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REVIEW OF *HAEMAPHYSALIS* (*KAISERIANA*) *LONGICORNIS* NEUMANN (RESURRECTED) OF AUSTRALIA, NEW ZEALAND, NEW CALEDONIA, FIJI, JAPAN, KOREA, AND NORTHEASTERN CHINA AND USSR, AND ITS PARTHENOGENETIC AND BISEXUAL POPULATIONS (IXODOIDEA, IXODIDAE)*

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ABSTRACT: The name *Haemaphysalis longicornis* Neumann, 1901, originally described from Australia, is resurrected for a distinctive taxon in the subgenus *Kaiseriana*, and the adult and immature stages are redescribed. This species has consistently been referred to in literature as *H. bispinosa* Neumann, 1897, a tropical Asian species from which it is easily distinguished structurally and biologically and which does not occur in Australia or New Zealand or in other areas where *longicornis* is reported. *H.* (*K.*) *longicornis* appears to have been imported into Australia from northern Japan in the nineteenth century and thence to New Zealand, New Caledonia, and Fiji. [A living female *longicornis* shipped to Hawaii from Australia on a sheep dog destined for Texas is recorded.] Reproduction of *longicornis* is parthenogenetic in all these areas, as well as in most of Primorye (northeastern USSR) and in Hokkaido and northern Honshu Islands of Japan. Strains of the bisexual population from southern Honshu and Kyushu Islands of Japan, and from Korea and the extreme south of Primorye, tentatively attributed to this taxon, differ only in that some are slightly smaller in average size. Apparently parthenogenetic and bisexual populations occur in northeastern China. The taxon *H. neumanni* Dönitz, 1905, is a synonym of *H.* (*K.*) *longicornis*. As shown elsewhere by Oliver and Bremner, *longicornis* represents the only known example of triploidy in ticks; chromosomes number 32 or 33 in the obligately parthenogenetic female and 31 in the reproductively nonfunctional male. This species is a vector of *Coxiella burneti* (Q fever) and is capable of transmitting *Theileria sergenti, T. mutans*, and the virus causing Russian spring–summer encephalitis. It is also a serious pest of cattle, horses, and deer. Life cycle data for laboratory reared material of *H.* (*K.*) *longicornis* from Japan are presented. In an Addendum, a female specimen from Tonga, Friendly Islands, is recorded.

The name *Haemaphysalis bispinosa* Neumann, 1897, has long been used for a distinctive parthenogenetic tick species, *H.* (*Kaiseriana*) *longicornis* Neumann, 1901, of temperate Australia and New Zealand. The true *H.* (*K.*) *bispinosa* is an easily recognized, bisexual, tropical species (Ceylon, Pakistan and India, to Malaya) that does not occur within the geographical or ecological range of *longicornis*. Parthenogenetic "*H. bispinosa*" and "*H. neumanni* Dönitz, 1905," of northern Japan (Hokkaido and northern Honshu Islands) and northeastern USSR are structurally and biologically identical to *longicornis* and are now referred to this taxon. The bisexual population of "*bispinosa*" and "*neumanni*" in southern Japan (southern Honshu and Kyushu Islands), and in Korea and the extreme south of Primorye, USSR, is tentatively referred to the taxon *longicornis* pending further study of the implications of its biological differences and generally slightly smaller average size. Apparently parthenogenetic and bisexual populations are present in northeastern China.

The Australian *H.* (*K.*) *longicornis* population was probably introduced on cattle from northern Japan, and thence to New Zealand, New Caledonia, and Fiji. Tremendous numbers sometimes infest domestic cattle, horses, and deer. This species is a vector of *Coxiella*

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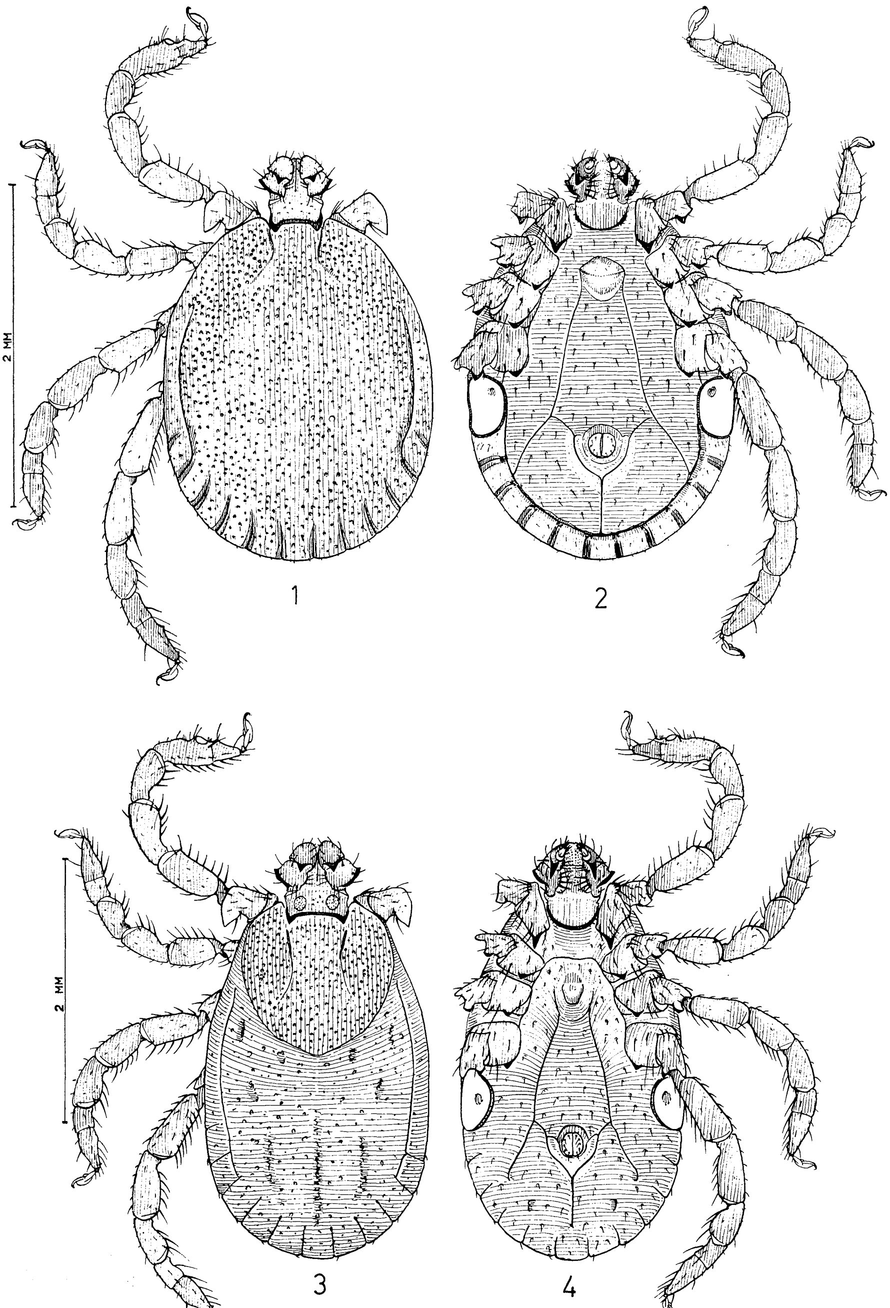
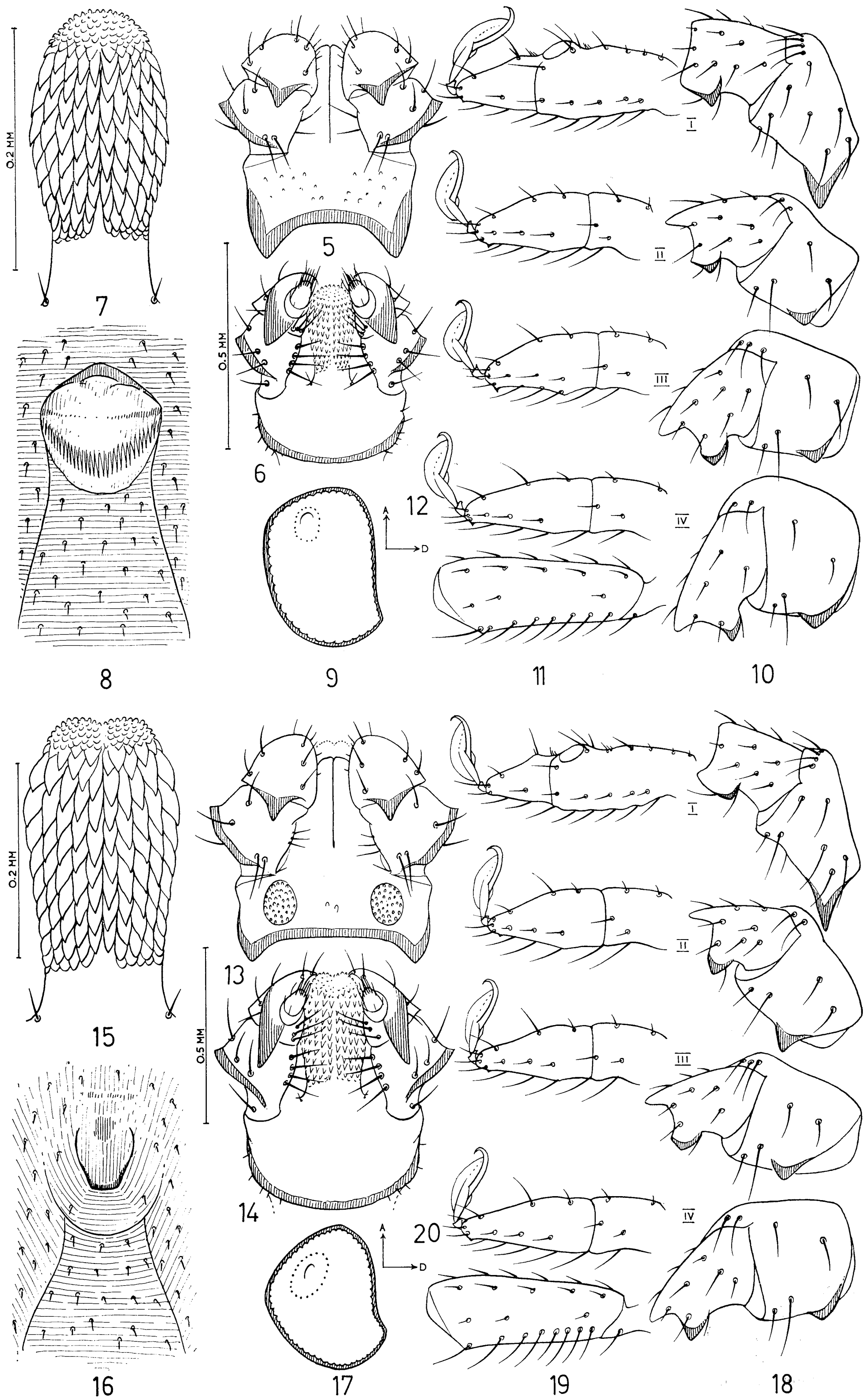


FIGURES 1–20. *Haemaphysalis* (*Kaiseriana*) *longicornis* Neumann, from cattle, Tamborine, Queensland, Australia; infertile male (CSIRO collection) and slightly engorged female (HH6833). **1, 2.** Male, dorsal and ventral views. **3, 4.** Female, dorsal and ventral views. **5, 6.** Male capitulum, dorsal and ventral views. **7.** Male hypostome, ventral view. **8.** Male genital area. **9.** Male spiracular plate (A = anterior; D = dorsal). **10.** Male coxae and trochanters I to IV. **11.** Male femur IV, internal view. **12.** Male tarsi I to IV, external view. **13, 14.** Female capitulum, dorsal and ventral views. **15.** Female hypostome, ventral view. **16.** Female genital area. **17.** Female spiracular plate. **18.** Female coxae and trochanters I to IV. **19.** Female femur IV, internal view. **20.** Female tarsi I to IV, external view.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burneti (Q fever) among Australian cattle and is capable of transmitting the virus causing Russian spring–summer encephalitis. It also transmits *Theileria sergenti* and *T. mutans* among domestic mammals.

Haemaphysalis (Kaiseriana) longicornis Neumann The Australian–Northeast Asian Haemaphysalid

(Figs. 1–35; map, Fig. 36)

Haemaphysalis longicornis; Neumann, 1901, p. 261, fig. 2, briefly described ♀ and illustrated palpus and coxa I, from "cow, Kempsey, New South Wales, Australia." The 2 specimens from which this species was described are in the Neumann collection (National Veterinary School, Toulouse, France) mounted on a single slide with 2 labels, as follows: "Animal Parasites, *Ixodes* sp., Cow tick, 15.3.97, loc. Kempsey, N. S. W., W. W. Froggatt, 5R," and "*Haemaphysalis concinna longicornis* var., ♀." One ♀ has been designated by G. M. K. as the LECTOTYPE, the other as the PARALECTOTYPE. Nuttall and Warburton, 1915, p. 512, 513, considered this to be a doubtful species and reviewed earlier literature referring to *H. longicornis* and *H. concinna longicornis*.

Haemaphysalis bispinosa Neumann, 1897. Following Nuttall and Warburton (see above), all material from Australia and New Zealand has been referred to *H. bispinosa* Neumann, 1897. Roberts, 1963, p. 69–77, briefly redescribed the ♂, ♀, nymph, and larva from Australian samples and suggested the origin of this population on cattle imported from northern Japan. This name has also been used in much literature concerning *H. (K.) longicornis* from Korea, Japan, New Caledonia, and USSR, and possibly also from China. The neotype of *H. (K.) bispinosa* was redescribed and illustrated by Hoogstraal and Trapido, 1966, p. 1188–1192, figs. 1–9, and both sexes and the nymph and larva are redescribed and illustrated by Hoogstraal (in preparation).

Haemaphysalis neumanni; Dönitz, 1905, p. 127–129, figs. 4–6, described and illustrated the ♂ and ♀ from a number of poorly documented specimens from various localities in Japan. Hoogstraal and Trapido, 1966, p. 1192–1193, figs. 10–26, redescribed and illustrated the ♀ lectotype and the ♂ paralectotype. This name has frequently been used in place of *H. (K.) longicornis* for the population in Japan, Korea, and northeastern USSR, and by Dhanda and Rao, 1964, p. 9, 10, figs. 2–5, for a different, undescribed species from N. E. F. A., India. The name *neumanni* is here considered to be a synonym of *longicornis* (see p. 1197).

Haemaphysalis cinnabarina punctata var. *longicornis* Oswald. This is apparently a synonym of *H. sulcata* Canestrini and Fanzago, 1878 (= *H. cholodkovskyi* Olenev, 1928). According to Oswald, 1939, p. 275, he had used this name in a 1937 issue of the Yugoslavia Veterinary Journal. We have been unable to find this reference.

REDESCRIPTION

Note: This redescription is based strictly on parthenogenetic samples (numerous ♀♀ and the single infertile ♂ illustrated here) from Australia, New Zealand, New Caledonia, Fiji, northeastern USSR, and northern Japan. See Material Examined for collection data and Structural Variation for other details.

Male (Figs. 1, 2, 5–12)

Length from palpal apices to posterior scutal margin approximately 2.51 mm, *breadth* 1.65 mm (for size range, see Structural Variation). *Color* reddish yellow.

Capitulum (Figs. 5–7). *Basis capituli* dorsally approximately 1.66 times as broad as long (including cornua), margins essentially straight; cornua triangular, pointed, length equal to anterior breadth, one-half as long as base of basis capituli; ventrally with 5 pairs of short posterior setae and 1 pair of short posthypostomal setae. *Palpi* moderately salient posteriorly; combined breadth approximately 1.35 times that of basis capituli; each palpus approximately 1.40 times as long as broad. Segment 1 a narrow pedicle with a single ventral seta. Segment 2 approximately 1.3 times as broad as long; posterior margins dorsally and ventrally curving anteriorly from internal margin to external surface; external profile 0.6 times as long as internal margin, acutely converging to anterior margin; posteroexternal juncture forming a small, externally directed triangle; dorsointernal margin approximately straight, slightly bulging anteriorly; ventrointernal margin almost straight; setae number 4 or 5 dorsally (may differ bilaterally), 3 ventrally; dorsointernal setae number 2, ventrointernal setae number 4. Segment 3 (except for dorsal spur) slightly shorter than 2 and broader posteriorly than 2 anteriorly (thus externally forming a small break in palpal profile at juncture of these segments); dorsal spur median, elevated, broadly triangular, sharply pointed, overlapping anterior one-third of segment 2; external profile confluent with bluntly rounded apex; dorsointernal margin rounded; ventral spur broadly triangular, narrowly pointed, extending to midlength of segment 2; setae number 5 dorsally, 3 ventrally, and 3 on internal margin ventrally. *Hypostome* (Fig. 7) short, stout, not so long as palpi, 2 times as long as broad; apex gradually rounded; corona moderately dense, approximately one-sixth as long as denticle files; dental formula 5/5; denticles in files of 8 to 10.

Scutum (Fig. 1) flat, broadly oval, L : B ratio 1.3 : 1.0; outline broadest at level of coxae IV and spiracular plates, all margins broadly rounded; apices of spiracular plates not visible from dorsal view. *Lateral grooves* narrow, distinct, extend to level of anterior one-third of scutal length, enclose first festoon. *Cervical grooves* as narrow, short, converging depressions. *Punctations* numerous, discrete, moderately deep, small and medium size, fairly regularly distributed over entire surface. *Festoons* number 11.

Venter and *genital* area as illustrated (Figs. 2, 8). *Spiracular plates* (Fig. 9) subquadrate; dorsal projection blunt and undifferentiated from the plate itself.

Legs (Figs. 1, 2, 10–12). *Coxa* I (Fig. 10) with spur elongate, spinelike, bluntly pointed, length and basal breadth of spur approximately equal, extending to but not beyond anterior margin of coxa II; coxa II and III each with a subequal, short, broadly triangular spur extending only slightly beyond posterior margin; coxa IV with a similar but slightly smaller spur. *Trochanter* I with dorsal plate triangular, sharply pointed (Fig. 1); ventral spur (Fig. 10) triangular, approximately one-third as long as spur of coxa I; other trochanters ventrally with pointed, spurlike elevations becoming smaller from II to IV. *Femur* IV with 8 ventrointernal setae, each approximately one-half as long as diameter of femur at its site of insertion (Fig. 11). *Tarsi* (Fig. 12) I to III moderately long, IV long; dorsal surfaces flat proximally, gradually taper distally; ventral surfaces each with a minute subapical hook and II to IV with a small angular ridge subproximally. *Claws* moderate. *Pulvilli* reach almost to apical curvature of claws.

Female (Figs. 3, 4, 13–20)

The female differs from the male in secondary sexual characteristics but is similar to it in diagnostic details. *Length* (unengorged) approximately 2.65 mm (2.7 to 3.4 mm), *breadth* 1.8 mm (1.4 to 2.0 mm).

Capitulum (Figs. 13–15). *Basis capituli* dorsally 2.35 times as broad as long (including cornua); margins essentially straight; cornua approximately one-third as long as base of basis capituli, broadly triangular, pointed; porose areas oval to subcircular, moderate size, widely spaced. *Palpi* as in male except for slightly greater comparative length of segment 3, ventral spur lanceolate rather than broadly triangular, dorsointernal setae number 3, ventrointernal setae number 4 or 5. *Hypostome* (Fig. 15) as in male except that apex may be truncate. Dental formula 5/5 (the inner denticle file in less than 1% of specimens examined is reduced or obsolete, thus giving a 4/4 or 4.5/4.5 formula); denticles in files of 7 to 9.

Scutum (Fig. 3) with L : B ratio 1 : 1; margins somewhat angular (becoming more so during engorgement). *Cervical grooves* as narrow, converging depressions from anterior emargination to level of anterior one-third of scutal length, continued as shallow, diverging depressions to level of posterior one-third of scutal length. *Punctations* as in male.

Genital operculum (Fig. 16) simple, elongate, outline gradually converging to truncate posterior margin. *Spiracular plates* (Fig. 17) with ventral margin angularly convex; dorsal projection short, blunt, hardly if at all differentiated from plate itself.

Legs (Figs. 3, 4, 18–20) approximately as in male. *Coxae* with spurs of II to IV extending well beyond posterior margin of coxae (as illustrated). *Trochanter* I with ventral spur more rounded and shorter than that of male. Other features of legs essentially as in male.

Nymph (Figs. 21, 22, 25–30)

Length unengorged approximately 1.76 mm, *breadth* 1.00 mm.

Capitulum (Figs. 25–27). *Basis capituli* dorsally 2 times as broad as long (including cornua); margins straight; cornua broadly triangular, approximately 0.3 times as long as base of basis capituli; ventrally as illustrated, with 2 or 3 pairs of posteroexternal setae and a pair of posthypostomal setae. *Palpi* quite similar in outlines to those of female. Segment 1 lacking setae. Segment 2 with 3 dorsal and 2 ventral setae; dorsointernal seta single; ventrointernal setae number 2. Segment 3 lacking dorsal spur; ventral spur broadly triangular, overlapping anterior one-half of segment 2; long setae number 3 dorsally and 5 ventrally. *Hypostome* (Fig. 27) approximately 1.95 times as long as broad, apex broadly rounded; corona small, one-eighth as long as outer denticle files; dental formula 3/3; denticles in files of 6.

Scutum (Fig. 21) 1.25 times as broad as long, outline broadly rounded; cervical grooves narrow, parallel, extend almost to scutal midlength; punctations rare.

Dorsum (Fig. 21) and *venter* (Fig. 22) as illustrated. *Spiracular plates* (Fig. 28) subcircular; dorsal extension bluntly triangular.

Legs (Figs. 21, 22, 29, 30). *Coxae* (Fig. 29) with spurs as in female. *Trochanters* (Fig. 29) lack ventral spurs. *Tarsi* (Fig. 30) narrowly elongate; dorsal surfaces flat proximally, gradually taper distally. *Claws* moderate. *Pulvilli* large, reach to or almost to apical curvature of claws.

Larva (Figs. 23, 24, 31–35)

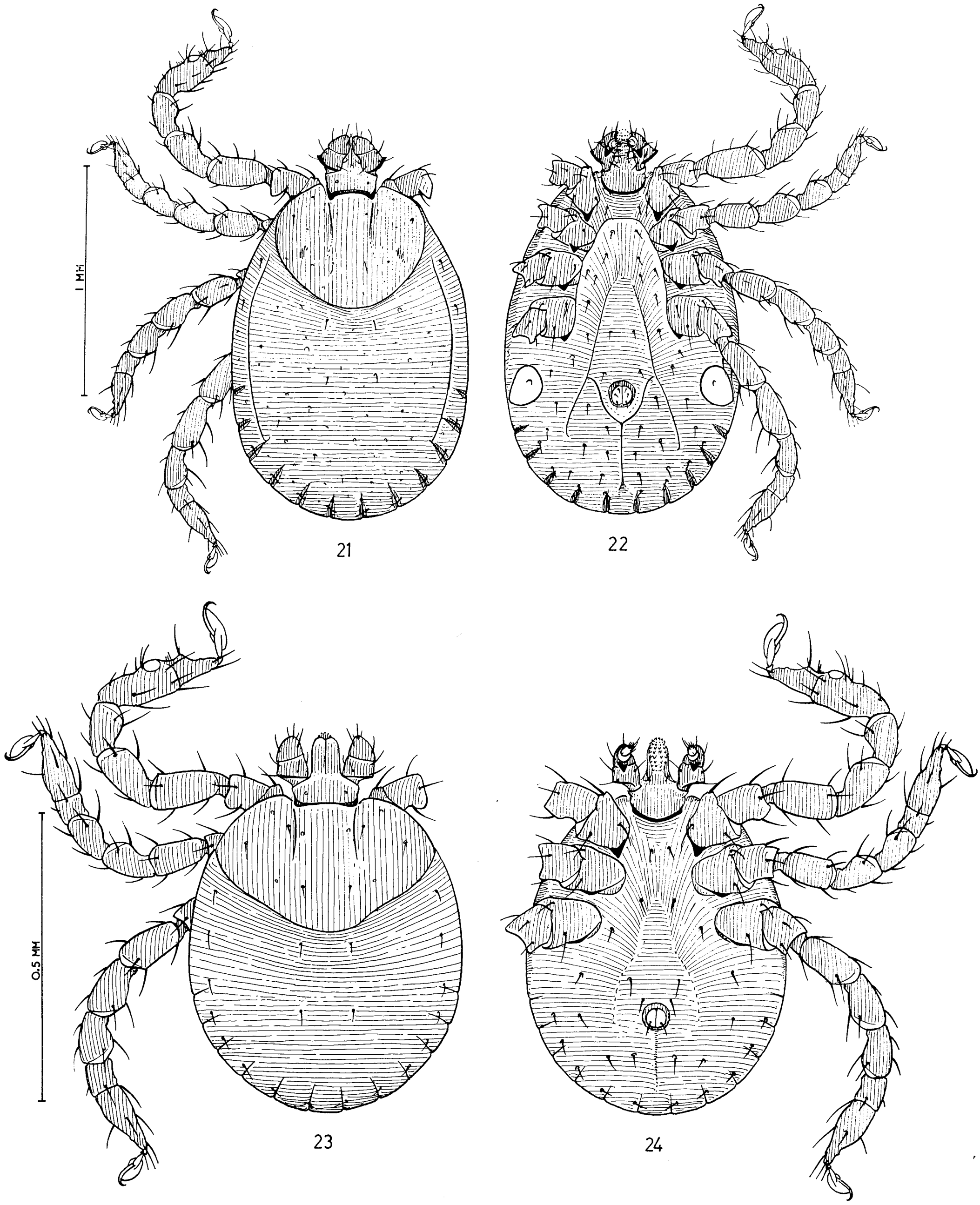
Length unengorged 0.58 to 0.62 mm, *breadth* 0.47 to 0.51 mm.

Capitulum (Figs. 31–33). *Basis capituli* dorsally 2.6 times as broad as long; cornua reduced to rounded posteroexternal bulges; ventrally as illustrated, with a pair of posthypostomal setae. *Palpi* with outlines essentially as in nymph; ventral spur of segment 3 broadly triangular, overlaps anterior one-fourth of segment 2; setae on segments 2 and 3 number 3 dorsally and 2 ventrally; dorsointernal and ventrointernal setae each single. *Hypostome* (Fig. 33) with 2/2 dental formula, denticles in files of 5, 6, or 7.

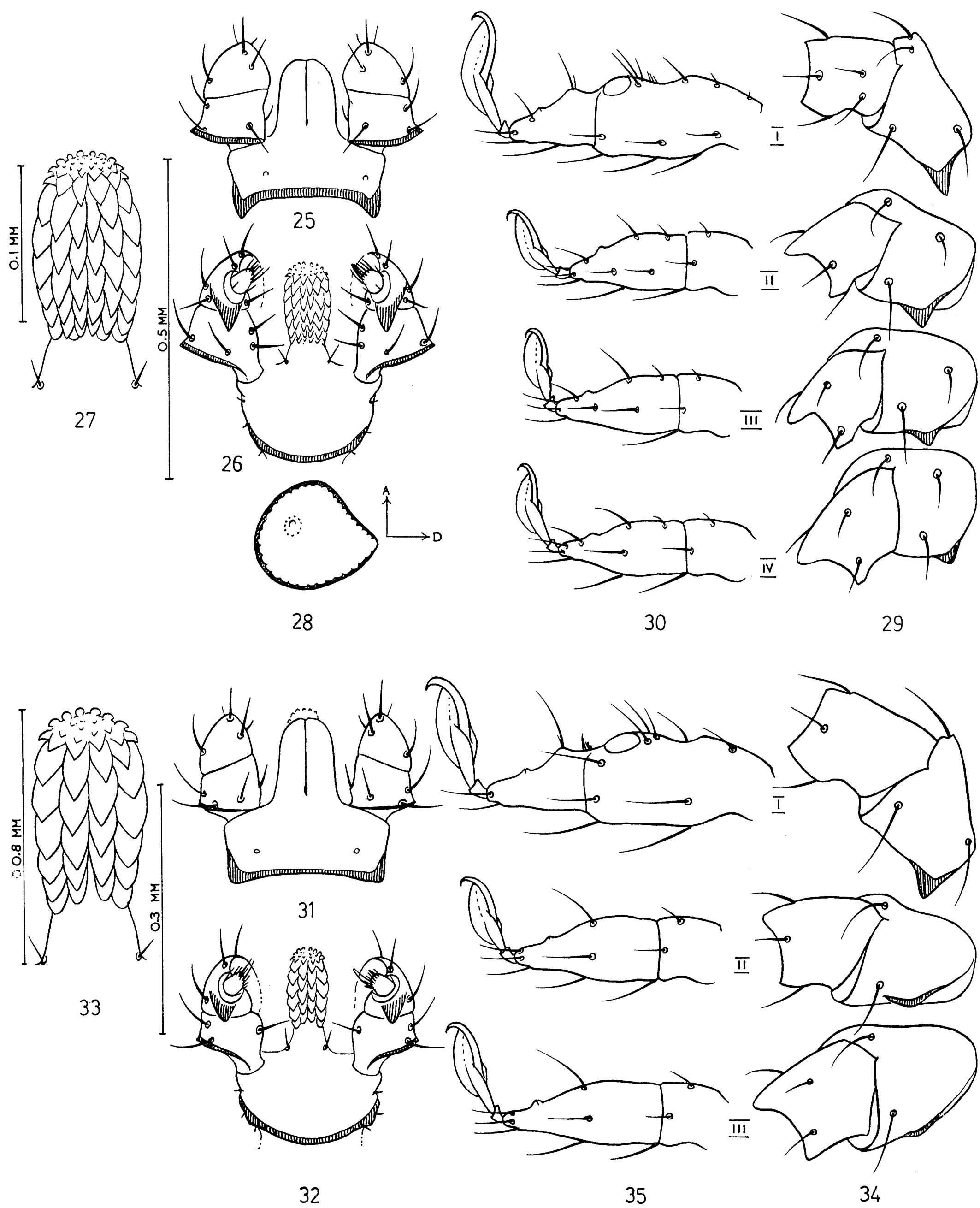
Scutum (Fig. 23) approximately 1.6 times as broad as long; outline, cervical grooves, punctations, and setae as illustrated.

Dorsum (Fig. 23) and *venter* (Fig. 24) as illustrated.

Legs (Figs. 23, 24, 34, 35). *Coxa* I (Fig. 34) with spur broadly triangular, proportionately slightly shorter than that of nymph; II and III each with a slightly elevated ridge in place of a spur. *Tarsi, claws,* and *pulvilli* (Fig. 35) as illustrated.



FIGURES 21–35. *Haemaphysalis* (*Kaiseriana*) *longicornis* Neumann (CSIRO laboratory reared), parent female from cow, Tamborine, Australia (HH7895). **21, 22.** Nymph, dorsal and ventral views. **23, 24.** Larva, dorsal and ventral views. **25, 26.** Nymph capitulum, dorsal and ventral views. **27.** Nymph hypostome, ventral view. **28.** Nymph spiracular plate (A = anterior; D = dorsal). **29.** Nymph coxae and trochanters I to IV. **30.** Nymph tarsi I to IV, external view. **31, 32.** Larva capitulum, dorsal and ventral views. **33.** Larva hypostome, ventral view. **34.** Larva coxae and trochanters I to III. **35.** Larva tarsi I to III, external view.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DIAGNOSIS (ADULTS, PARTHENOGENETIC POPULATIONS)

A medium to moderately large size haemaphysalid (subgenus *Kaiseriana*) [total length: ♂, 2.55 mm (2.44 to 2.67); ♀, 2.65 mm (2.6 to 3.4)]. *Basis capituli* L : B ratio dorsally 1.00 : 1.66 (♂) or 1.00 : 2.35 (♀); cornua triangular, one-half (♂) or one-third (♀) as long as base of basis capituli; porose areas (♀) oval to subcircular, moderate size, widely spaced. *Palpi* moderately salient posteriorly, each approximately 1.4 times as long as broad. Segment 2 with posterior margins dorsally and ventrally curving; dorsointernal setae number 2 (♂) or 3 (♀); ventrointernal setae number 4 (♂, ♀) or 5 (♀). Segment 3 with dorsal spur broadly triangular, overlapping anterior one-third of segment 2; ventral spur broadly triangular (♂) or lanceolate (♀), overlapping anterior one-third of segment 2. *Hypostome* with moderate corona approximately one-sixth as long as denticle files; dental formula 5/5 (in fewer than 1% of ♀♀, may be 4/4 or 4.5/4.5). *Scutum* (♂) with L : B ratio 1.3 : 1.0, margins broadly rounded; lateral grooves narrow, distinct, extend to level of anterior one-third of scutal length, enclose first festoon; punctations numerous, discrete, moderately deep, small and medium size, fairly regularly distributed. *Scutum* (♀) with L : B ratio 1 : 1; margins gradually curving or somewhat angular (easily distorted), cervical grooves linear; punctations as in ♂. *Genital operculum* (♀) simple. *Spiracular plates* subquadrate, dorsal projection blunt and undifferentiated from the plate itself (♂); or with ventral margin angularly convex, dorsal projection short, blunt, hardly if at all differentiated from plate itself (♀). *Coxae* I with spur elongate, spinelike, bluntly pointed, length and basal breadth approximately equal; in ♂ spurs of II to IV (possibly blunted apically in ♂ specimen examined) broadly triangular, extending only slightly beyond posterior margin of coxa, spurs II and III subequal, IV slightly smaller; in ♀ spurs of II to IV extend well beyond posterior margin of coxae. *Trochanter* I ventrally with short, triangular spur (♂), or shorter, rounded spur (♀); II to IV with elevated spurlike ridges. *Femur* IV with 8 ventrointernal setae. *Tarsi* moderately long (I to III) or long (IV), gradually taper.

MATERIAL EXAMINED

Total: 509♂♂, 1,747♀♀, +526 nymphs (NN), +1,375 larvae (LL).

USSR [Primorye (Maritime) Province]. From *Bos taurus*; 3♀♀ (proven. Chine), Primorsk, W. D. Korsak, July 1909 and December 1910 [presented to Neumann collection (N1786), National Veterinary School, Toulouse, by W. L. Yakimoff (seen by H. H.)].

China [Shantung]. Collected in summer 1934, by R. T. Shields: *From goat:* 2♂♂, 50♀♀, Tsinan (RML10,447). *From cattle:* 9♀♀, 40 mi from Tsinan (RML10,450). *From dog:* 7♂♂, 3♀♀, Mt. Taishan (40 mi from Tsinan) (RML-10,448). Nuttall collection No. 2976 in BM(NH) (identified by H. H.). *From dog:* 3♀♀, Tsingtao, Professor Hoffman.

North Korea. *From vegetation:* 1♀, Ch'onsong-Ni, 16 June 1952, R. Traub (RML33,092).

South Korea. All collections and reared materials are from Cheju Do Island, except RML-30,938 from Koje Do Island. All collected by SFC Parsons and/or assistants (Driggers and Yi Munsi) of the Fifth Preventive Medicine Unit, Korea [except single collections from P. Oman (RML-30,938) and F. B. Bang (HH7057)].

Laboratory reared (♀ parents from cattle): 5♂♂, 5♀♀, 20NN, 60LL, Naedo-Ri, 5 May 1967 (RML48,803). 10♀♀, 30NN, 40LL, Aewol, 5 May 1967 (RML48,804).

From cattle: 7♂♂, 8♀♀, Naedo-Ri, 5 May 1967 (RML48,803). 1♂, 4♀♀, 3NN, Aewol, 5 May 1967 (RML48,804). 1♂, 1N, Hallim, 5 May 1967. 6♂♂, 13♀♀, 5NN, Song-Ga, 5 May 1967. 3♂♂, 2♀♀, 1N, Nabum-Ni, 5 May 1967. 3♀♀, Kumik, 6 May 1967. 1♂, Kumsong-Ni, 6 May 1967. 2♂♂, 2♀♀, Sogan, 6 May 1967. 1♂, 8♀♀, 2NN, Kwanson, 6 May 1967. 1♂, 1N, Iho-Ri, 5 May 1967. 3♂♂, 2♀♀, 1N, Ha-gi, 5 May 1967. 7♀♀, 21NN, 1964 (HH6435). 3♂♂, 57♀♀, 1N, May 1966, F. B. Bang (HH 7057). 7♀♀, 13 July 1957 (RML34,435). *From horses:* 6♂♂, 5♀♀, Skin-Um, 5 May 1967. 3♀♀, 2NN, Todu-Ri, 5 May 1967. 2♂♂, 1♀, 13 July 1957 (RML34,434). *From sheep:* 6♂♂, 1♀, Isidor Farm, 6 May 1967. *From goat:* 39♂♂, 23♀♀, Koje Do, 5 July 1951, P. Oman (RML 30,938). *From dog:* 3♀♀, 12 July 1957 (RML 34,433).

Japan. Paralectotype ♂, lectotype ♀, syntypes (2♂♂, 6♀♀) of *Haemaphysalis neumanni* [Neumann collection (N1425), National Veterinary School, Toulouse (seen by H. H.)]. 2♂♂, 3♀♀ marked "type," 1♀, cow, Kyago, and 1♀, dog, Haragi [Berlin Museum (seen by H. H.)]. 1♀, Izu [BM(NH)11.12.12.44 (seen by H. H.)].

Collectors' (406th Medical Laboratory) initials: J. Akiyama (J. A.), W. J. Betchley (W. J. B.), W. Holubec (W. H.), K. Mizusawa (K. M.), S. Sasagawa (S. S.), V. J. Tipton (V. J. T.), S. Toshioka (S. T.), and N. Yamaguti (N. Y.). Other collectors: Y. Saito (Y. S.) (Niigata University) and H. Takahasi (H. T.) (Japanese Self Defense Forces).

All data are arranged in order of their location, from north (Hokkaido Island) to south (Kyushu Island). Note the absence of ♂♂ from Hokkaido Island and from northern Honshu Island (Aomori, Iwate, Gumma, Nagano, and Tokyo Prefectures) and the presence of ♂♂ from southern Honshu Island (Nara, Hiroshima, and Shimane Prefectures) and Kyushu Island.

Hokkaido Island. *From cattle:* 23♀♀, Higashimokoto, Abashiri, 13 August 1955, S. T. & J. A. 3♀♀, Shintoku, Kamikawa, 15 July 1967, S. T. & S. S. 16♀♀, Kozawa, Shiribeshi, 18 July 1967, S. T. & S. S. *From horses:* 17♀♀, Hiyama, 17 August 1955, S. T. & J. A. (RML34,124).

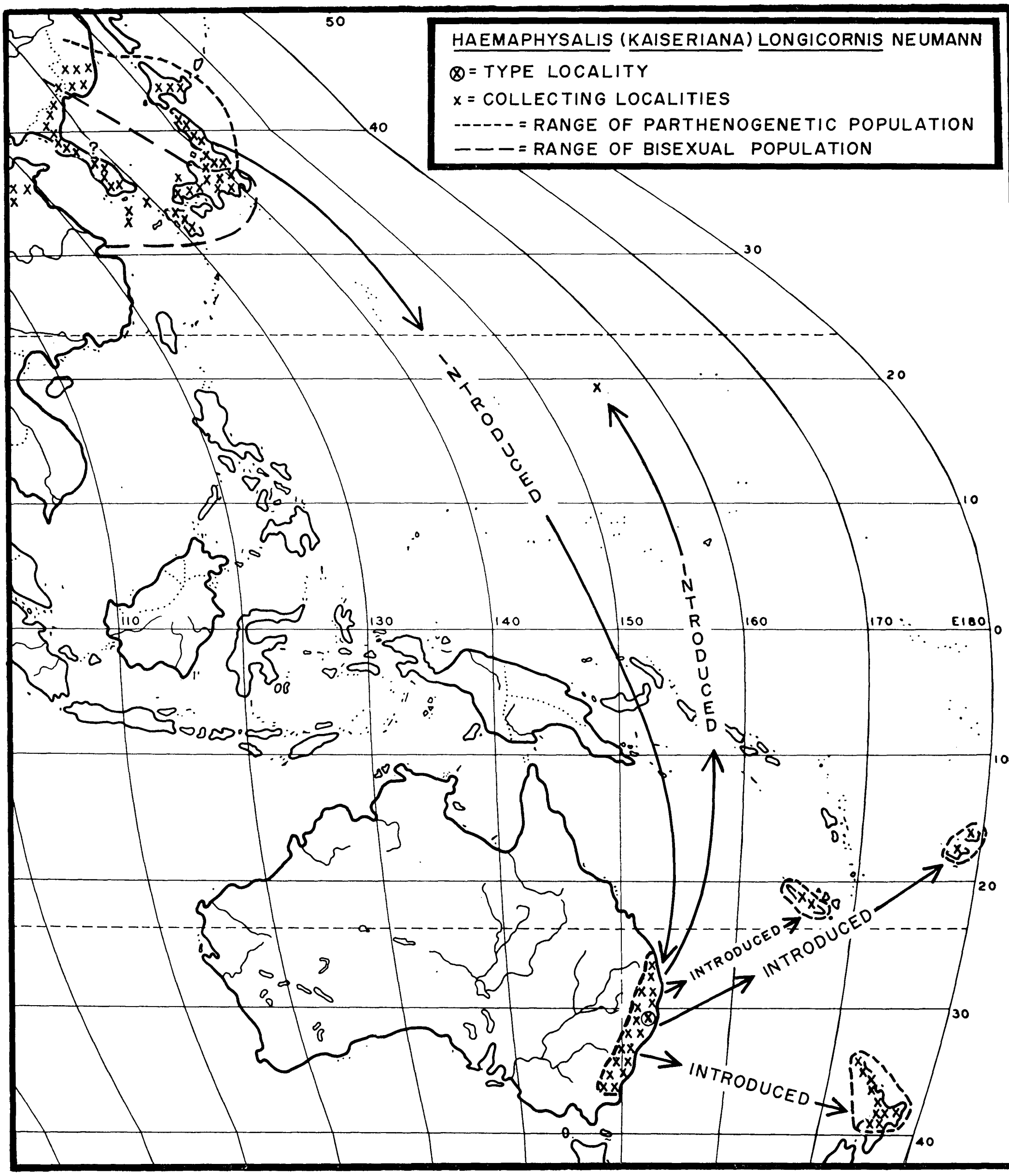

FIGURE 36. Distribution of *Haemaphysalis* (*Kaiseriana*) *longicornis* Neumann. The lines separating bisexual and parthenogenetic populations in Japan and southern Primorye, USSR, are approximate. Some bisexual demes may occur in the general area occupied by the parthenogenetic population, and vice versa.

9♀♀, Tomioka, 2 August 1955, S. T. & J. A. 8♀♀, Misaki, Abashiri, 13 July 1967, S. T. & S. S. *From dogs:* 1♀, Kozawa, Shiribeshi, 18 July 1967, S. T. & S. S. 4♀♀, Misaki, Abashiri, 13 July 1967, S. T. & S. S.

HONSHU ISLAND. AOMORI PREFECTURE. *From dog:* 8♀♀, Towada Mura, 13 October 1955, J. A. IWATE PREFECTURE. *Laboratory reared* (♀ *parent from cow*): 10♀♀, 30NN, 60LL, Koiai, 26 April 1962, Y. S. (RML48,798). GUMMA PREFECTURE. *Laboratory reared* (♀ *parents from cattle*): 10♀♀, 10NN, 10LL, Takayame-Mura, Agatsuma, 3 September 1966, N. Y. 10♀♀, 10NN, 10LL, Komochi, Agatsuma, 3 September 1966, N. Y. (HH7893). NAGANO PREFECTURE. *From dog:* 1♀, 2NN, Asama. TOKYO PREFECTURE. *Laboratory* *reared* (♀ *parent from cow*): 6♀♀, numerous reared LL, Aoga Shima Island, 26 July 1967, H. T. (RML48,806). NARA PREFECTURE. *From badger* (*Meles m. anakuma* Temninck): 1♂, 2♀♀, Nara, 24 June 1946, Kawamura (RML27,084). *From deer:* 56♂♂, 26♀♀, Nara, 13 June 1946, Kawamura (RML27,086). HIROSHIMA PREFECTURE. *From cattle:* 4♂♂, 6♀♀, Mt. Azumayama, 19 September 1955, S. T. & J. A. SHIMANE PREFECTURE. *From cattle:* 2♂♂, 1N, 4LL, Mt. Sanbe, 6 October 1966, W. H. (HH8071). *Laboratory reared* (♀ *parents from cattle*): 15♀♀, 15NN, 50LL, Mt. Sanbe, 13 July 1966, S. T., W. J. B., & W. H. (RML48,800); 2♂♂, 10♀♀, 10NN, 10LL, from same collection (HH7894). 5♂♂, 10♀♀, numerous NN and LL, reared from ♀ collected as L from cow, Okinoshima Island, 12 September 1966, N. Y. (RML47,612); 19♀♀, 10NN, 10LL, from same collection (HH7117–7120; 7483; 7892).

