Panstrongylus hispaniolae sp. n. (Hemiptera: Reduviidae: Triatominae), a new fossil triatomine in Dominican amber, with evidence of gut flagellates

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Abstract

A new species of triatomine bug, *Panstrongylus hispaniolae* sp. n. (Hemiptera: Reduviidae: Triatominae) is described from Dominican amber. Diagnostic characters for *P. hispaniolae* include an almost uniformly ferruginous body color, elongate anteriolateral projections and prominent discal and lateral tubercles on the pronotum, a series of paired denticles on the inner apices of all femora and the unique venation of the hemelytra. Flagellates similar to epimastigotes of *Blastocrithidia* were present in an anal droplet attached to the tip of the abdomen.

Keywords: Triatomine fossil, *Panstrongylus hispaniolae,* Dominican Republic, Tertiary amber.

1. Introduction

Members of the reduviid subfamily Triatominae not only represent some of the largest known hemipterans, but their exclusive diet of vertebrate (including human) blood and vector capabilities makes them extremely important medically. Their bite can cause allergic responses, and their feeding behavior has resulted in the transfer of trypanosomatid protozoa, such as *Trypanosoma cruzi*, the causal agent of Chagas' disease, to millions of people in South and Central America. The extant species, *Triatoma infestans* (Fig. 1), which is predominately domestic (in human dwellings) and peridomestic (in dwellings of animals maintained by humans), is the main vector of Chagas' disease in South America (Lent & Wygodzinsky 1979).

The previous fossil record of the subfamily was the Dominican amber fifth instar nymph *Triatoma dominicana* Poinar (Poinar 2005). Fecal droplets adjacent to *T. dominicana* contained stages of the extinct *Trypanosoma antiquus* Poinar (2005), thus providing the first fossil evidence of a triatome-trypanosomatid vector association. Bat hairs in the same piece of amber indicated the likely host. The present paper describes a second species of triatomine in Dominican amber, an adult in the extant genus *Panstrongylus* Berg.

Dating of Dominican amber is still controversial with the latest proposed age of 20–15 mya based on foraminifera (Iturralde-Vinent & MacPhee 1996) and the earliest as 45–30 mya based on coccoliths (Cêpek in Schlee 1990). What makes dating of the amber difficult is that it is secondarily deposited in turbiditic sandstones of the Upper Eocene to Lower Miocene Mamey Group (Draper et al. 1994). The plant species that formed the amber is a member of the legume family (*Hymenaea protera* Poinar (1991) and the original environment was similar to a present day moist tropical forest (Poinar & Poinar 1999).

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2. Material and methods

The piece of amber containing the triatomine originated from La Toca mine, located between the cities of Puerto Plata and Santiago surrounding the Cordillera Septentrional mountain range in the northern portion of the Dominican Republic.

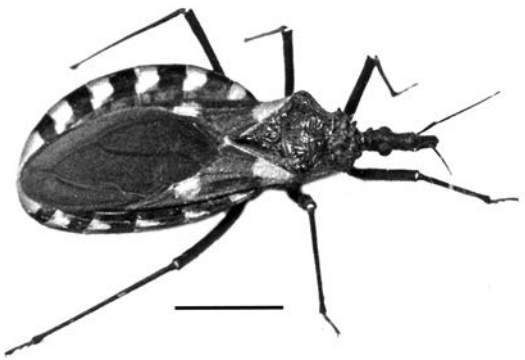


Fig. 1. Adult *Triatoma infestans*, the main vector of Chagas' disease in South America. Photo taken by the author in Chiapas, Mexico, September 28th, 1982. Bar = 5.6 mm.

Fig. 2. Dorsal view of Holotype male of *Panstrongylus hispaniolae* sp. n. in Dominican amber. Bar = 3.2 mm.

