

THE GIANT TICKS OF THE MALAYAN
RHINOCEROSES; WITH A NOTE ON
IXODES WALCKENAERII Gervais

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In January, 1932, Major Arthur S. Vernay obtained, in Lower Perak, for the British Museum, one of the few remaining specimens of the Sunda Rhinoceros, *Rhinoceros sondaicus* Desmarest. At the suggestion of my friend and colleague, Harold J. Coolidge, Jr., he undertook to collect the ecto- and endoparasites of this animal. The helminths have been reported upon by my colleague, Dr. Jack H. Sandground (1933, *Jl. of Parasitology*, XIX, pp. 192-204). Of ectoparasites, only numerous ticks were found; but shortly after the animal was shot, a number of horse-flies (*Tabanus brunneus* Macquart) were observed biting through the thick hide.

More recently (June, 1933) Major Vernay commissioned Major Rawley to secure, if possible, another *R. sondaicus*. An animal believed to be of that species was located in Selangor; but, after being shot, it proved to be a Sumatran Rhinoceros, *Rhinoceros sumatrensis* Cuvier. Again the only ectoparasites met with were ticks; these were very few in number, eight in all being collected.

Since the ticks obtained from these two Rhinoceroses belong to two different species, one of which is as yet imperfectly known, some notes on these parasites may be of interest. I am much indebted to Major Vernay, Major Rawley, and Mr. Coolidge for the efforts they made in order to secure the specimens; and to Dr. P. H. Hodgkin, Entomologist, Institute for Medical Research, Kuala Lumpur, for preserving and mailing them.

Amblyomma crenatum Neumann

Amblyomma crenatum Neumann, 1899, Mém. Soc. Zool. France, XII, p. 214, fig. 52 (♀; off a *Rhinoceros* supposedly from the Cape of Good Hope); 1901, *Loc. cit.*, XIV, p. 297 (♀♂; Sumatra; no host); 1911, Das Tierreich, Lief. 26, Acarina, Ixodidae, p. 77, fig. 34 (♀♂). Robinson, 1926, Ticks, IV, *Amblyomma*, pp. 12, 21 and 75, figs. 32-33 (♀♂).

Amblyomma subluteum Neumann, 1899, Mém. Soc. Zool. France, XII, p. 263 (♂; two without locality, one of them supposedly off an African *Rhinoceros*).

? *Acarus elephantinus* Linnaeus, 1758, Syst. Nat., 10th Ed., I, p. 615 ("Habitat in India", no host); 1767, *Loc. cit.*, 12th Ed., I, pt. 2, p. 1022. Gervais, 1844, in Walckenaer, Hist. Nat. Ins. Aptères, II, p. 250. Neumann, 1911, Das Tierreich, Lief. 26, Acarina, Ixodidae, p. 126. A. C. Oudemans, 1926, Tijdschr. v. Entom., LXIX, Suppl., p. 95; 1929, *Loc. cit.*, LXXII, Suppl., p. 207 (with references to the older literature). Not of Schrank, 1776.

? *Ixodes elephantinus* Fabricius, 1805, Syst. Antl., p. 351.

? *Amblyomma elephantinum* C. L. Koch, 1844, Arch. f. Naturgesch., X, pt. 1, p. 230; 1847, Uebersicht des Arachnidensystems, IV, p. 19. Neumann, 1899, Mém. Soc. Zool. France, XII, p. 282.

Specimens Examined.—Twenty-four males and twelve females (two fully engorged), off *Rhinoceros sondaicus* Desmarest, shot four miles north of Teluk Anson and south of the Sungei Lampan, Lower Perak, Federated Malay States (Major Arthur S. Vernay and Dr. P. H. Hodgkin).

The true country of origin and correct host of *A. crenatum* are now definitely established with this material. The information available thus far was summarized by Robinson as follows: "*Amblyomma crenatum* is an African species and the only known host is the *Rhinoceros*. Neumann's earlier description of the female was based on a single specimen off *Rhinoceros*, Cape of Good Hope (Paris Mus.); his description of *Amb. subluteum* was based on two males, one

of unknown origin, the other off Rhinoceros, Africa. The Berlin Museum collection contains 2 males and 2 females labelled as having been collected by Mösch, in Sumatra. It would seem improbable that this tick is to be found in two parts of the world so remote as Africa and Sumatra without its occurrence being recorded in intermediate parts, and the indication of origin of the Berlin specimens is probably erroneous." The present collection from Perak shows, on the contrary, that the locality "Sumatra" was correct, while there is no reliable evidence of this tick occurring in Africa. Neumann's specimens were most likely obtained from animals kept in captivity in Europe. Ticks have frequently been collected in large numbers in Africa from both the White and the Black Rhinoceros; but, so far as I know, *A. crenatum* was never found among them.¹

A. crenatum is one of the largest ticks in existence. In our series of 24 males, the scutum of the largest measures 9 mm. in length (not including the capitulum) and 7.8 mm. in greatest width, and that of the smallest 5 mm. and 4.8 mm. respectively. It is noteworthy that the smaller the specimen, the more the scutum approaches the perfect orbicular shape. The 10 unengorged females are 8 to 9 mm. long (without the capitulum) and 7 to 8 mm. wide, the scutum proper being about the same size in the largest and smallest specimens. Two engorged females are enormous, reaching 21 and 22 mm. in length (without the capitulum), 20 mm. in greatest width, and 16 and 17 mm. in thickness. Capitulum and legs also are unusually long. The coloration is remarkably uniform in the series seen and agrees well with Robinson's account. The most remarkable feature is the absence of metallic spots in the male, while the female has three distinct coppery areas, one in each corner of the scutum, that of the apical corner the largest.

The holotypes of *A. crenatum* (♀ and of *A. subluteum* (♂) are at the Paris Museum.

I strongly suspect that Linnaeus based the following

¹I am unable to account for Neumann's including "Liberia" in the range of *A. crenatum* (1911, *Das Tierreich*, Lief. 26, p. 78), since there is no *Rhinoceros* in that country and he does not mention it in his earlier papers.

description of his *Acarus elephantinus* upon *A. crenatum*: "A. orbicularis depressus: macula baseos ovata. Habitat in India. Magnitudo seminis Lupini albi, depressus, lividus, margine crasso, subtus utrinque 3 sulcis. Macula baseos nigra, ovata, trifida." No host is mentioned and the name refers, not to the supposed host, as Houuttuyn surmised, but to the unusual size ("elephantine"), this being one of the largest ticks known to Linnaeus. In answer to an inquiry concerning this tick, Professor Ivar Arwidsson writes me that the type is not in Linnaeus' collection at the Zoological Museum of the University of Uppsala. Perhaps it is kept at the Linnaean Society of London, a point which I have not yet been able to investigate.

***Amblyomma infestum infestum* C. L. Koch**

Amblyomma infestum C. L. Koch, 1844, Arch. f. Naturgesch., X, pt. 1, p. 226 (♀ ♂; no host; Bintang Island near Singapore); 1847, Uebersicht des Arachnidensystems, IV, p. 68, Pl. XII, figs. 41-42 (♀ ♂).

Amblyomma infestum infestum Schulze, 1932, Zeitschr. f. Parasitenk., IV, pt. 3, p. 468 (♀ ♂; after Koch's types).

Amblyomma testudinarium Robinson, 1926, Ticks, IV, *Amblyomma*, pp. 17, 23 and 253 (in part; not the description and figures).

Specimens Examined.—One male and three females (two partly engorged), off *Rhinoceros sumatrensis* Cuvier, shot on the Bernam River, Selangor, Federated Malay States (Major Rawley).

A. infestum is a much smaller tick than *A. crenatum*, with the capitulum and legs of normal length.

P. Schulze has recently claimed (1932, Zeitschr. f. Parasitenk., IV, pt. 3, p. 468) that the tick described and figured by Robinson (1926) as *A. testudinarium*, was not Koch's species of that name, but a new tick, which he calls *A. fallax* P. Schulze. Robinson's specimens came from Mouse-Deer (*Tragulus* sp.) at Biserat, Jalor, Federated Malay States. P. Schulze also attempts to separate *infestum* Koch and *testudinarium* Koch as distinct races of a

species for which he uses the name *A. infestum* (because it comes before *testudinarium* on the same page of Koch's paper). Although I have seen no ticks agreeing with Robinson's descriptions and figures, I am inclined to believe that Schulze was correct in introducing *A. fallax* as a new species. At any rate, the male off Sumatran Rhinoceros ventrally lacks the small muscular scutes shown in Robinson's figure, while the peltæ run parallel with the festoons (in Robinson's figure they are oblique, slightly salient at the postero-internal angles. In the three females, the inner margin of the scapulæ is yellowish (not brown, as in Robinson's figure); and the median anterior area of the scutum is almost wholly yellowish (not dark, as in Robinson's figure), although I am not able to see that the yellow color forms two longitudinal stripes.

I am, however, by no means convinced that *infestum*, proper, and *testudinarium* are racially distinct. Obviously, Schulze's material was insufficient to show that they are geographically segregated. Of *infestum*, proper, he saw only Koch's types from Bintang Island near Singapore, one of the Rhio Archipelago, not 75 miles off the Northeast coast of Sumatra. Of *testudinarium*, he saw, in addition to Koch's type from "Java," 4 males and 4 females from Soekaranda, Sumatra.

The male of *infestum*, proper, is said to be smaller (length, including palpi, 6 mm.; width, 5 mm.), with much white enamel among the coarse punctures of the alloscutum. That of *testudinarium* would be larger (8 by 6 mm.), with reduced enamel among the coarse punctures. The single male from Selangor measures 7 mm. (with the palps) by 4.8 mm., and the enamel is quite extensive. According to Schulze, in the female of *infestum*, proper, the scutum measures 3 by 5 mm. and has the scapular stripe well-defined, dark brown. In that of *testudinarium* the scutum is larger (4 by 5 mm.), with the scapular stripe obsolete, pale brown. In all three females from Selangor the scutum measures 3 by 4.5 mm.; but the scapular stripes (on the anterior margin, between the scapulæ and the eyes) are dark brown and sharp in two specimens, very faint and pale in the third. While the Selangor specimens are un-

doubtedly typical *infestum*, the value of *testudinarium* as a distinct race remains a question.

In the foregoing bibliography, I have not included Neumann's references to *A. testudinarium* (1899; 1901; 1911), nor those of Krijgsman and Ponto (1931; 1932), since these authors may have confused more than one species under that name. Neumann (1901) synonymized with his *testudinarium*, *Ixodes auriscutellatus* Koningsberger (1900, Teysmannia, XI, pt. 1, p. 6) and later (1911) also *Amblyomma compactum* Neumann (1901, Mém. Soc. Zool. France, XIV, p. 296; ♀; Sumatra; no host). The standing of these two names remains open to discussion. Robinson's many locality and host records of *testudinarium* probably cover more than one species. In view of this fact the true distribution and range of hosts of *A. infestum* cannot be given.

Hyalomma (?) walckenaerii Gervais

Ixodes walckenaerii Gervais, 1842, Ann. Soc. Ent. France, XI, Bull. Séances, p. xlvii (off Rhinoceros; without description); 1844, in Walckenaer, Hist. Nat. Ins., Aptères, III, p. 246, Pl. XXXIV, fig. 11 (no sex; no locality, off a rhinoceros of unknown species). Neumann, 1911, Das Tierreich, Lief. 26, Acarina, Ixodidae, p. 133.
Amblyomma (?) walckenaerii Neumann, 1899, Mém. Soc. France, XII, p. 279.

