogs.