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## Research article

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# