

**ZOROTYPUS PALAEUS, NEW SPECIES, A FOSSIL ZORAPTERA
(INSECTA) IN DOMINICAN AMBER**

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Abstract.—The first fossil member of the order Zoraptera (Insecta), *Zorotypus palaeus*, new species is described from amber originating from the Dominican Republic. The description is based on a single, apterous, chitinized female lacking eyes and ocelli. The amber came from mines located in the Cordillera Septentrional in the Altamira facies of the El Mamey formation. Sedimentary and geological evidence indicate a range of lower Miocene to upper Eocene for the amber from this region.

A piece of amber from the Dominican Republic was observed to contain a member of the order Zoraptera. The piece had been purchased by J. Brodzinsky in 1985 and Dr. José Mari-Mutt (Puerto Rico) was the first to recognize one of the entrapped insects as a member of the Order Zoraptera. This piece was included in the Brodzinsky-Lopez-Penha collection later purchased by the Smithsonian Institution.

The Zoraptera constitute the smallest order of insects and represent a single family, the Zorotypidae, with a single genus *Zorotypus*, represented by 28 described species. The present find represents the first fossil representative of this order. The amber piece came from mines located in the Cordillera Septentrional in the Altamira facies of the El Mamey formation, a shale-sandstone interspersed with a conglomerate of well rounded pebbles which has been assigned to the upper Eocene (Eberle et al., 1980). Prior dating of amber from the Palo Alto mine in the Cordillera Septentrional based on an analysis of foraminifera counts suggested a lower Miocene age (Baroni-Urbani and Saunders, 1980). Thus, sedimentary and geological evidence indicate a range of lower Miocene to upper Eocene for the amber mines in the Cordillera Septentrional.

MATERIALS AND METHODS

The amber piece containing the apterous female zorapteran weighed 1.8 grams and was triangular-shaped in outline, measuring 17 mm × 17 mm × 18 mm, with a thickness of 8.5 mm. The piece also contained three complete adult Formicidae, 3 complete adult Staphylinidae and 2 complete Dermaptera.

The specimen was observed under both dissecting and compound microscopes at magnifications of 20 to 200×. Drawings were made with the assistance of a camera lucida.

RESULTS

Comparison of the fossil specimen with descriptions of recent species indicated that it is new to science and a description follows below.

Zoraptera Silvestri 1913
Zorotypidae Silvestri 1913
Zorotypus Silvestri 1913
Zorotypus paleus, new species
Figs. 1-7

Description. APTEROUS FEMALE: The specimen is well preserved although a portion of the middle right leg is missing as are some portions of the dorsal plates on the head (Fig. 1). Body length without antennae, 2.9 mm; length of antenna 1.6 mm; mouthparts, mandibulate; maxillary palp 5-segmented, labial palp 3-segmented; right antenna 8-segmented, left antenna 9-segmented; all tarsi 2-segmented; cercus 1-segmented; wings, compound eyes, ocelli and fontanelle absent; all sclerites and appendages dark-pigmented; abdomen with 10 segments; cerci present; gonopore just posterior to the seventh sternite (hypogynium), which is emarginate medially (Fig. 2); the apex of a sclerotized, trough-shaped structure (possibly representing the ovipositor) issues from the gonopore; eight abdominal sternite narrow, yet complete, partially overlaps segment nine which is non-sclerotized and composed of a short, medial, emarginate section and an apically narrowed central portion forked at the apex (possibly representing styli); sternite ten sclerotized on opposing lateral posterior surfaces beneath cerci; the sclerotized surfaces could be paraprocts; tergites eight, nine and ten abdominal are complete (Fig. 3); tergite nine with posterior medial margin extended, tergite ten posteriorly emarginate; cerci distinct, each with 4 large and 1 small setae; sclerotized patches on dorsal anterior and posterior bases of cerci (Fig. 3); thoracic tergites typical sclerotized, with a series of setae; antennal segment one longest, followed by the smallest (second) and next-to-smallest (third) (Figs. 4, 7); flagellomeres four-eight on right side and four-nine on left side elongate and subequal in length and width; right antenna with only eight flagellomeres, but fifth to eighth segments are proportionally longer than segments four to nine on left antenna; thus both antennae are approximately equal in length. Left hind femur with three long setae and a spine on outer apical margin, and a long seta flanked by two smaller ones on outer posterior margin (Fig. 5); inner femoral margin well developed with a row of four spines and two apical setae; three spines occur on inner margin of the hind tibia; outer margin of hind tibia with long seta between basal and sub-basal spines; basitarsus small without setae; second tarsal segment with rows of short setae; claws paired, equal, typical for the genus (Figs. 5,6).

Holotype. Apterous female; in piece #7406 of the Brodzinsky-Lopez-Penha amber collection in the Department of Entomology of the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Source. Mines from the Cordillera Septentrional in the Dominican Republic. Exact locality unknown.

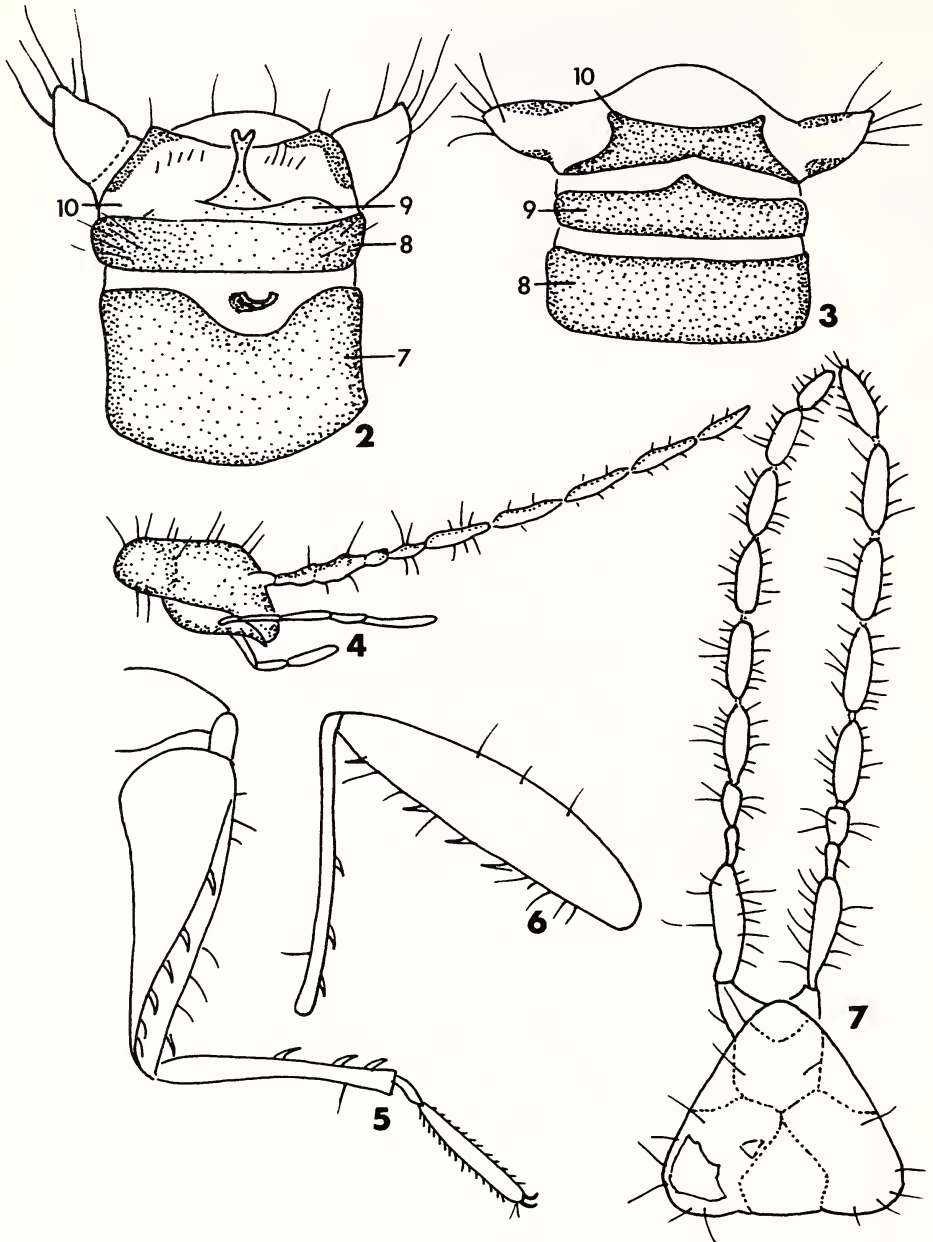
Discussion. Some interesting aspects of zorapteran morphology have been acquired from this investigation. Both Gurney (1974) and Riegel (1987) have described two types of individuals in their resumés of the order Zoraptera. One of these is a pale apterous form which has the eyes rudimentary or absent; the other is a winged, dark-pigmented type with compound eyes and ocelli. The fossil form represents an intermediate stage lacking eyes but being dark-pigmented. This type was recognized by Caudell (1920) as "an apterous form, fully chitinized and superficially resembling



Fig. 1. *Zorotypus palaeus* holotype in Dominican amber.

the dealated chitinized adult of *Z. hubbardi* but differing in having neither eyes nor ocelli." Gurney (1938) considered this observation as a misunderstanding, however the present study indicates that Caudell (1920) was indeed correct in establishing a third morphological type for the Zoraptera.