Gervais' species is as yet unrecognized. Neumann merely suggested that it might have been an *Amblyomma*. The original description reads: "Corps roux-grenat, un peu plus pale en dessous, passant au roux-cannelle ainsi que les pattes qui sont allongées et fauves à leurs articulations; abdomen ridé en dessous; point de taches sur le dos; denticules des machoires médiocres; palpes un peu velus montrant un pore terminal à leur dernier article; ouverture génitale au niveau de la deuxième paire de pattes; hanches de la première paire bispinulées à leur bord postérieur; celles des autres simplement échancrées; stigmates dans une impression en fossette subréniforme à l'aisselle de chaque patte postérieure. Longueur du corps, 0.005 [m];

de la patte postérieure, 0.006 $\frac{1}{2}$ [m]. Cette espèce, dont les hanches antérieures ressemblent à celles de l'Ixode de Savigny, a été prise sur un Rhinocéros dont nous ignorons le nom spécifique; nous l'avons dédiée à M. de Walckenaer, de qui nous tenons l'unique exemplaire que nous en avons observé." The rather crude figure represents the ventral side of what appears to be an unengorged female.

Surmising that Gervais' type might be preserved at the Paris Museum, I wrote to Mr. Marc André, who kindly informed me that none of Gervais' ticks are in their collections. Neumann evidently never saw them and I have been unable to trace whether or not they are lost.

I believe, however, that a study of the description and figure might help to recognize the species. Turning first to the *Amblyomma* known to occur on Rhinoceroses, *A. crenatum* is ruled out at once by the size, the hind legs of that species measuring 11 to 12 mm. in length. On the other hand, none of the smaller Rhinoceros ticks could be described as having the body "roux-grenat", all being distinctly spotted dorsally. The statement about the color, and even more so the comparison of the coxæ I with those of *Ixodes savignyi* Gervais, induce me to regard *Ixodes walckenaerii* as based in all probability upon a female *Hyalomma*.¹ Ticks of that genus have been found repeatedly on the African Black Rhinoceros; and P. Schulze bases his *Hyalomma planum* (1919, Sitzungsber. Ges. Naturf. Fr. Berlin, pp. 195 and 196; ♂ ♀; Tanganyika Territory) on ticks taken from this host. Might not *H. planum* and *H. walckenaerii* be one and the same species?

¹*Ixodes savignyi* was based upon the common cattle *Hyalomma* of Egypt. According to P. Schulze (1930, Zeitschr. f. Parasitenk., III, pt. 1, p. 28). *Hyalomma savignyi* (Gervais) is the correct name of the cattle tick which thus far has been called *Hyalomma aegyptium* (Linnaeus).

Special Issue on Orphaned Topics of Pesticide Resistance and Resistance Management in Insect Systems

Call for Papers

Research on “resistance” in the entomological community has primarily focused on pesticide resistance associated with target-site insensitivity and a few constitutively overexpressed “usual suspect” resistance-associated genes. This has led to some overly simplistic explanations regarding the basis of xenobiotic resistance in certain insect species. However, resistance or tolerance to xenobiotics is often polygenic, involving a complex set of interactions between genotype, phenotype, and changing environmental parameters. Some of the genes and proteins differentially transcribed and translated in pesticide-resistant insects are not part of what are classically considered “resistance genes.” Documenting the expression and ultimately elucidating the role of these “other” genes and proteins in resistant insects remain to be determined. Additionally, xenobiotic resistance levels vary greatly between insect strains; the molecular differences between these strains, and their respective roles in resistance are not well understood. There is also a need to bring together issues of resistance management models and our current knowledge regarding the “omics” of resistance in order for us to gain a better understanding of how insects evolve resistance to xenobiotics.