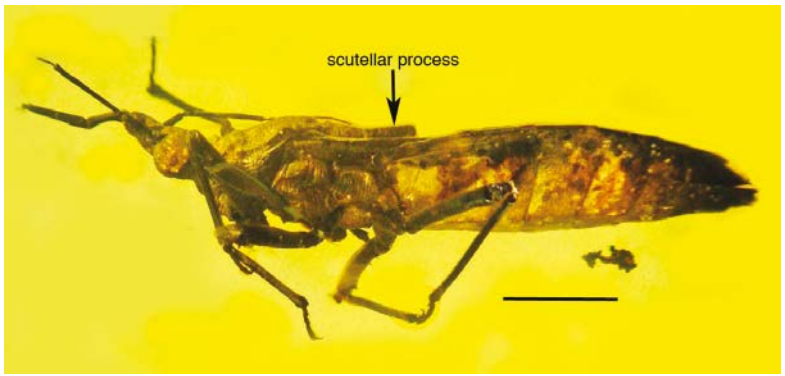
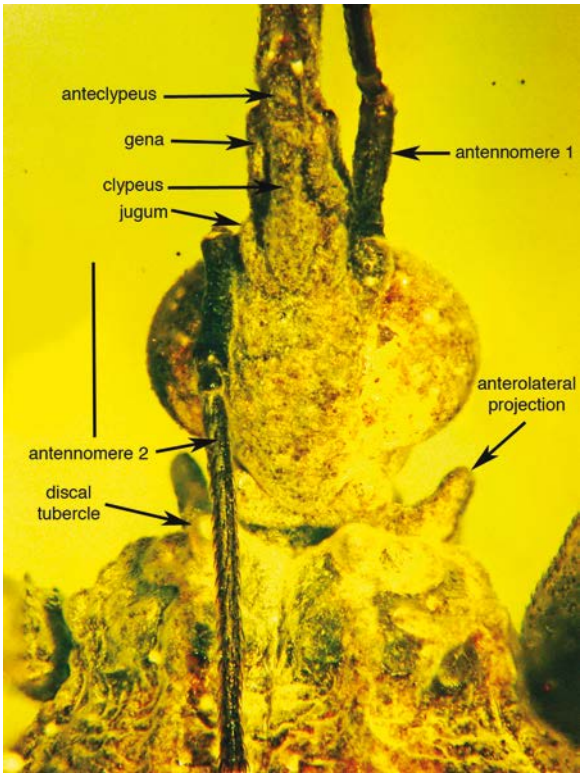


Fig. 3. Lateral view of *Panstrongylus hispaniolae* sp. n. with forward directed rostrum in Dominican amber. Bar = 3.8 mm.



The specimen is in a rectangular block of amber 50 mm in length, 18 mm in width and 16 mm in depth. The specimen is almost complete except the apical segment of the rostrum and the last two segments of the right antenna are missing. The tips of the junctions of the bent meso and meta femur-tibial segments have also been slightly polished away. Observations and photographs were made with a Nikon stereoscopic microscope SMZ-10 and Nikon Optiphot Transmission microscope at magnifications up to 1000X.

3. Description

Reduviidae Latreille, 1807
Triatominae Jeannel, 1919

Dorsal interocular sulcus obsolete; antennae inserted laterally adjacent to eyes with first segment shorter than second and not quite surpassing head apex; third and fourth segments filiform; ocelli inserted on widely separated pro-

◀ **Fig. 4.** Dorsal view of head of *Panstrongylus hispaniolae* sp. n. in Dominican amber. Bar = 1.3 mm.

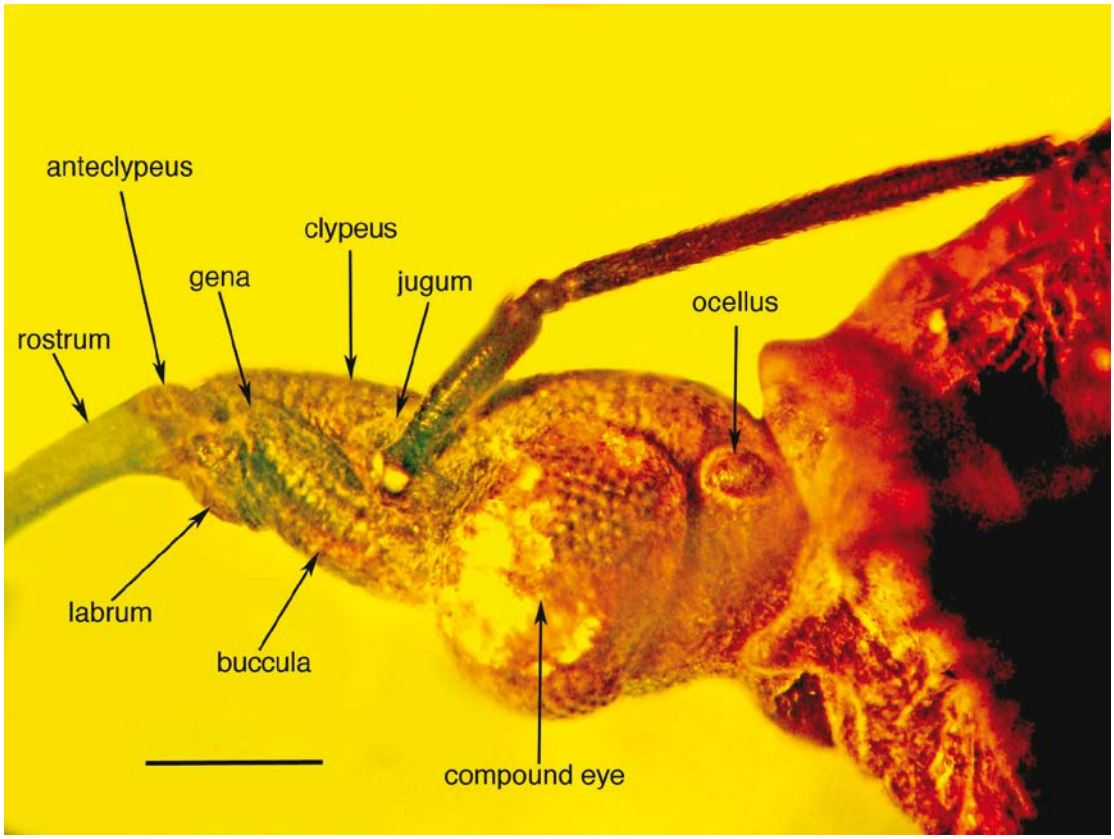


Fig. 5. Lateral view of head of *Panstrongylus hispaniolae* sp. n. in Dominican amber. Bar = 0.9 mm.

tuberances; pronotum with posterior lobe longer than anterior lobe; scutellum triangular with single posterior process.

Triatomini Jeannel, 1919

Antenniferous tubercles without apical spine-like projections; head without setiferous callosities behind eyes; 2nd antennal segment with 4–10 trichobothria (5 occur on the fossil) arranged in one row along length of segment; corium with distinct veins; abdomen with well-developed dorsal connexival segments.

Fig. 6. Dorsal view of head, pronotum, scutellum and antenna of *Panstrongylus hispaniolae* sp. n. in Dominican amber. Bar = 1.5 mm.

Panstrongylus Berg, 1879

Ocelli situated on distinct elevations; head lacking callosities behind eyes; size greater than 10 mm; head short and wide; antenniferous tubercles inserted close to anterior border of eyes (not distant to the eyes as in the genus *Triatoma* (Fig. 1); head and body glabrous; first rostral segment shorter than second; femora armed with denticles (5 pairs on profemora in fossil).

Panstrongylus hispaniolae sp. n.
Figs. 2–9

Etymology: The specific name refers to the geographical location of the fossil.

Type: Holotype deposited in the Poinar amber collection (accession # He-4-81) maintained at Oregon State University, Corvallis, Oregon.

Type locality: La Toca amber mine in the Cordillera Septentrional of the Dominican Republic.

Length of Holotype male: 22 mm.

Description: Diagnostic characters of *P. hispaniolae* include the almost uniformly ferruginous body, the elongate anteriolateral projections and prominent lateral and discal tubercles on the pronotum, the series of paired denticles on the inner apicies of all femora and the unique venation of the hemelytra. *Panstrongylus hispaniolae* has the following plesiomorphic character states (Lent & Wygodzinsky 1979): simple color pattern (considered to be close to the original coloration), first rostral segment shorter than second, jugal apex blunt; clypeus not bilobed, pronotum with discal and lateral tubercles; scutellar spine elongate and lacking basal hump, absence of accessory sublateral tubercles on pronotum, femoral denticles present and dark spots on all connexival segments. In the character analysis of *Panstrongylus* by Lent & Wygodzinsky (1979), *P. hispaniolae* aligns with the *P. geniculatus* clade, although *P. hispaniolae* clearly differs from all extant species in the genus.

The specimen has its rostrum directed forward with its longitudinal axis continuous with the head, which is raised at about a 40 degree angle.This is essentially the feeding position of extant triatomines.

Overall color ferruginous with darker areas on sides and hemelytra; rostrum and legs darker but with some faint ferruginous areas. The color pattern, while undoubtedly faded, is considered to be distinctive for the fossil since the hues and design resemble those found on some extant members of the genus.

Head (Figs. 2–7): Length, 2.9 mm; width, 2.3 mm; glabrous, ferruginous, slightly convex in lateral view; anteocular region approximately equal to postocular; upper surface granular; clypeus grey, narrower at apex, anteclypeus pointed anteriorly; genae flattened, narrowly rounded apically, not reaching apex of clypeus; jugae

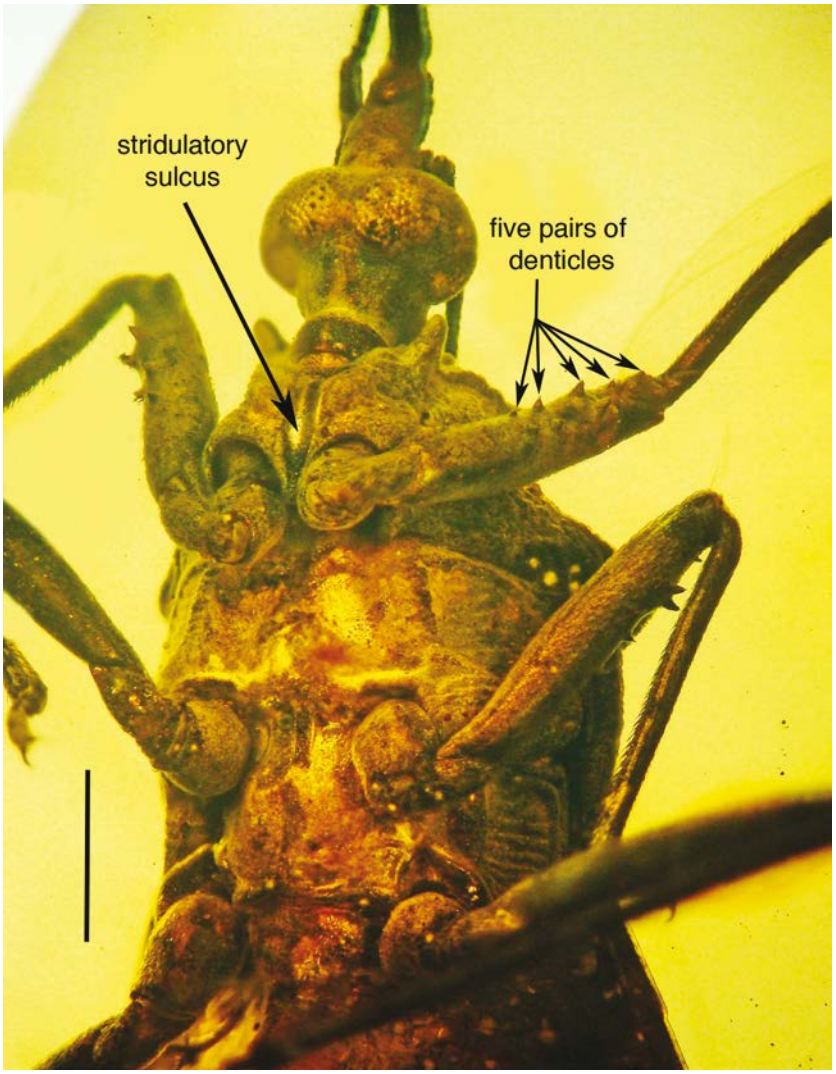


Fig. 7. Ventral view of anterior portion of *Panstrongylus hispaniolae* sp. n. in Dominican amber. Bar = 1.8 mm.

small, pointed, apically curved; jugae small, triangular, positioned above the base of the gena; labrum narrow; antenniferous tubercles positioned below jugae, close to anterior border of eyes, with apico-external process; eyes protruding, greatest dorsal diameter, 1.3 mm; synthlipsis, 0.9 mm; ocelli distinct, inserted on widely separated protuberances connected at base; first antennal segment wide, glabrous, reaching middle of anteclypeus; second segment wide with inclined stiff setae shorter than diameter of segment and 5 trichobothria arranged in single row; third and fourth antennomeres slender, bearing inclined stiff setae shorter than diameter of segment; length of antennal segments; first, 0.9 mm, second, 2.7 mm, third, 2.4 mm, fourth, 2.4 mm; basal two rostral segments smooth, lacking setae.

T h o r a x (Figs. 2–3, 6–8): Pronotum: Ferrugineus; distinct division line separating anterior and posterior lobes; anterior lobe convex, with sides parallel, strongly rugose, with distinct discal and lateral tubercles; posterior lobe rugose, with declivous lateral explanate margins, humeri pointed, submedian carina extending nearly to posterior margin; anterolateral projections long, rounded apically.

Scutellum: Uniformly ferrugineus, submedian callosities prominent, adjacent to pronotal margin; process of scutellum horizontal, narrowing toward apex, transversely rugose, rounded apically.

Ventrum: Stridulatory sulcus distinct with adjacent setae absent.

Pleura: All pleura glabrous, with deep, vertical ridges, especially noticeable on mesopleura and metapleural.

Hemelytra: Length, 14 mm; center ferruginous with broad dark border, covering most of clavus; wings not attaining apex of abdomen. Venation complex, with Sc meeting wing margin and connected to R by short cross vein; strong fold extending posterior from junction of r-m with R (Fig. 9).

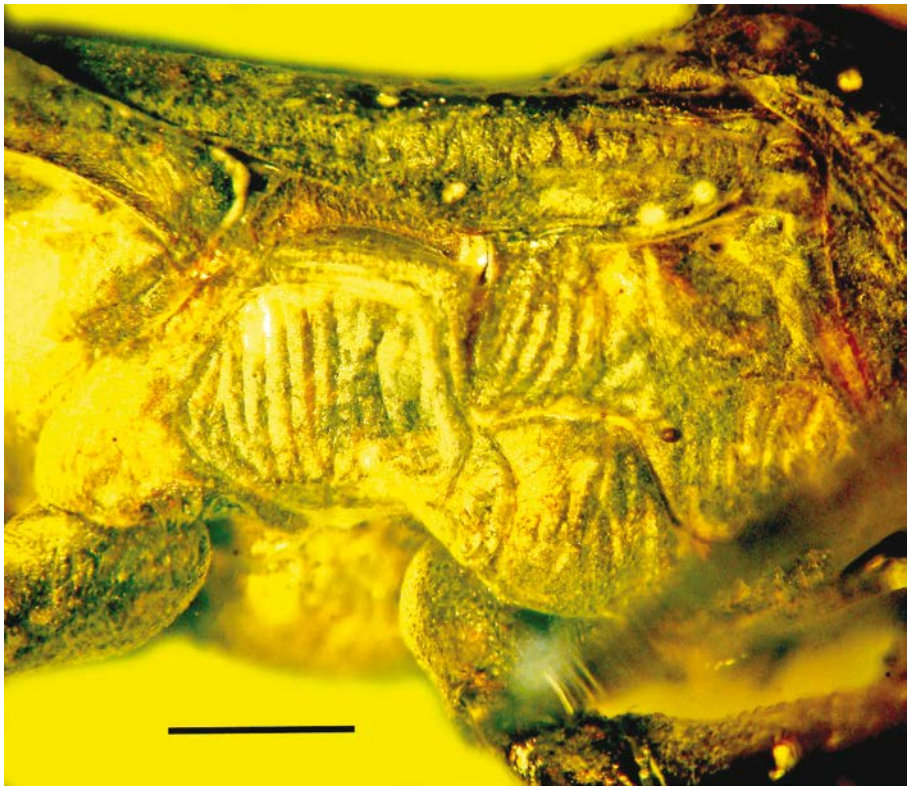


Fig. 8. Vertical ridges on thoracic pleura of *Panstrongylus hispaniolae* sp. n. in Dominican amber. Bar = 1.2 mm.

