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ZABROTES SYLVESTRIS, A NEW SPECIES FROM THE UNITED STATES AND MEXICO RELATED TO *Z. SUBFASCIATUS* (BOHEMAN) (COLEOPTERA: BRUCHIDAE: AMBLYCERINAE)

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Abstract

The new species *Zabrotes sylvestris* is described from the United States and Mexico. Its very close relative *Z. subfasciatus* (Boheman), the economic Mexican bean weevil, is redescribed. The two species differ in characters of the male and female genitalia, color of pubescence, carinae on their legs, they do not interbreed, and have distinct differences in DNA. The male and female genitalia of both species are figured and host plants of both species listed.

The Mexican bean beetle, *Zabrotes subfasciatus* (Boheman), is the best known species in the bruchid subfamily Amblycerinae because it feeds in several legumes of economic importance, principally lima beans *Phaseolus lunatus* (Linnaeus) and common beans *P. vulgaris* (Linnaeus). This seed beetle species originated in the New World (Credland and Dendy 1992*b*) along with its primary legume seed hosts. Because it feeds on seeds of economically important legumes, it is cosmopolitan in distribution due to commercial activity. The literature is replete with papers on the economics of this species.

Recently we found a new species closely related to but distinct from *Z. subfasciatus* that usually feeds in seeds of non-cultivated *Phaseolus vulgaris*. We name this species *Z. sylvestris* and it is described below.

Materials and Methods

We used an ocular index in the descriptions. Ocular index = LO/DO, where LO= length of the eye and DO= the distance between the eyes in anterior view. The techniques described by Kingsolver (1970) were used to prepare the genitalia for study and genitalia vials were used to store the genitalia. We also used the nomenclature of Kingsolver (1970) but we modified it so that the description of the sclerites of the internal sac of the male genitalia are made when the internal sac is in repose. Most of the taxonomic publications of Johnson and of Kingsolver contain descriptions of the male genitalia when the internal sac is exerted. For example, our descriptions differ from Kingsolver's

(1970) only in that the sclerites that are in the apical portion of the internal sac, will correspond to the basal portion when the internal sac is in repose.

Synonymy and Redescription of Zabrotes subfasciatus (Boheman)

Spermophagus subfasciatus Boheman 1833:111.
Spermophagus semifasciatus: Boheman 1839:137; Sharp 1885:493; Bottimer 1968:1015.
Spermophagus musculus: Boheman 1833:112; Blackwelder 1946:763.
Spermophagus pectoralis: Sharp 1885:492; Horn 1894:411; Bridwell 1942: 249.
Spermophagus dorsopictus: Lepesme and Vayssiere 1941:201.
Spermophagus semicinctus: Horn 1894:41.
Amblycerus semifasciatus: Blackwelder 1946:763.
Bruchus cingulatus: Suffrian 1870:169; Sharp 1885:493.
Zabrotes subfasciatus: Zacher 1930; Blackwelder 1946:763; Lukianovich and Ter-Minasyan 1957:199; Bottimer 1968:1013; Center and Johnson 1974: 1098; Pfaffenberger and Johnson 1976:42; Pfaffenberger 1985:2; Kingsolver 1990:50; Pfaffenberger 1990:37.
Zabrotes pectoralis: Schaeffer 1907:292; Leng 1920:306; Bridwell 1942:249; Blackwelder 1946:763.
Zabrotes semicinctus: Leng 1920:306; Blackwelder 1946:763; Bottimer 1968: 1013; Johnson 1968:1271.
Zabrotes semifasciatus: Bottimer 1968:1015.

Male. *Integument Color.* Body black, but some specimens with first 2 antennal segments and distal portion of labrum yellowish. *Vestiture.* Head white, except for a yellowish-brown spot on vertex, spot sometimes inconspicuous; pronotum and elytra clothed with short intermixed yellow and brown pubescence, without particular pattern; scutellum white; pygidium yellowish with a longitudinal medial white stripe; metacoxa brown; abdomen clothed with white, sometimes yellowish, pubescence, lateral portion of abdominal segments brown. *Head.* Vertex and frons finely punctured, with a frontal carina; length of ocular sinus 0.66 to 0.75 length of width of eye; antennal segment one 1.75 to 2.25 times as long as segment 2, and segment eleven 1.11 to 1.60 times as long as segment 1. Length of antenna 0.83 to 0.90 of length of body. Ocular index 1.63 to 2.14. *Prothorax.* Pronotum semicircular, clothed with micropunctures, foveolate on lateral areas. *Mesothorax and Metathorax.* Scutellum triangular and minute. Elytra uniformly micropunctured and slightly microfoveolate, 1.80 to 1.93 times longer than wide; striae deep; stria 6 arcuate at base; strial punctures deep. Metasternum micropunctured and foveolate, with a fossa mesally and a longitudinal shallow sulcus, some specimens with only a small basal notchlike sulcus. Metepisternum finely micropunctured and foveolate. Metacoxal surface foveolate and setose on 0.44 to 0.6 of its lateral surface and length of posterior border, remaining 0.40 to 0.56 impunctate and shining. Metatibia with ventral carina and faint lateral carina; mucro of first metatarsal segment 0.10 to 0.15 as long as metatarsus. *Abdomen.* Sterna 1–5 finely micropunctured and foveolate; sternum 5 emarginated at apex; pygidium micropunctulate and foveolate. *Length* (pronotum-elytra) 1.56–2.16 mm; width 1.26–1.62 mm; maximum thoracic depth 0.96–1.14 mm. *Genitalia.* Median lobe slightly constricted on its lateral margins, wider at base; ventral valve subtriangular, with some pores on its apical portion; dorsal valve slightly wider and acuminate apically; armature of internal sac with a medial horseshoe-like sclerite, with 2 groups of spines, 1 on ventral surface, 1 at apex, 2 diffuse sclerites apically (Fig. 1). Lateral lobes 0.52 as long as median lobe, and cleft to 0.08 their length (Fig. 2).

Female. Sexually dimorphic. Pubescence similar to male except female with 1 median white stripe on pronotum, 1 small white spot on each corner, and 1 transverse white stripe on elytron. Antenna slightly shorter than male, reaching to 0.60 to 0.63 of body length. Length (pronotum-elytra) 2.28–2.46 mm; width 1.74–1.86 mm; maximum tho-

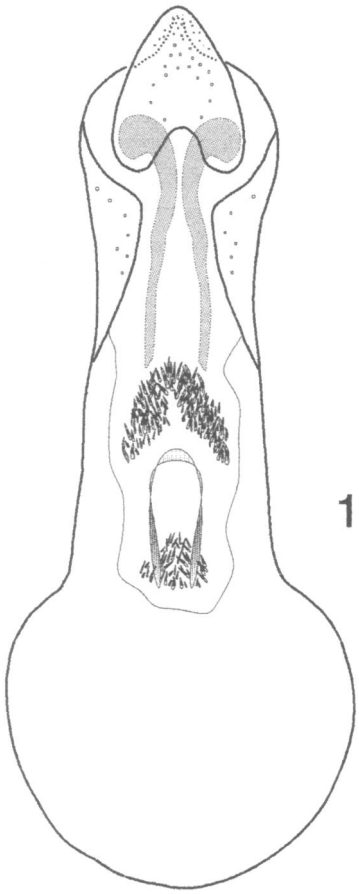

Fig. 1. *Zabrotes subfasciatus.* Median lobe, male genitalia.

racic depth 1.26–1.32 mm. Female genitalia with 1 broad, short, irregular, glabrous sclerite on bursa copulatrix (Fig. 3).

Host plants. Old records: *Cajanus cajan* (Kingsolver 1990), *Cajanus indicus* (Udayagiri and Wadhi 1989), *Cicer arietinum* (Kingsolver 1990; Udayagiri and Wadhi 1989; Zacher 1952:475), *Dipogon lignosus* (Kingsolver 1990), *Dolichos lablab* (Udayagiri and Wadhi 1989), *Dolichos lignosus* (Udayagiri and Wadhi 1989; Zacher 1952), *Dolichos sesquipedalis* (Udayagiri and Wadhi 1989), *Dolichos soja* (Udayagiri and Wadhi 1989), *Glycine hispida* (Lukianovich and Ter-Minasyan 1957; Udayagiri and Wadhi 1989; Zacher 1952), *Glycine max* (Kingsolver 1990), *Lablab niger* (Zacher 1952), *Lablab purpureus* (Kingsolver 1990), *Phaseolus acutifolius* (Udayagiri and Wadhi 1989; Bridwell 1942), *Phaseolus angularis* (Kingsolver 1990; Southgate *et al.* 1978), *Phaseolus articulatus* (Lukianovich and Ter-Minasyan 1957; Udayagiri and Wadhi 1989), *Phaseolus coccineus* (Kingsolver 1990; Bridwell 1942), *Phaseolus lunatus* (Arora 1977; Bridwell 1942; Kingsolver 1990; Janzen 1977,

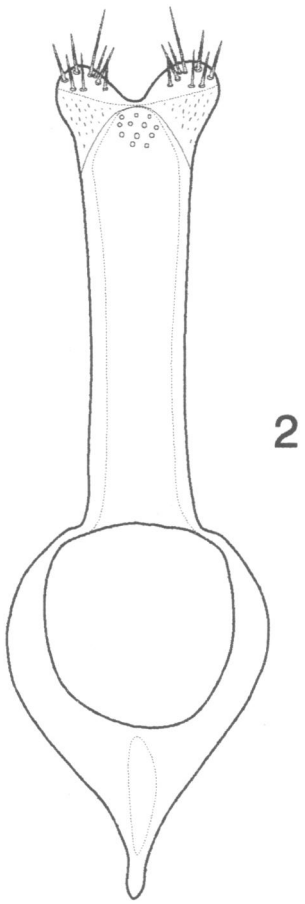

Fig. 2. *Zabrotes subfasciatus*. Lateral lobes, male genitalia.

1978, 1980; Leroi *et al.* 1990; Lukianovich and Ter-Minasyan 1957; Pimbert and Jarry 1988; Southgate *et al.* 1978; Udayagiri and Wadhi 1989; Zacher 1952), *Phaseolus multiflorus, Phaseolus mungo* (Lukianovich and Ter-Minasyan 1957; Udayagiri and Wadhi 1989; Zacher 1952), *Phaseolus vulgaris* (Bridwell 1942; Kingsolver 1990; Leroi *et al.* 1990; Pimbert and Jarry 1988; Sharma and Sharma 1979; Sharma *et al.* 1979; Udayagiri and Wadhi 1989; Zacher 1952), *Pisum arvense* (Lukianovich and Ter-Minasyan 1957; Udayagiri and Wadhi 1989; Zacher 1952), *Pisum sativum, Vicia faba* (Kingsolver 1990; Lukianovich and Ter-Minasyan 1957; Udayagiri and Wadhi 1989; Zacher 1952), *Vicia sebastiana* (Udayagiri and Wadhi 1989), *Vigna mungo* (Kingsolver 1990), *Vigna sinensis* (Arora 1977; Udayagiri and Wadhi 1989), *Vigna subterranea* (Southgate *et al.* 1978), *Vigna unguiculata* (Kingsolver 1990; Southgate *et al.* 1978), *Voandzeia subterranea* (Udayagiri and Wadhi 1989).

Distribution. Cosmopolitan.

Discussion. The external morphology and genitalia of *Z. subfasciatus* and

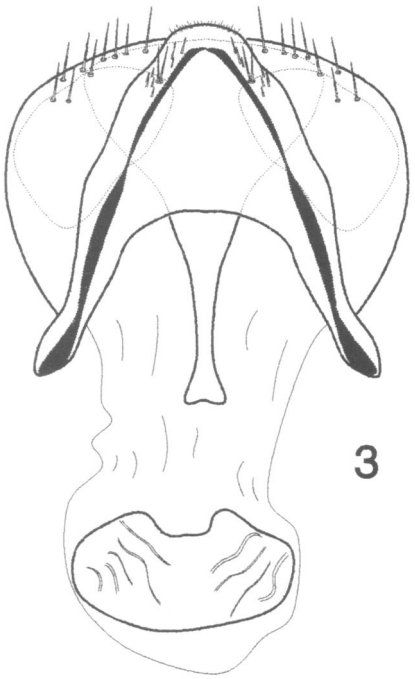

Fig. 3. *Zabrotes subfasciatus.* Female genitalia (spermatheca not shown).

Z. sylvestris are similar, and both species are sexually dimorphic. See discussion and diagnosis of *Z. sylvestris* for differences between species.

Zabrotes sylvestris Romero and Johnson, **new species**

Male. *Integument Color.* Body black, some specimens with antennal segments 1–2 and apical portion of labrum yellowish. *Vestiture.* Head clothed with intermixed white and yellow pubescence, without yellowish-brown spot on vertex; pronotum with minute brown and yellowish spots, without particular pattern; scutellum white; elytron with minute brown and yellow spots and a minute mesal white spot, in some specimens white spot inconspicuous and brown and yellow spots vague; pygidium yellowish with 1 median longitudinal stripe of lighter color; abdomen white, except 1 minute yellowish spot on either side of first sternum; metacoxa brown; metepisternum with a minute yellowish spot; in some specimens abdomen clothed with mixed yellow and white pubescence. *Head.* Vertex and frons finely punctured, usually with median frontal carina but varies to an impunctate line; ocular sinus 0.50 to 0.65 length of width of eye; antennal segment 1 1.50 to 2.25 times as long as segment 2, and segment eleven 1.27 to 1.45 times as long as segment 1. Length antenna 0.81 to 0.86 of length of body. Ocular index 1.46 to 1.83. *Prothorax.* Pronotum semicircular, slightly bulky mesally, micropunctured with foveolae scattered over entire surface. *Mesothorax and Metathorax.* Scutellum triangular and minute. Elytron 1.82 to 2.20 times longer than wide; uniformly micropunctured, foveolae minute; striae deep, strial punctures deep principally at base, stria 6 arcuate at base. Metasternum micropunctured and foveolate, with a small fossa mesally, some specimens with small basal notchlike sulcus. Metepisternum finely micropunctured and foveolate. Metacoxal surface foveolate and setose on 0.51 to 0.58 of its lateral surface and length of posterior border, remaining 0.42 to 0.49 impunctate, finely striated and shining.

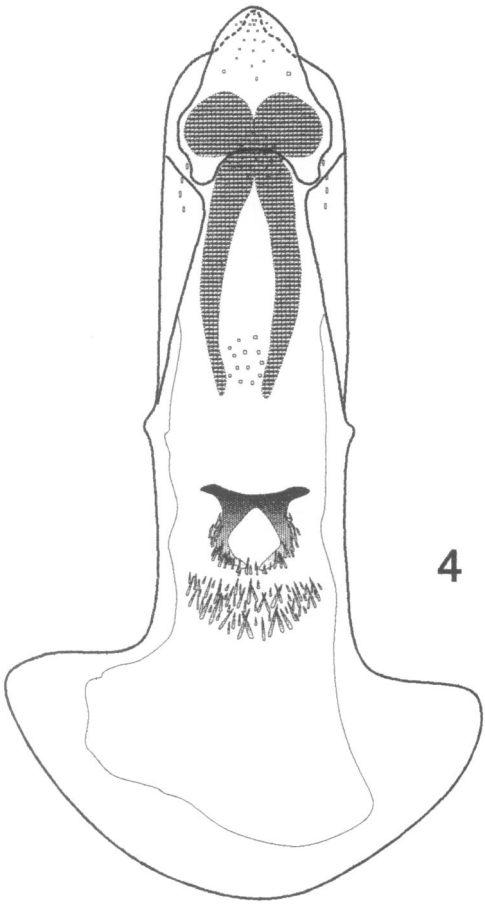

Fig. 4. *Zabrotes sylvestris.* Median lobe, male genitalia.

Metatibia with only ventral carina; mucro of first metatarsal segment 0.11 to 0.13 as long as metatarsus. *Abdomen.* Sterna 1–5 finely micropunctured and foveolate; sternum 5 emarginate at apex; pygidium micropunctured and strongly foveolate. *Length* (pronotum-elytra) 1.50–1.98 mm; width 1.2–1.5 mm; maximum thoracic depth 0.96–1.14 mm. *Genitalia.* Median lobe with lateral margins parallel, except basal portion wider; ventral valve subtriangular, with pores on apical portion; dorsal valve slightly wider, acuminate at apex; armature of internal sac with a median anvil-like sclerite, surrounded by spines, with a group of spines basally, and two diffuse sclerites apically (Fig. 4). Lateral lobes 0.61 as long as median lobe, and cleft to 0.05 their length (Fig. 5).

Female. Similar to male except with 1 transverse white stripe on elytron contrasting with remaining pubescence; ocular sinus 0.66 to 0.73 length of eye, and ocular index 1.36 to 1.40; antenna shorter, reaching 0.60 to 0.75 of body length. Length (pronotum-elytra) 2.10–2.52 mm; width 1.50–1.86 mm; maximum thoracic depth 1.20–1.44 mm. Female genitalia with 1 large, elongate pubescent sclerite on bursa copulatrix (Fig. 6).

Host Plants. *Phaseolus vulgaris* L.: Mexico. Tehuacan, Puebla, 19-VII-

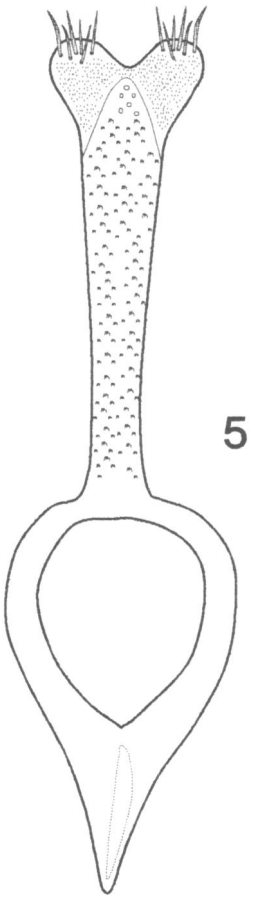

Fig. 5. *Zabrotes sylvestris.* Lateral lobes, male genitalia.

1996, Alicia Callejas collector; Tehuacan, Puebla, 1-XI-1995, Alicia Callejas collector; San Luis Potosi, S.L.P., 1-XI-1995, Alicia Callejas collector.

Type Series. Male Holotype: **Mexico.** Tehuacan, Puebla, 19-VII-1996, Alicia Callejas collector. Female Allotype: same data of holotype. Paratypes: Mexico: 4.4 mi E. Cuernavaca, Mor., 6-8-VII-1974, Clark, Murray, Ashe & Schaffner; San Luis Potosí, S.L.P., 1-XI-1995, Alicia Callejas collector; Tehuacan, Puebla, 19-VII-1996, Alicia Callejas collector; Tehuacan, Puebla, 1-XI-1995, Alicia Callejas collector. **United States.** Berkeley, Cal., 11-II-1946, W. F. Barr collector; Berkeley, Cal., 10-I-1947, Arthur J. Walz collector.

Holotype, allotype and numerous paratypes deposited in the Colección Entomológica del Instituto de Fitosanidad, Colegio de Postgraduados, Montecillo, México (CEIFIT). Paratypes deposited in the C.D. Johnson Collection, the U.S. National Museum of Natural History, William F. Barr Entomological Museum, and Texas A&M University Collection.

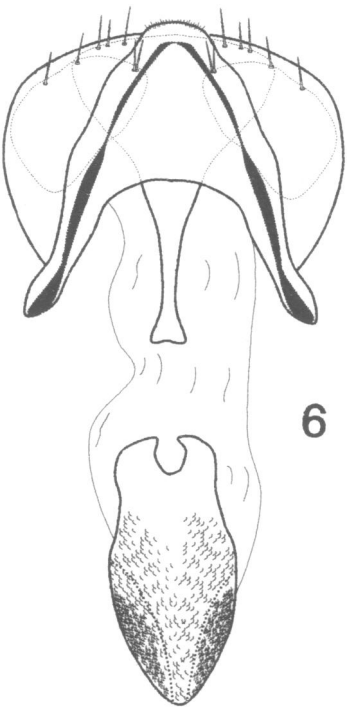

Fig. 6. *Zabrotes sylvestris.* Female genitalia (spermatheca not shown).

Distribution. United States (California) and Mexico (Morelos, Puebla, and San Luis Potosi).

Etymology. The specific epithet is an adjective which refers to the probability that this species feeds predominantly on wild beans.