These aforementioned topics represent but a few of the many important issues regarding resistance and “omic” responses to pesticides, in insects, that have not been sufficiently explored in the literature. Other topics of interest include, but are not limited to:

- Transcripts and proteins induced by treatment with xenobiotics including insecticides
- Changes in the genomes of resistant insects that influence their responses to other environmental challenges
- Evolutionary conservation of responses of different insect species to common xenobiotic challenges
- Negative cross-resistance
- “Achilles’ heel” resistance traits
- The pesticide treadmill concept (evolutionary “steps” associated with increasing levels of resistance to pesticides in insect populations)
- Resistance management and modeling for pests of crops in developing nations

For this Special Issue, we invite authors to submit original research articles as well as review articles on the above (or other) aspects of xenobiotic and pesticide resistance that have been classically underrepresented in the literature. Before submission, authors should carefully read over the journal’s Author Guidelines, which are located at <http://www.hindawi.com/journals/psyche/guidelines.html>. Prospective authors should submit an electronic copy of their complete manuscripts through the journal Manuscript Tracking System at <http://mts.hindawi.com/>, according to the following timetable:

Manuscript Due	September 1, 2009
First Round of Reviews	December 1, 2009
Publication Date	March 1, 2010

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Special Issue on Foraging Biology of Neglected Social Pollinators

Call for Papers

Recognition of the importance of native pollinating insects has grown with our understanding of their role in diverse ecosystems, many of which are imperiled. In addition, advances in our understanding of honey bee foraging biology have spurred general interest in other social insect pollinators in the bees and social wasps. This research has enhanced our understanding of the evolution of social insect foraging. It has also revealed how much there is to learn about the foraging biology of non-*Apis* social and communal pollinators such as vespid wasps, bumble bees, stingless bees, and, particularly, the halictine bees, andrenid bees, and social thrips.

We invite authors to submit original research articles as well as review articles that will contribute to our understanding of these relatively neglected social pollinators and stimulate discussion about how and why their different forms of social foraging have evolved. We are particularly interested in papers that will stretch the boundaries of the field by contributing to our understanding of foraging in nonmodel species.

Since its creation in 1874, *Psyche* has a distinguished history as the journal of the Cambridge Entomological Society and has a tradition of publishing on social pollinators. We believe that there is a body of high-quality international work that could benefit by appearing in a special *Psyche* issue devoted to neglected social pollinators.

Potential topics include, but not limited to:

- Foraging communication
- Agricultural role
- Importance in conservation
- Physiology of foraging
- Sensory biology of foraging
- Social regulation of foraging
- Organization and division of labor in foraging
- Learning and memory of foraging
- Phylogeny and evolution of foraging species

Before submission authors should carefully read over the journal's Author Guidelines, which are located at <http://www.hindawi.com/journals/psyche/guidelines.html>. Prospective authors should submit an electronic copy of their complete

manuscript through the journal Manuscript Tracking System at <http://mts.hindawi.com/>, according to the following timetable:

Manuscript Due	August 1, 2009
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Special Issue on Endless Forms: The Frontiers of Biodiversity Discovery

Call for Papers

One of the greatest endeavors of entomologists has been and continues to be the discovery and description of the millions of undescribed life forms. This year marks the 200th year since the birth of Charles Darwin on February 12, 1809. *Origin of Species* concludes with the following passage: "There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved." No fewer than two literary works have taken portions of this sentence as their titles (*This View of Life* by Stephen J. Gould, and *From So Simple A Beginning*, a collection of Darwin's four great works). So, in honor of the 200th anniversary of Darwin's birth, we call for papers that represent the frontiers of research in the discovery of biodiversity, including, but not limited to:

- Newly explored habitats (e.g., extreme arboreal and entirely aerial)
- Novel collecting techniques (e.g., canopy traps)
- New investigative techniques (e.g., sibling or cryptic species discovered due to host differences, male-female signaling, genomic differences)
- The "creation" of new species due to introduced plants (e.g., *Rhagoletis*)
- Regions of the world that have recently become available for field work (e.g., Cambodia, Mozambique, Rwanda)
- Cybertaxonomy and digital methods for rapid species description

We invite authors to present original research articles as well as papers that sum such discoveries. We encourage papers in which new taxa are described and systematic revisions as long as they are pertinent to the "frontiers" concept.

Before submission authors should carefully read over the journal's Author Guidelines, which are located at <http://www.hindawi.com/journals/psyche/guidelines.html>. Prospective authors should submit an electronic copy of their complete manuscript through the journal Manuscript Tracking Sys-

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