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Peaceful giant ground beetles: The genus *Tefflus* Latreille
(Coleoptera: Carabidae) in the Republic of South Africa

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Peaceful giant ground beetles: The genus *Tefflus* Latreille (Coleoptera: Carabidae) in the Republic of South Africa

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Abstract. Two species of the genus *Tefflus* Latreille (Coleoptera: Carabidae), commonly known as “peaceful giant ground beetles,” are recorded from the Republic of South Africa: *T. carinatus carinatus* Klug and *T. meyerlei delagorguei* Guérin-Méneville. Distribution records from the Republic of South Africa are summarized and mapped for both species. *Tefflus c. carinatus* has been collected in KwaZulu-Natal and Mpumalanga Provinces, while *T. m. delagorguei* has been recorded from Free State, Gauteng, KwaZulu-Natal, Limpopo, and Mpumalanga Provinces. Adults of both species are illustrated. Seasonal and temporal activity patterns and defensive and foraging behaviors are characterized for *T. m. delagorguei* based on recent field studies in the Kruger National Park, Republic of South Africa.

Introduction

The genus *Tefflus* Latreille (Coleoptera: Carabidae) contains 14 species widely distributed throughout sub-Saharan Africa (Basilewsky 1946). Members of this genus can be recognized by their large body size (24-55 mm in length) and their distinctive body form (Figure 1). In South Africa, these beetles are known by the popular name of “peaceful giant ground beetles” (Picker et al. 2004) to distinguish them from the “oogpisters” of the tribe Anthiini (Carabidae), which spray highly concentrated acidic secretions from their pygidial glands when disturbed (Scott et al. 1975; Huey and Pianka 1977).

Species of the genus *Tefflus* are predators of land snails, particularly the giant land snails in the genus *Achatina* Lamarck (Gastropoda: Achatinidae; Figure 2). These snails have the potential to become agricultural pests when introduced into areas outside their natural distribution (Barker 2002), and species of *Tefflus* have been considered as possible biological controls of *Achatina* species (Krauss 1955, 1964). According to Davis and Butler (1964), four species of *Tefflus* have been introduced to Hawaii as potential biological control agents of the introduced giant land snail *Achatina fulica* Bowdich.

As with other genera of flightless Carabidae, the taxonomy of *Tefflus* has been problematic, and the genus has been revised in whole or in part several times (Chaudoir 1878; Kolbe 1886, 1904; Sternberg 1908, 1909, 1910). The most recent revision is that of Basilewsky (1946) who incorporated studies of male reproductive structures as well as a comprehensive study of external anatomy and geographic distribution. Questions remain, however, about the number and identity of the species of *Tefflus* found in southern Africa. Péringuey (1896) did not record any species of this genus from the present-day Republic of South Africa in his monumental revision of southern African Carabidae. Basilewsky (1946) provided several records from the present-day Republic of South Africa for one species and a questionable record for a second. Picker et al. (2004) illustrated a live adult and a live larva of one species in a field guide to South

African insects but only identified these individuals to genus. In this paper, we present new information about the natural history and distribution of the species of *Tefflus* known from the Republic of South Africa.

This paper also forms part of a series investigating the taxonomy and natural history of southern African Carabidae (including Cicindelinae), with focus on the fauna of the Kruger National Park. Kruger National Park is the largest conservation area in the Republic of South Africa and home to significant populations of many large-bodied mammalian taxa, including African elephant (*Loxodonta africana* (Blumenbach)), white rhinoceros (*Ceratotherium simum* (Burchell)), black rhinoceros (*Diceros bicornis* (L.)), hippopotamus (*Hippopotamus amphibius* L.), Cape buffalo (*Syncerus caffer* (Sparrman)), lion (*Panthera leo* (L.)), leopard (*Panthera pardus* (L.)), cheetah (*Acinonyx jubatus* (Schreber)), and numerous antelope species (Du Toit et al. 2003). In contrast, the carabid beetle fauna of the Park is poorly known, although components of the Park's fauna have been treated in monographs by Basilewsky (1977) and Cassola (2002). Our recent contributions towards the knowledge of this fauna include Mawdsley and Sithole (2008, 2009) and Mawdsley (2009).

Materials and Methods

Specimens examined are deposited in the following collections: **KNPC** - Kruger National Park Museum Collection, Skukuza, Republic of South Africa; **NMNH** - National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA; **TMSA** - Transvaal Museum, Pretoria, Republic of South Africa.

Field investigations of the natural history of *T. m. delagorguei* were conducted in the Kruger National Park, Mpumalanga Province, Republic of South Africa, between 7 December and 20 December, 2009, and between 28 November and 16 December, 2010. Our investigations focused on the areas surrounding the Skukuza, Pretoriuskop, and Satara tourist camps, where many of the museum specimens of *T. m. delagorguei* and other large-bodied Carabidae had been collected. Diurnal visual surveys for adult beetles were conducted by either driving slowly or walking along roads, trails, and firebreaks. Diurnal surveys were conducted in multiple vegetation communities as defined by Gertenbach (1983): *Acacia grandicornuta* Gerstner (Leguminosae) bottomland sodic flats; *Acacia nigrescens* Oliver (Leguminosae) – *Combretum apiculatum* Sonder (Combretaceae) woodland; *Terminalia prunioides* Lawson (Combretaceae) woodland; *Terminalia sericea* Burchell (Combretaceae) woodland; and riparian gallery forest. Diurnal surveys were conducted from 8 AM to 4 PM daily under all weather conditions, ranging from full sun to partial clouds to overcast to light rain to heavy rain. In addition to the diurnal surveys, pitfall traps of 7 cm to 20 cm diameter were deployed in the same vegetation communities where diurnal surveys were conducted, in order to sample nocturnally active Carabidae. Nocturnal “headlamping” surveys for *Tefflus* spp. and other Carabidae were also conducted in the Skukuza tourist camp and the N’waswitshaka research camp near Skukuza.



Figure 1. Adult female of *Tefflus meyerlei delagorguei*, N’waswitshaka Research Camp, Kruger National Park.



Figure 2. Adult *Achatina* land snail, Skukuza, Kruger National Park.

Genus *Tefflus* Latreille (1822: 87)

Type species. *Carabus meyerlei* Fabricius (1801:169).

Diagnosis. From sympatric species in the tribe Panagaeini, the species of *Tefflus* can be immediately recognized by the large body size (length 24-55 mm), hexagonal pronotal shape, planate pronotal disc, elytral punctures in double rows separated by large elevated carinae, lack of functional flight wings, and lack of orange or yellow elytral markings (Basilewsky 1946). Males in this genus have the first and second tarsomeres of the protarsi enlarged (Figures 3, 5).

Distribution. The genus *Tefflus* is widely distributed throughout sub-Saharan Africa, with 14 species and 41 subspecies (Basilewsky 1946). For the Republic of South Africa, Basilewsky (1946) published several collection records for *T. meyerlei delagorguei* Guérin-Méneville, and a doubtful record for *T. carinatus carinatus* Klug. In this paper we confirm the presence of both taxa in the Republic of South Africa and add new records.

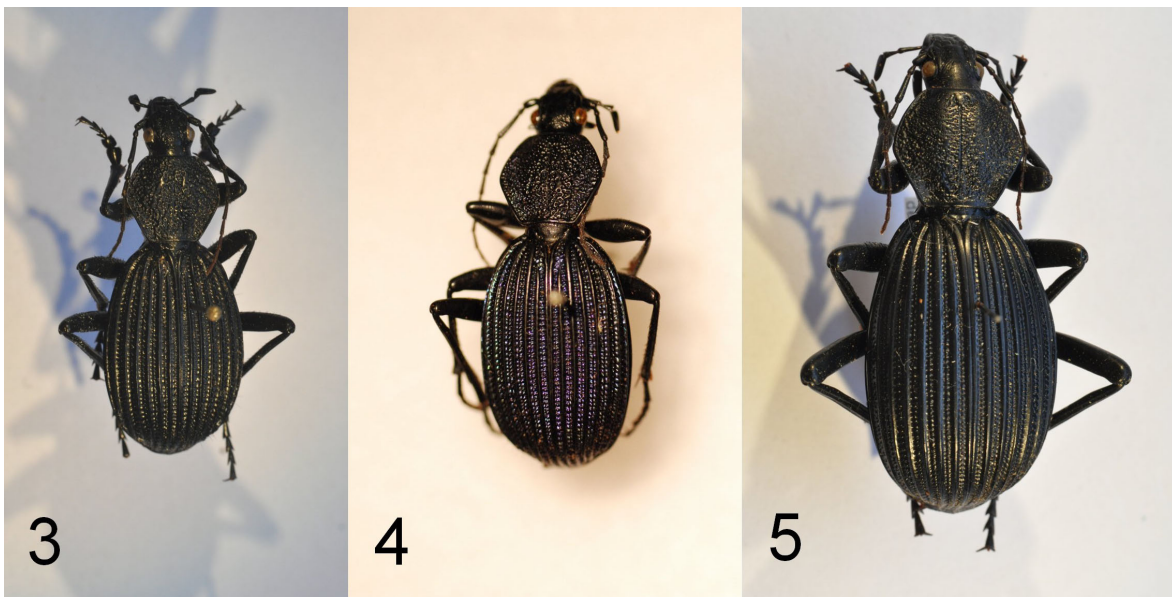
Taxonomic note. The specific epithet of the type species of this genus has often been written “megerlei” (e.g. Basilewsky 1946) but the original published spelling for this name is “meyerlei” (Fabricius 1801:169).

***Tefflus carinatus carinatus* Klug (1853: 247)**

Figures 3-4, 6.

Diagnosis. The smaller of the two species of *Tefflus* in the Republic of South Africa (length 26-37 mm); vertex of head with large, round distinct punctures; pronotum with large, irregular round punctures, punctures not confluent; femora and tibiae with multiple stout suberect setae; elytra flattened, disc planate; elytral carinae narrower than adjacent rows of punctures; integument black or metallic violet.

Historical record from South Africa. “Transvaal” (Basilewsky 1946). The species has also been recorded from present-day Democratic Republic of the Congo, Malawi, Mozambique, Tanzania, and Zimbabwe (Basilewsky 1946).



Figures 3-5. Adult males of *Tefflus* spp. **3)** *Tefflus carinatus carinatus*, Ndumu, KwaZulu-Natal Province, South Africa. **4)** *Tefflus carinatus carinatus*, Nelspruit, Mpumalanga Province, South Africa. **5)** *Tefflus meyerlei delagorguei*, Loskop, Mpumalanga Province, South Africa.

Specimens examined. REPUBLIC OF SOUTH AFRICA: KwaZulu-Natal Province, Ndumu, XII.1960 (1 male, TMSA). Mpumalanga Province, Nelspruit (1 male, NMNH).

Taxonomic note. Basilewsky (1946) divided *T. carinatus* into three subspecies on the basis of dorsal coloration and geographic distribution. Two of these subspecies, the nominate *T. c. carinatus* and *T. c. violaceus*, occur in southern Africa, with the Zambezi River serving as a dividing line between the geographic distributions of these two subspecies. According to Basilewsky (1946), the southern subspecies *T. c. carinatus* has black dorsal coloration, while the northern subspecies *T. c. violaceus* Klug has violet dorsal coloration. We examined black as well as metallic violet specimens of *T. carinatus* from the Republic of South Africa (Figures 3-4), suggesting that further revision of this complex and re-evaluation of the subspecific taxa recognized by Basilewsky (1946) is probably in order.

Tefflus meyerlei delagorguei Guérin-Ménéville (1845: 285)

Figures 1, 5, 6.

Diagnosis. The larger of the two species of *Tefflus* in the Republic of South Africa (length 39-54 mm); vertex of head smooth with transverse rugae adjacent to eyes; pronotal punctures less distinct and often confluent; femora and tibiae with few if any stout suberect setae; elytral disc convex; elytral carinae as broad or broader than adjacent rows of punctures, top of each carina smooth and shining; integument black and shining. This is the species whose adult and larval forms were illustrated by Picker et al. (2004).

Historical records from South Africa. Free State Province, Vrede. Gauteng Province, Monts Zoutpans, Pretoria. KwaZulu-Natal Province, Durban, Nagana, "Tongaland," "Zululand." Limpopo Province: Nylstroom (Basilewsky 1946). *Tefflus meyerlei* is widely distributed throughout sub-Saharan Africa (Basilewsky 1946) and the subspecies *T. m. delagorguei* has also been recorded from present-day Malawi, Mozambique, Swaziland, and Zimbabwe (Basilewsky 1946; Magagula 2003, 2006).

Specimens examined. REPUBLIC OF SOUTH AFRICA : KwaZulu-Natal Province, Dukuduku, 10.I.1903 (1 male, TMSA), Empangeni, XII.1976 (1 female, TMSA), Eshowe, 16.XI.1967 (1 male, NMNH), "E. Zululand" (1 male, TMSA), Frieschgewaag, II.1903 (1 female, TMSA), Mkuzi, IV.1950 (1 male, TMSA), Umfolozi, X.1924 (1 female, TMSA), Umfolozi River, 1.XI.1922 (1 male, TMSA). Limpopo Province, Koedoes River, XII.1902 (1 female, TMSA), Marieps Mountain, IX.1925 (1 male, TMSA), 25 miles N of Punda Milia, Kruger National Park, II.1960 (1 male, TMSA), Tzaneen, X-XI.1974 (1 male, NMNH), Tzaneen, Glen Allen, IV.1974 (2 males, NMNH), 12 miles N Tzaneen, 15.XII.1964 (3 males, 2 females, NMNH). Mpumalanga Province, Barberton, 8.I.1911 (1 male, TMSA), 7.II.1957 (1 male, TMSA), Loskop, XII.1959 (1 male, TMSA), Nelspruit, XII.1967 (1 female, TMSA), N'waswitshaka Research Camp, 19.XII.2009 (1 female, NMNH), Pretoriuskop, 19.XI.2010 (1 female, TMSA), Skukuza, Kruger National Park (1 male, 1 female, KNPC).

Observations on the natural history of *Tefflus meyerlei delagorguei*

In November 2009 and November-December 2010, we conducted preliminary investigations of the natural history of *Tefflus meyerlei delagorguei* in the Kruger National Park, Republic of South Africa. Based on the specimen records presented above, this species appears to be widely distributed in the Park, from Punda Maria (= Punda Milia) in the north to Pretoriuskop and Skukuza in the south (Figure 6). There are relatively few specimens of *T. m. delagorguei* from the Kruger National Park in museum collections but in our experience this most likely represents a lack of collecting activities rather than actual scarcity. *Tefflus m. delagorguei* is not uncommon in the Park and adults are encountered approximately as frequently as adults of other large Carabidae (specifically species of the tribe Anthiini).

Adults of *T. m. delagorguei* are typically encountered singly, walking rapidly along the ground in open woodlands, including *Terminalia sericea* Burchell (Combretaceae) woodland and *Acacia nigrescens*

Oliver (Leguminosae) – *Combretum apiculatum* Sonder (Combretaceae) woodland (Gertenbach 1983). Productive sampling methods for *T. m. delagorguei* include: driving slowly along sand or gravel roads during seasonal rains and looking for adult beetles; using an electric light or headlamp to examine the ground at night after seasonal rains (the so-called “headlamping” technique); and the use of large-diameter (10 cm or greater) pitfall traps. We have observed that smaller diameter pitfall traps (less than 10 cm diameter) are less effective at capturing adults of *T. m. delagorguei* and other large carabids.

As noted in the introduction, species of *Tefflus* are predators of land snails, particularly the giant land snails in the genus *Achatina* Lamarck (Krauss 1955, 1964; Barker 2002). In Kruger National Park, we have observed that the activity patterns of these snails are markedly associated with seasonal rains. Adult snails (Figure 2) are active diurnally during rainfall events and remain active until the ground dries. After the ground dries, the adult snails are no longer active diurnally but may still be active nocturnally.

The activity patterns of adults of *T. m. delagorguei* closely follow the activity patterns of their snail prey. The records summarized above for the Republic of South Africa suggest that adults of *T. m. delagorguei* are active primarily during the summer monsoon season, with all known collections between September and April and the majority of collections between November and February, coinciding with the summer monsoon season. In Kruger National Park, adults of *T. m. delagorguei* emerge during or immediately following seasonal monsoon rain events and remain active briefly diurnally following rain events. The adult beetles are also active nocturnally during the rainy season and can be collected by the use of headlamps in open woodland areas. We did not observe snail predation by adult *T. m. delagorguei* but we did observe empty snail shells on the ground in areas where beetles were active. The rapid walking behavior noted above probably represents a foraging behavior aimed at detecting snail prey.