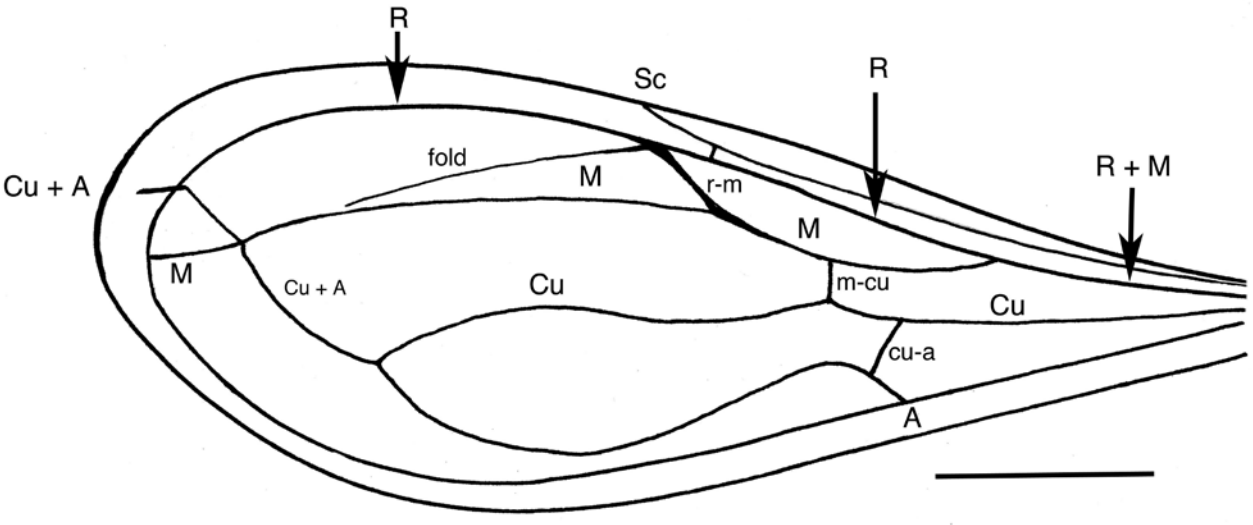


Fig. 9. Venation of hemelytra of *Panstrongylus hispaniolae* sp. n. in Dominican amber. A= anal; Cu= cubitus; M= median; R= radius, Sc= subcosta. Bar = 2.6 mm.

Legs: Dark with ferruginous areas; all femora with paired series of denticles; profemur with 5 pairs, the third pair from apex the largest; mid-femur with 4 pairs, the second pair from apex the largest; hind femur with 4 pairs. the second pair from apex the largest; spongy fossulae on apicies of fore and mid tibiae; metathoracic scent glands within hind coxal cavities; tarsi 3-segmented; claws paired; arolia absent.

Abdomen (Figs. 2–3): Ferruginous, disc flattened, glabrous, minutely striate transversally; connexivum light