Adult Zoraptera are known to possess nine-segmented antennae whereas the nymphs normally have eight-segmented antennae. Since the fossil specimen possesses one eight- and one nine-segmented antenna, but on the basis of the gonopore and terminal abdominal segments is an adult, the thought arose that the ninth left antennal segment had been broken off. However Caudell (1920) reported a similar condition in an "apterous unchitinized adult" of *Z. hubbardi*. He stated "one specimen has one antenna normal while the other one is abnormal in having but eight segments instead of nine; that this abnormal antennae is complete is shown by the structure of the terminal segment." Thus, the fossil condition of the antennae is considered natural although abnormal.



Figs. 2-7. *Zorotypus palaeus*. 2. Terminal abdominal sternites. 3. Terminal abdominal tergites. 4. Lateral view of head, showing labial and maxillary palpi and right antenna. 5. Left hind leg. 6. Right hind leg. 7. Dorsal view of head and antennae.

Table 1. Chronological list of published species of *Zorotypus* with known distribution.

Species		Distribution
<i>Z. javanicus</i> Silvestri	1913	Indonesia
<i>Z. ceylonicus</i> Silvestri	1913	Ceylon
<i>Z. guineensis</i> Silvestri	1913	Guinea
<i>Z. neotropicus</i> Silvestri	1916	Costa Rica
<i>Z. hubbardi</i> Caudell	1918	North America
<i>Z. snyderi</i> Caudell	1920	Jamaica, North America
<i>Z. swezeyi</i> Caudell	1922	Hawaii
<i>Z. manni</i> Caudell	1923	Bolivia
<i>Z. silvestri</i> Karny	1926	Indonesia
<i>Z. caudelli</i> Karny	1926	Sumatra
<i>Z. longicercatus</i> Caudell	1927	Jamaica
<i>Z. buxtoni</i> Karny	1932	Samoa
<i>Z. zimmermani</i> Gurney	1938	Fiji
<i>Z. cramptoni</i> Gurney	1938	Guatemala
<i>Z. barberi</i> Gurney	1938	Cocos Island
<i>Z. philippinensis</i> Gurney	1938	Philippines
<i>Z. shannoni</i> Gurney	1938	Brazil
<i>Z. mexicanus</i> Bolivar Pieltain	1940	Mexico
<i>Z. brasiliensis</i> Silvestri	1946	Brazil
<i>Z. delamarei</i> Paulian	1949	Madagascar
<i>Z. vinsoni</i> Paulian	1951	Mauritius
<i>Z. huxleyi</i> Bolivar Pieltain and Coronado-G.	1962	Peru, Brazil
<i>Z. congensis</i> Van Ryn-Tournel	1971	Congo
<i>Z. sinensis</i> Hwang	1974	China (Tibet)
<i>Z. medoensis</i> Hwang	1976	China (Tibet)
<i>Z. lelupi</i> Weidner	1976	Galapagos
<i>Z. weidneri</i> New	1978	Brazil
<i>Z. hamiltoni</i> New	1978	Colombia

There are at present 28 described species of *Zorotypus* (Table 1), mostly from the New and Old World tropics, however *Z. hubbardi* is unusual in extending its range into the North American temperate zone, although this may be dependent on it locating microclimates which simulate sub-tropical conditions. Specimens of *Zorotypus* have been collected from the Dominican Republic by E. Ross. These have been identified as *Z. barberi* by Jae Choe at the Museum of Comparative Zoology, Harvard.

On the basis of the size and shape of the antennal segments, cerci, tibia and tarsal segments, terminal abdominal tergites and sternites as well as the setal and spinal armature of the hind femora and other parts of the body, the fossil specimen can be separated from all the species listed in Table 1. It should be noted that the fossil specimen is a female and that in comparison with species described only from males, it is assumed that the cerci and antennal structure are similar in both sexes. This has proven to be the case, but unfortunately does not hold true for the armature on the hind femur, which tends to be more strongly developed in males.

Aside from representing the first record and description of a fossil zorapteran the

present report is apparently the first time that the position of the female gonopore has been definitely established for the order. It is interesting to note that the location of the gonopore and the structure of the seventh sternum is very similar to the condition found in female termites. Also the presence of what appears to be the tip of a sclerotized ovipositor is interesting since among the Isoptera this structure is known to occur only in a few species of lower termites (Roonwal, 1970).

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