KYUSHU ISLAND. NAGASAKI PREFECTURE. *From cattle:* 211♂♂, 1♀, Iwazato, Tsushima Island, 6 May 1967, V. J. T. & K. M. 49♂♂, 33♀♀, 50NN, Hatsuyama, Iki Island, 4 May 1967, V. J. T. & K. M. *Laboratory reared* (♀ *parents from cattle*): 5♂♂, 5♀♀, 25NN, 60LL, Hatsuyama, Iki Island, 4 May 1967, V. J. T. & K. M. 5♂♂, 5♀♀, 30NN, 60LL, Gonoura, Iki Island, 2 May 1967, V. J. T. & K. M. (RML48,797). *From horses:* 4♂♂, 1♀, 4NN, Iwazato, Tsushima Island, 6 May 1967, V. J. T. & K. M. KAGOSHIMA PREFECTURE. *From cattle:* 1♀, Komen, Sakurajima Island, 14 May 1967, K. M. 8♀♀, Ichinari, 10 May 1967, V. J. T. & K. M.

MISCELLANEOUS. *From cattle:* 1♂, 4♀♀, Kyushu, 14 July 1933, M. Sugimoto (RML15,185). *From horses* (Nuttall collection in BM(NH), identified by H. H.): 1♂, 9♀♀, Takanabe, Kyushu, 1912, Dr. M. Miyajima (N2909); 8♀♀, Dasien, N. W. of Central Japan, 1912, Dr. M. Miyajima (N2908).

AUSTRALIA (*All in CSIRO collection unless otherwise stated*; for dates and collectors see Roberts, 1963, p. 75).

QUEENSLAND: *From cattle and laboratory reared:* 8 infertile ♂♂, +50♀♀, +100NN, +1,000LL; all from Tamborine (CSIRO and HH6833; 7895; 8072). *From cattle:* 2♀♀, Murgon; 1♀, Maryvale; 18♀♀, Buderim; 7♀♀, Montville; 19♀♀, Maleny; 1♀, Mt. Mee; 3♀♀, Dayboro; 1♀, Helidon; 1♀, Amberley; 3♀♀, Yeerongpilly; 1♀, Beaudesert; 1♀, 2NN, Tallebudgera; 28♀♀, 2NN, Coolangatta.

From human: 1♀, Sandy Creek, Kilcoy. *From dog:* 7♀♀, Tamborine. *From pig:* 1♀, Currumbin. *From horses:* 2♀♀, 1L, Gympie; 3♀♀, Coolangatta. *From sheep:* 18♀♀, Buderin. *From Brindled Bandicoot* (*Isoodon macrourus* Gould): 3NN, Tamborine. *From European Hare* (*Lepus europaeus occidentalis* de Winton): 1♀, 13NN, Tamborine. *From pasture:* 27NN, Tamborine. *From unrecorded hosts:* 3♀♀, 10NN, Maleny; 17♀♀, Booroobin.

NEW SOUTH WALES: *From cattle:* 119♀♀, Wingham District, December 1925 [Department of Entomology, London School of Hygiene and Tropical Medicine (det. by H. H.)]. 4♀♀, Woodenbong; 3♀♀, Murwillumbah; 9NN, Byron Bay; 305♀♀, Bungalow; 1♀, Bonalbo; 3♀♀, Tabulam; 4♀♀, Tenterfield; 1♂, 3♀♀, 1N, Casino; 1N, Woodburn; 79♀♀, 10NN, Grafton; 4♀♀, Dorrigo; 13♀♀, Clybucca; 6♀♀, Smithtown; 8♀♀, Macksville; 1♀, 1N, Gladstone; 66♀♀, Kempsey [INCLUDING 2♀♀ IN TYPE SERIES (ONE LECTOTYPE AND ONE PARALECTOTYPE)]; 9♀♀, 1N, Port Macquarie; 22♀♀, Raleigh; 1♀, Comboyne; 25♀♀, 2NN, Glouster; 1♀, Paterson; 18 NN, Maitland; 20♀♀, Trundle; 19♀♀, 4NN, Campbelltown; 5NN, Young; 4♀♀, Bundanoon; 7♀♀, Kiama; 4♀♀, Berry; 9♀♀, Milton; 4♀♀, Bodalla.

From horses: 1♀, Lismore; 6♀♀, Leumeah; 1♀, Ballina [Nuttall 1851, British Museum (Natural History) (det. by H. H.)]. *From Great Gray Kangaroo* (*Macropus major* Shaw): 2♀♀, Bonalbo. *From Black-striped Wallaby* (*Wallabia dorsalis* Gray): 2NN, Bonalbo. *From European Hare* (*Lepus europaeus occidentalis* de Winton): 5♀♀, Numulgi. *From unrecorded host:* 1♀, Bellingen.

VICTORIA: *From cattle:* 1♀, Wy Yung; 2♀♀, Orbost; 3♀♀, Bairnsdale; 3♀♀, Wodonga; 1♀, Wangaratta; 6NN, 3LL, Beechworth; 1♀, Staghorn Flat. *From horse:* 4♀♀, Tallangatta.

NEW ZEALAND. *From cattle:* 184♀♀, 13NN, North Auckland area, December 1966, gift of Professor J. A. R. Miles (HH7302).

NEW CALEDONIA. *From cattle:* 6♀♀, 4NN, Noumea, G. F. Hill [Waite Agricultural Research Institute collection (det. by F. H. S. R.)].

FIJI ISLANDS. *From cattle:* 42♀♀, 16NN, Viti Levu, Tailevu, 5 January 1968, A. C. Stenhouse (HH8070). 1♀, Landoka, 29 September 1963, K. J. Garnett [Commonwealth Institute of Entomology coll., BM(NH) (det. by H. H.)].

HAWAII. *From domestic "sheep dog"* from South West Rocks, Australia: 1♀, Honolulu Quarantine Station (U. S. Public Health Service), 14 November 1967, C. R. Joyce. The specimen, identified by G. M. K., is deposited in the Honolulu Quarantine Station. The host was destined for an Animal Research Station in Texas. South West Rocks is near Kempsey, the type locality of *H. longicornis.*

STRUCTURAL VARIATION

MALE. *Size and outline.* The preceding male redescription was written from study of the CSIRO specimen illustrated (figs. 1, 2, 5–12). The illustrated specimen is somewhat broader than most others in samples from Australia (cf. Roberts, 1963, fig. 19), Japan (cf. Keegan and Toshioka, 1957, plate 16; Hoogstraal and Trapido, 1966, figs. 10, 11, 14–19), and its coxal spurs are shorter than those in other male specimens (see below). The illustration of *H. neumanni* from USSR (by Pospelova-Shtrom) in Pomerantzev (1950;

TABLE I. *Measurements of unfed, reared* Haemaphysalis (K.) longicornis *(in mm).*

Number and sex	Length (avg.)	Breadth (avg.)
Cheju Do Island, Korea (RML48,803; 48,804; bisexual population)		
5 ♂♂	2.44–2.57 (2.49)	1.50–1.59 (1.56)
12 ♀♀	2.75–3.05 (2.95)	1.39–1.90 (1.80)
Okinoshima Island, Shimane (HH7483; 7492; bisexual population)		
10 ♀♀	3.09–3.39 (3.21)	1.75–2.05 (1.85)
Mt. Sanbe, Shimane, Honshu Island (HH7894; bisexual population)		
2 ♂♂	2.60–2.67 (2.63)	1.64–1.78 (1.71)
7 ♀♀	2.89–3.14 (2.99)	1.65–1.84 (1.73)
Komochi, Gumma, Honshu Island (HH7893; parthenogenetic population)		
6 ♀♀	3.04–3.13 (3.06)	1.72–1.83 (1.77)
Australia (C. S. I. R. O.; nonfertile ♂♂, parthenogenetic ♀♀)		
5 ♂♂	2.10–2.40 (–)	1.50–1.70 (–)
20 ♀♀	2.00–2.60 (–)	1.50–1.80 (–)

fig. 377) practically duplicates that of our illustrated Australian specimen. Measurements for unengorged adults from Japan, Cheju Do Island (Korea), and Australia are given in Table I.

Capitulum. We have observed no difference in the notably narrowly elongate basis capituli of Australian males and those from southern Japan and Cheju Do Island [L : B ratio 1:00 : 1.66; cf. *H.* (*K.*) *lagrangei* Larrousse and *H.* (*K.*) *luzonensis* Hoogstraal and Parrish]. The presence of 4 dorsointernal setae on palpal segment 2 of the Japanese specimen illustrated by Keegan and Toshioka (1957; plate 16) is probably an artist's error; we have observed no more than 2 setae in this situation. In the original description of *H. neumanni*, Dönitz stated that the male dental formula may be 5/5 or 6/6, and Pospelova-Shtrom (in Pomerantzev, 1950) repeated these formulae. However we have seen only a 5/5 dental formula in all males examined.