Diagnosis. *Zabrotes subfasciatus* has a yellowish-brown spot of hairs on the vertex, a vague spot in some specimens; pronotum foveolate on lateral areas; metatibia with ventral and lateral carina. *Zabrotes sylvestris* is without a yellowish-brown spot of hairs on the vertex; pronotum foveolate over entire surface; metatibia with only ventral carina. Genitalia: Internal sac of male genitalia of *Z. subfasciatus* with a medial horseshoe-like sclerite and with 2 groups of spines, 1 in basal position and the other apically. Zabrotes sylvestris with a medial anvil-like sclerite, with only 1 group of spines basally. Female genitalia of *Z. subfasciatus* have a broad, short, irregular, glabrous sclerite on the bursa copulatrix; contrasting with female genitalia of Z. sylvestris that have a large, elongate pubescent sclerite on the bursa copulatrix.

Discussion. This species was recently collected feeding on beans in markets in Tehuacan, Puebla, Mexico. Then the genitalia of specimens from Berkeley, California were identified as *Z. sylvestris.* This new species was unnoticed because both *Z. subfasciatus* and *Z. sylvestris* have very similar external morphology. Apparently *Z. sylvestris* feeds on wild species of Fabaceae (probably wild varieties of *P. lunatus* and *P. vulgaris*); however it is able to develop on

cultivated *P. vulgaris* as the wild hosts and cultivated hosts are sometimes in close proximity.

The impetus for this study and eventual description of a new species arose when samples of what were thought to be *Zabrotes subfasciatus* (Boheman) were sent to us for verification of their identity by a team of researchers at the Universidad Nacional Autónoma de México (UNAM) studying the ecology of this species. Some moderately rare specimens were initially separated from other specimens by the research team because they exhibited slightly different behavior. We found that these specimens had male and female genitalia that were consistently different from specimens of *Z. subfasciatus*. Further intensive studies showed that there were external differences from *Z. subfasciatus* in these specimens as well.

There are also differences in DNA between the two species. While studying isoenzymes using electrophoresis, Gonzalez R. (1997) found that *Z. subfasciatus* and *Z. sylvestris* had different alleles at the locus PGI. This suggested to him that there was no gene flow between the two species.

According to Alicia Callejas, Facultad de Ciencias, UNAM (pers. com.) the two species do not interbreed. In the laboratory, members of the two species were offered the opportunity to breed with the other species. In spite of attempts to copulate, apparently copulation did not occur. These females of both species only oviposited infrequently and none of these eggs developed into adult hybrids. This, we believe, with all the other evidence, is confirmation that these are two distinct species.

Initially we were hesitant to consider this as a new species because some other species of bruchids of economic importance that are studied intensively have shown various biotypes and behavioral and morphological patterns that may be due to evolution while in storage or simply because they have been studied intensively and these traits of variability are also present in non-economic and less well-studied species. For example, Messina and Renwick (1985) discussed traits of the economic, polymorphic *Callosobruchus maculatus* (Fabricius) that have been observed and studied by economic entomologists and insect ecologists. The sedentary, "normal" adults of this species have wings but do not fly. The morphologically distinct, "active" adults are produced during crowding in a population and disperse by flying.

In *Z. subfasciatus* several biotypes have been reported which vary in their ability to use various cultivars of plant seeds (Credland and Dendy 1992*a*). Five different geographic populations were found to differ in fecundity, patterns of egg distribution, times of development and adult sizes when kept under identical conditions (Credland and Dendy 1992*b*).

Morphologically distinct forms of *Z. subfasciatus* were reported by Kapila and Pajni (1987). They found that "black" pygidium females were present throughout the year but vary in their abundance. But "white" pygidium females occurred only during the warmer months of the year. The "white" pygidium females were less fecund than the "black" pygidium females.

Acanthoscelides obtectus (Say) is the most economically important bruchid because it is cosmopolitan and it feeds voraciously in stored seeds of *Phaseolus vulgaris*. *Acanthoscelides argillaceus* (Sharp) and *A. obvelatus* Bridwell are two other species that are very similar and often confused with *A. obtectus* (see Kingsolver 1968, 1975; Johnson 1983). We hypothesize that our new species is similar to the situation with these three species: origin in Central America - Mexico and evolution from a common ancestor into similar but distinct species.

Despite variations in *Z. subfasciatus* and *Callosobruchus maculatus* in various aspects of their biology reported in the literature, we feel our evidence is sufficient to support *Z. sylvestris* as a new and distinct species.

Acknowledgments

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