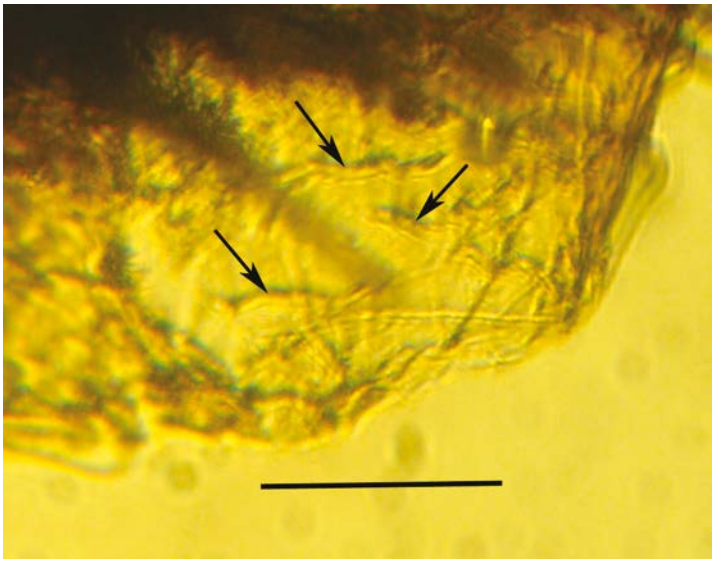


Fig. 10. Epimastigotes (arrows) of *Blastocrithidia* sp. in anal droplet of *Panstrongylus hispaniolae* sp. n. in Dominican amber. Bar = 77µm

with dark markings; ventrum 11 segmented with spiracles laterally on urostermites II-VII, positioned close to connexival suture.

Associated protozoa: Attached to the apex of the abdomen of *P. hispaniolae* is a small fecal droplet (Fig. 10) apparently excreted by the triatomine after entering the resin. Within this droplet are numerous flagellated protozoa ranging from 57 µm to 69 µm in length. The nucleus occurs in the posterior part of the body and the flagellum extends along most of the body. Some small cysts accompany the flagellates.

4. Discussion

The Triatominae, now restricted to the Nearctic, Neotropical, Oriental and Australian regions, probably originated in South America, which is currently the center of diversity, in the mid-Cretaceous, when the climate was mild (Boucot et al. 2013). Since triatomines are considered poor flyers (Lent & Wygodzinsky 1979), it is unknown how they reached the Oriental and Australian regions. Possibilities include vicariance events or rafting. Some triatomines could have been transported by their hosts as eggs. A few triatomines produce eggs covered with a sticky deposit or the surfaces are pitted or spined (Usinger 1944). It is possible that these modifications are adaptations for attachment to hair or feathers, thus facilitating long distance distribution.

Only a single extant species of Triatominae has been reported from Hispaniola, namely *Triatoma rubrofasciata* (De Geer) (Perez-Gelabert 2008). This is a tropicopolitan species that has been widely distributed through commerce and was probably introduced into the Island. It is curious why no endemic species of triatomines occur in Hispaniola, especially since fossil evidence shows that representatives of both *Triatoma* and *Panstrongylus* occurred there in the Tertiary and endemic triatomines occur in Cuba and Jamaica (Lent & Wygodzinsky 1979). Survival of *T. flavida* and *T. obscura* in Cuba and Jamaica, respectively, may have been due to the bugs residing in secure refugia during Pliocene-Pleistocene cooling events. The other possibility is that triatomines were eliminated from Hispaniola when their hosts disappeared (sloths, carnivores, ungulates, primates) (Poinar & Poinar 1999).

The range of *Panstrongylus,* the second largest genus in the Triatomini with 14 species (Bérenger & Blanchet 2007), extends from Central America to central Argentina. Ecological preferences include mesic forest habitats to semiarid shrub lands. *Panstrongylus geniculatus* is a major sylvatic vector for *T. cruzi* and typically inhabits burrows excavated by armadillos (Lent & Wygodzinsky 1979). It has also been found naturally infected with *T. cruzi* in limestone caves containing large numbers of roosting bats in Venezuela (Molinari et al. 2007). *Panstrongylus megitus* is considered to be one of the four principle vectors of Chagas' disease in Central and South America. The other three vectors are *Rhodnius prolixus*, *Triatoma infestans* (Fig. 1) and *T. dimidiata* (Robert 2002).

The flagellated protozoa in the small fecal droplet attached to the apex of the abdomen of *P. hispaniolae* are similar in size and shape to epimastigotes of the trypanosomine *Blastocrithidia triatomae* Cerisola et al. (1971) described from the intestine of *Triatoma infestans* and are hereby assigned to that genus. Epimastigotes are stages in the development of trypanosomes that have short undulating membranes and kinetoplasts anterior to the nuclei. Members of the genus *Blastocrithidia* are not only symbi-

onts since they can be pathogenic in *T. infestans*, especially when large numbers collect in the midgut (Schaub 1994; Kollien & Schaub 2003).

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