Scutum and spiracular plates. It is noteworthy that scutal and spiracular plate characters are identical in all males examined.

Legs. As noted above, the coxal spurs of the Australian specimen illustrated here are shorter than those in other males examined. This may be due to wear. All sharply pointed spurs of the capitulum, coxae, and trochanters of this species are quite fragile and their apices are frequently blunted and worn from friction against the tough hairs and hide of the host. As true in many haemaphysalid species with some expression of ventral elevations or spurs on trochanters, it is sometimes difficult to define precisely whether that on leg II is a true spur or a spurlike elevation; some variation in this character is to be expected.

FEMALE. The preceding female redescription is based on numerous parthenogenetic specimens, as qualified above. All specimens from elsewhere, listed in Material Examined, conform to this description. The rare occurrence of Australian females with a 4/4 or 4.5/4.5 dental formula should be noted; other than this, we have seen no deviation from the 5/5 formula typical of this species. The scutum is unusually pliable and with the slightest degree of engorgement it stretches laterally and anteroposteriorally and its outline becomes marked by various angles. Even among unengorged females from one egg batch there is some variation in the L : B ratio of the scutum. Remarks on blunting of male capitular, coxal, and trochanter spurs apply equally to those of females. Measurements of females from Japan, Korea, and Australia are given in Table I.

NYMPH AND LARVA. Reared immature specimens from Australia, Japan, and Korea are identical. Allowing for the fact that the larva and nymph from USSR illustrated by Pospelova-Shtrom (1940, figs. 17–20) were drawn as seen with pressure of the cover slip on slide mounted specimens, these are also identical to those studied and illustrated herein from Australia and Japan.

TAXONOMIC SYNONYMY OF *HAEMAPHYSALIS NEUMANNI* DÖNITZ

References to the taxonomic literature on *H. neumanni* Dönitz, 1905, have been listed above. Dönitz described this species from an unstated number of males and females "from horses, cattle, and dogs in different provinces of Japan" without further detail. Trapido (1965) selected as the lectotype of this taxon a partly engorged female (illustrated by Hoogstraal and Trapido, 1966, figs. 12, 13, 20–26) which in each critical structural character conforms exactly to all material of *H.* (*K.*) *longicornis* from Australia. The male paralectotype of *neumanni* from Japan is also structurally identical to infertile males of *longicornis* from Australia. The taxon *neumanni*

Dönitz, 1905 is a synonym of *longicornis* Neumann, 1901. If subsequent research shows that bisexual populations in southern Japan, Korea and the extreme south of Primorye, northeastern USSR, now attributed to *longicornis* should in fact require a separate taxon, the name *neumanni* would not be available for this purpose.

PARTHENOGENETIC AND BISEXUAL POPULATIONS

The definitive work on parthenogenetic and bisexual populations of *H.* (*K.*) *longicornis* in Japan is that of Kitaoka (1961d, as *H. bispinosa*), who also reviewed other studies on this subject. Kitaoka's distribution data for these populations conform to those listed herein under Material Examined; *i.e.* the population north of Tokyo is (with the exception of two known local demes) parthenogenetic while to the south (and in South Korea), the population is bisexual and contains a varying proportion of males. Some intermingling appears to occur in the area of contact and available data are not yet sufficient to permit drawing a definite geographical borderline between parthenogenetic and bisexual populations.

Larvae, nymphs, and females of the totally parthenogenetic population were slightly larger in average size than those of the bisexual population (Kitaoka, loc. cit.). Parthenogenetic females laid fewer eggs and "low" temperatures were suitable for egg development while high temperatures (27.5 and 30 C) were detrimental to egg development. Eggs of bisexual samples usually developed at 30 and 32 C. Females from bisexual samples required fertilization by males for reproduction. Kitaoka concluded that parthenogenesis in the population in which this reproductive phenomenon occurs is obligative, not governed by external factors, and does not alternate with bisexual reproduction from one generation to the next.

Unfertilized bisexual females laid sterile eggs but when parthenogenetic females and bisexual males were mated, male : female numbers of the progeny were 11 : 21 (F_1) and 83 : 44 (F_2). Spermatozoa were found in squash preparations of all mated females after oviposition (Kitaoka, loc. cit.).

That the parthenogenetic populations of northeastern USSR, northern Japan, Australia, New Zealand, New Caledonia, and Fiji, previously referred to *H. neumanni* or to *H. bispinosa* are in fact a single biological entity for which *H.* (*K.*) *longicornis* is the correct name appears to be demonstrated beyond question. We tentatively conclude from available evidence that the bisexual population in southern Japan and in Korea should also be referred to the taxon *longicornis*. This obviously challenging view offers a rich field for further biological and taxonomic research.

H. (*K.*) *longicornis* also occurs in northeastern China. The evidence presented by Teng (1955), referred to in the literature review below, is vague. Material that we have seen from China apparently derives from both parthenogenetic and bisexual populations.

In Primorye, northeastern USSR, it appears that the parthenogenetic population is widespread and that the bisexual population is restricted to the extreme south, adjacent to North Korea, where it alternates or coexists with the parthenogenetic population. Parthenogenetic females from this area, in laboratory tests utilizing thousands of specimens, produced six generations of only parthenogenetic females over a 5-year period, whether they fed on hosts on which males were also present, or not (Belikova, 1966). Zhmaeva (1950), Belikova (1962), Laptev (1963), and Abramov and Laptev (1966) obtained only females among F_1 progeny reared from females from Primorye farms. The life history data of Laptev (1963) are particularly detailed.

In Australia, Roberts (1963) found very few males and Bremner (1959) reported a ratio of 1 male to 400 females. No spermatozoa were present in dissections of 5 fed and unfed males (1 of which is that illustrated in the present paper). *H.* (*K.*) *longicornis* (Australian sample) represents the only known example of triploidy in ticks; chromosomes number 32 or 33 in the obligately parthenogenetic female and 31 in the reproductively non-functional male (Oliver and Bremner, 1968).

Parthenogenesis, with very few males all of which presumably are infertile, also typifies the New Zealand population (Myers, 1924; and present data). Samples from New Caledonia and Fiji seen by F. H. S. R. and H. H. contain only females.

TABLE II. *Laboratory observations on life cycle of samples from parthenogenetic and bisexual populations of* Haemaphysalis (K.) longicornis *from Japan (406th Medical Laboratory [1966–1967]).*

Period	Number of days					
	Least		Most		Average	
	P	B	P	B	P	B
Oviposition to hatching	24	38	31	39	27.5	38.6
Resting (larvae)	3	3	5	4	4.0	3.5
Feeding (larvae)	4	5	5	7	4.5	6.0
Drop-off to molt (larvae)	14	20	17	22	15.5	21.0
Resting (nymphs)	2	3	3	3	2.5	3.0
Feeding (nymphs)	5	4	7	5	6.0	4.5
Drop-off to molt (nymphs)	12	14	16	16	14.0	15.0
Resting (adults)	4	2	6	4	5.0	3.0
Feeding (adults)	11	11	19	13	15.0	12.0
Drop-off to oviposition (♀♀)	3	3	7	6	5.0	4.5
Oviposition (♀♀)	11	17	27	18	19.0	17.5
Number of eggs					2,024	2,740
Egg hatch (%)					94	96

P = Parthenogenetic population sample.
B = Bisexual population sample.

LIFE CYCLE OBSERVATIONS

Details of the life cycle of parthenogenetic and bisexual populations of *H.* (*K.*) *longicornis* have been provided by a number of workers mentioned in the literature review below.

Life cycle observations on 33 parthenogenetic females and 3 bisexual females from Komochi Pasture (Gumma Prefecture) and Sanbe Pasture (Shimane Prefecture) recorded at the 406th Medical Laboratory are presented in Table II. The temperature ranged from 26 to 28 C, R. H. from 20 to 30%. Hosts for each developmental stage were New Zealand white rabbits. Factors influencing the differences in feeding and resting periods of each developmental stage of these two populations should be especially worthy of more detailed study.

DIFFERENTIATION BETWEEN *H.* (*K.*) *LONGICORNIS* AND *H.* (*K.*) *BISPINOSA*

Criteria for differentiating *H.* (*K.*) *longicornis* from several other species will be presented in a review of the *H.* (*K.*) *bispinosa* group (Hoogstraal, in preparation). For present purposes, however, details are provided for taxonomic separation of *H.* (*K.*) *bispinosa* and *H.* (*K.*) *longicornis*. *H.* (*K.*) *bispinosa* is a tropical, typically bisexual species ranging from Pakistan, Ceylon, India, and Nepal to Burma, Thailand, and the Malay Peninsula. It is a small tick (male length approximately 2.0 mm, female length 2.2 mm) with a 4/4 dental formula, few scutal punctations, and exceptionally short, widely triangular spurs on coxae II to IV. In comparison, *longicornis* is essentially temperate in ecology and distribution, parthenogenetic as well as bisexual in reproduction, and larger, with a 5/5 dental formula, numerous scutal punctations, and conspicuously pointed spurs on coxae II to IV. The *bispinosa* larva is smaller but otherwise quite similar to that of *longicornis*. The *bispinosa* nymph is also smaller, has a 2/2 rather than 3/3 dental formula, short spurs on coxae II to IV, no dorsal projection of the spiracular plates, and a small median bulge of the posterodorsal margin of palpal segment 3, which is lacking in the *longicornis* nymph.