Larvae of *T. m. delagorguei* are free-living (Picker et al. 2004) and can be found actively crawling on bare ground or in leaf litter, particularly in areas where their snail prey are active. We interpret this active crawling behavior as a foraging behavior, although it may also serve the mature larvae as a mechanism for finding a suitable pupation site. In Kruger National Park, we encountered larvae of *T. m. delagorguei* during diurnal searches of leaf litter of riparian gallery forests and in upland *Acacia nigrescens* – *Combretum apiculatum* woodland (Gertenbach 1983).

In capturing and handling adults of *T. m. delagorguei*, we discovered that these beetles emit strongly-scented pygidial gland secretions. As in other Carabidae (Scott et al. 1975; Huey and Pianka 1977), these secretions probably constitute an anti-predator defense. We never observed spraying of secretions from the pygidial glands as has been reported in species of the carabid tribe Anthiini (Huey and Pianka 1977). We also did not observe predation by other organisms on adults or larvae of *Tefflus* species. On one occasion we observed an adult female of *T. m. delagorguei* with damaged elytra that apparently was the result of an attempted predation event. The size and extent of the damage are suggestive of predation by a species of mongoose (Mammalia: Herpestidae), which have been reported as potential predators of other large-bodied Carabidae (Mares 2002).

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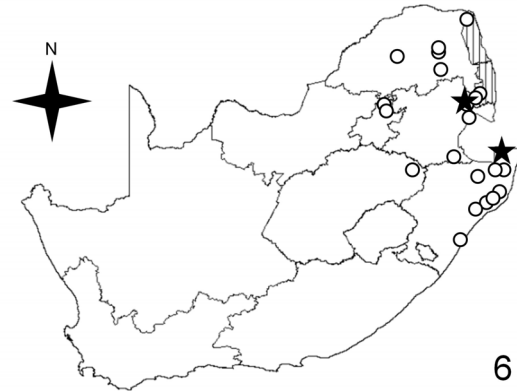


Figure 6. Distribution of *Tefflus* species in South Africa. Collecting localities of *T. carinatus carinatus* are indicated by black stars. Collecting localities of *T. meyerlei delagorguei* are indicated by black and white circles.

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Literature Cited

- Barker, G. M. 2002.** Molluscs as crop pests. Centre for Agriculture and Biosciences International (CABI); Wallingford, England. 468 p.
- Basilewsky, P. 1946.** Monographie du genre *Tefflus* Latreille (Col. Carabidae, Panagaeinae), Étude morphologique, systématique et géographique. *Novitates Entomologicae*, 5^e supplement 1: 1-56.
- Basilewsky, P. 1977.** Revision du genre *Graphipterus* Latreille (Coleoptera Carabidae). *Musée Royal de l'Afrique Centrale, Annales, Serie in 8°, Sciences Zoologiques* 221: 1-472.
- Cassola, F. 2002.** Materials for a revision of the African genus *Dromica* (Coleoptera, Cicindelidae). *Memorie della Società Italiana di Entomologia* 81: 3-166.
- Chaudoir, M. de. 1878.** Essai monographique sur les Panagaeides. *Annales de la Société Entomologique de Belgique* 1878: 83-186.
- Davis, C. J. and G. D. Butler, Jr. 1964.** Introduced enemies of the giant African snail, *Achatina fulica* Bowdich, in Hawaii (Pulmonata: Achatinidae). *Proceedings of the Hawaiian Entomological Society* 18(3): 377-389.
- Du Toit, J. T., K. H. Rogers, and H. C. Biggs, eds. 2003.** The Kruger experience: ecology and management of savanna heterogeneity. Island Press; Washington, D.C. xv + 519 p.
- Fabricius, J. C. 1801.** *Systema eleutheratorum, secundum ordines, genera, species, adjectis synonymis, locis, observationibus, descriptionibus*, Tom. 1. Bibliopolii Academici Novi; Kiel. xxiv + 506 p.
- Gertenbach, W. P. D. 1983.** Landscapes of the Kruger National Park. *Koedoe* 26: 9-121.
- Guérin-Méneville, F. E. 1845.** Description de quelques insectes les plus remarquables du Pays des Boshimans, des Ama-Zoulous, des Massilicatzi et du Port Natal. *Revue Zoologique* 8: 283-286.
- Huey, R. B., and E. R. Pianka. 1977.** Natural selection for juvenile lizards mimicking noxious beetles. *Science* 195: 201-203.
- Klug, J. C. F. 1853.** Uebersicht der von Herrn Dr. Peter während seines Aufenthaltes in Mozambik veranstalteten entomologischen Sammlungen. *Monatsberichte der Königlichen Preussische Akademie des Wissenschaften zu Berlin* 1853: 244-250.
- Kolbe, H. J. 1886.** Tabellarische Uebersicht von sechszehn *Tefflus*-Arten. *Entomologische Nachrichten* 12: 225-229.
- Kolbe, H. J. 1904.** Die morphologischen Verhältnisse der Artengruppen der afrikanischen Coleopterengattung *Tefflus*. *Berliner Entomologische Zeitschrift* 18: 117-158.
- Krauss, N. L. H. 1955.** *Tefflus zanzibaricus alluaudi* Sternberg. *Proceedings of the Hawaiian Entomological Society* 16: 1.
- Krauss, N. L. H. 1964.** Investigations on biological control of giant African (*Achatina fulica*) and other land snails. *The Nautilus* 78: 21-27.
- Latreille, P. A. 1822.** *Histoire naturelle et iconographie des insectes coléoptères d'Europe*. Chez Crevot; Paris. 198 p. + 15 pl.
- Magagula, C. N. 2003.** Changes in carabid beetle diversity within a fragmented agricultural landscape. *African Journal of Ecology* 41(1): 23-30.
- Magagula, C. N. 2006.** Habitat specificity and variation of Coleopteran assemblages between habitats in a southern African (Swaziland) agricultural landscape. *Biodiversity and Conservation* 15(1): 453-463.
- Mares, J. 2002.** *Manticora*: a monograph of the genus. Taita Publishers; Hradec Králové, Czech Republic. 205 p.
- Mawdsley, J. R. 2009.** Taxonomy, ecology, and phylogeny of species of *Lophyra* Motschulsky 1859, subgenus *Eriolophyra* Rivalier 1948 (Coleoptera: Cicindelidae). *Tropical Zoology* 22: 57-70.
- Mawdsley, J. R. and H. Sithole. 2008.** Dry season ecology of riverine tiger beetles in Kruger National Park, South Africa. *African Journal of Ecology* 46(2): 126-131.

- Mawdsley, J. R. and H. Sithole. 2009.** Natural history of the African riverine tiger beetle *Chaetodera regalis* (Dejean) (Coleoptera: Cicindelidae). *Journal of Natural History* 43: 1891-1908.
- Péringuey, L. 1896.** Descriptive catalogue of the Coleoptera of South Africa, part II. *Transactions of the South African Philosophical Society* 7: 99–623.
- Picker, M., C. Griffiths, and A. Weaving. 2004.** Field guide to insects of South Africa [new edition]. Struik Publishers; Cape Town. 444 p.
- Scott, P. D., H. R. Hepburn, and R. M. Crewe. 1975.** Pygidial defensive secretions of some carabid beetles. *Insect Biochemistry* 5(6): 805-811.
- Sternberg, C. 1908.** Neue Arten aus den Gattungen *Chlaenius*, *Polyhirma*, und *Tefflus* gesammelt 1900 von Prof. O. Neumann auf seiner Durchquerrung Nord-Ost-Afrikas, hauptsächlich Abessyniens und der Gallaländer. *Stettiner Entomologische Zeitung* 66: 96-109.
- Sternberg, C. 1909.** Neue Arten aus der Gattung *Tefflus* I. *Stettiner Entomologische Zeitung* 70: 102-120.
- Sternberg, C. 1910.** Neue Arten aus der Gattung *Tefflus* II. *Stettiner Entomologische Zeitung* 71: 225-281.

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