LITERATURE REVIEW

In this section we list some of the most important literature concerning *H.* (*K.*) *longicornis*, except that already cited, from each geographical area in which this species is known to occur.

USSR. This species occurs only in the Far East of USSR (Primorye or Maritime Province) in southern ussuri type forests. Each developmental stage feeds between May and October. Females infest cattle, deer, horses, badgers, and dogs; larvae and nymphs were found on badgers and dogs (Pomerantzev, 1950; Belikova, 1966; Semenova, 1966). In an especially interesting biological and ecological study of Primorye ticks, Somov and Shestakov (1963) reported tremendous infestations of female and nymphal "*H. neumanni*," and fewer larvae, on spotted deer where these animals are bred on farms "for medicinal properties of their horns." Larvae infest many bird and small mammal species, chiefly the Asiatic chipmunk, which is the most common small mammal of the region. Other female hosts are roe deer, bears, foxes, racoons, and wildcats. Larvae, nymphs, and females attack humans; larvae feed on humans for 3 or 4 days. A shepherd who experienced a heavy attack by larvae later suffered from acute dermatitis. Seven generations, exclusively of females, were obtained by laboratory rearing of Primorye samples in a 40-month period (Abramov and Laptev, 1966).

H. (*K.*) *longicornis* appears to be important in transmission of the virus causing Russian spring–summer encephalitis (RSSE) in Primorye (Hoogstraal, 1966). Nymphs infected from feeding on an RSSE-infected animal molted into females that yielded this virus when tested 87 days later; virus was also recovered from mice bitten by other females that had been infected as nymphs (Tatarinova and Belikova, 1962). Laptev (1960) found that many nymphs that had fed as larvae on a *Theileria sergenti*-infected calf were able to transmit this agent.

CHINA. Teng's (1955) description and illustrations of "*H. bispinosa*" from Peking appear to conform to *H.* (*K.*) *longicornis*. In discussing the life cycle, Teng did not record the male or mating, only that he found a single male and a single female hibernating under a stone, but he widely quoted Myers' (1924) work in New Zealand and mentioned no discrepancy between male–female ratios in the Peking area and in New Zealand.

KOREA. Published records of *H. bispinosa* from North and South Korea apply to *H.* (*K.*) *longicornis*; these are in Ogura and Takada (1927), Kishida (1936), Itagaki, Noda, and Yamaguchi (1941, 1959), Keegan and Toshioka (1957), and Kitaoka (1961a). This species is common and widely distributed throughout the Korean Peninsula. Presumably the bisexual population predominates in this area.

JAPAN. As already stated, the definitive work on *H.* (*K.*) *longicornis* in Japan is that of Kitaoka (1961d, as *H. bispinosa*). The same author (1961a, b, c) and Kitaoka and Yajima (1958a, b) studied physiological aspects of feeding and development of this species. Increase in female size during feeding occurs in 3 stages, with the greatest amount being imbibed and condensed during the last night, followed by dropping from the host the next morning (Kitaoka, 1962). Other studies of this species in Japan are those of Nakamura and Yajima (1937, 1942), Itagaki, Noda, and Yamaguchi (1941, 1959), Namba (1953, 1958, 1963a, b), Chikaki and Otaka (1956), Saito (1962), and Saito et al. (1965). Experimental infection of calves with *Theileria mutans* by the bite of *H.* (*K.*) *longicornis* was reported by Ishihara and Ishii (1956, as *H. bispinosa*) and Namba (1963b) refers to this species as an important vector of *T. mutans* in Japan.

AUSTRALIA. The type locality of *H.* (*K.*) *longicornis* is Kempsey, New South Wales (Neumann, 1901). The biology and economic importance of this species in Australia has been reviewed by Roberts (1952) (as *H. bispinosa*). Collecting localities listed by Roberts (1963) and herein are all from Queensland and New South Wales, and from nearby in Victoria. *H.* (*K.*) *longicornis* is confined to southeastern Queensland but becomes numerous only in temperate coastal areas 1,000 ft. or more in altitude. In New South Wales, it also occurs in coastal areas in temperate (southern) and subtropical (northern) regions.

When feeding larvae and nymphs on an immature house sparrow (*Passer domesticus*), Wilkinson and Utech (1962) noted that the engorgement periods (3 to 5 days for larvae; 3 days for nymphs) were shorter than when these stages fed on a bullock (5 and 6 days, respectively). Adults did not attach to this bird.

This species acquires *Coxiella burneti* (the agent of Q fever) during feeding on infected cattle in its larval, nymphal, or adult (female) stage and the infection persists from the larva to the nymph to the adult (Smith, 1942). Nymphs that had fed on infected rabbits in the larval stage were able to transmit the infection when feeding on a clean rabbit or guinea pig. Smith believed this species, together with *Boophilus microplus* (Canestrini), to be responsible for spreading Q fever among cattle. *H.* (*K.*) *longicornis* is also a vector of *Theileria mutans* among cattle (Riek, 1966; as *H. bispinosa*).

NEW ZEALAND. In an extensive study of the life history, hosts, distribution, ecology, and control of "*H. bispinosa*" in New Zealand, Myers (1924) reported it from ecologically suitable areas in the North Auckland Peninsula (North Auckland Botanical District) and from 6 isolated localities in the South Auckland Botanical District and 3 in the Volcanic Plateau Botanical District. Legg (1926) also studied the life history of this species. More recently, Dumbleton (1953) observed that this tick, the only species of any economic importance in New Zealand, now occurs throughout the northern half of North Island as far south as Hastings and Foxton.

Myers reported larvae of this 3-host tick from children, cattle, horses, hares, cats, and birds (thrush, skylark, house sparrow, and domestic chickens); nymphs from cattle, horses, hares, and dogs; and adults from humans, cattle, horses, hares, sheep, dogs, and goats, as well as "reliable information" of adult feeding on the cat, pig, rabbit, and domestic duck, turkey, chicken, and pheasant. Nymphs feed in late winter and early spring, larvae in late summer and fall, and adults chiefly in midsummer. Unfed nymphs overwinter. The numbers of this tick on domestic animals, Myers stated, caused considerable alarm among farmers, but there apparently have been no verified reports of disease transmission in New Zealand. On the red deer (*Cervus elaphus* L.), this tick feeds on the back of the neck, shoulders, and inside flanks (Andrews, 1964). Infestation of the red deer may be so heavy that the engorged ticks "hang from the host like bunches of grapes" and blood loss is considerable.

Pasture management is said to be the only effective way to check *H.* (*K.*) *longicornis* in New Zealand, where this tick costs farmers thousands of pounds annually through reduction of dairy production by as much as 25%, irritation to cattle, anemia, and occasional death of calves; damage to cattle and sheep hides results in lower prices on the international market and wool clips are reduced in quantity and quality through sheep rubbing to relieve irritation (Mutch, 1966).

New Caledonia. *H.* (*K.*) *longicornis*, which appears to have been imported into New Caledonia from Australia, is a serious pest of livestock on this island (Rageau and Vervent, 1959; as *H. bispinosa*).

Fiji Island. At Viti Levu between 17 August and 15 December 1966, Miles (1967, as *H. bispinosa*) collected 4,454 specimens of *H.* (*K.*) *longicornis* from horses, 2,081 from cattle, 1,624 from dogs, and 10 from goats. During the same period he collected 138 and 1,076 specimens of *Rhipicephalus sanguineus* from horses and dogs, respectively, and 41 and 2 specimens of *Amblyomma cyprium* from wild pigs and horses, respectively, and a single specimen of *A. cyprium* from a dog.

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ADDENDUM

After completion of this manuscript, a female *H.* (*K.*) *longicornis* from a cow, Tonga, Friendly Islands, G. Swain *legit*, was found by H. H. in British Museum (Natural History) collections labeled as *H. bispinosa* (Commonwealth Institute of Entomology lot number A1034).

H. (*K.*) *longicornis* (= *H. bispinosa*) was first reported from Fiji in 1931, and movement of cattle was restricted to prevent the spread of this tick (Anom. 1931. Editorial. Animal Health. Agric. J. Dep. Agric. Fiji **4**: 1–2).

H. (*K.*) *longicornis* was recorded (as *H. bispinosa*) from Efate Island, New Hebrides, by Rageau 1967, Wiadomośći Parazytologiczne, 13, NR 4–5: 547–553. Although the species was reported to be common, its pathogenic role in New Hebrides and New Caledonia was regarded as insignificant and it did not transmit any diseases of animals so far as known.

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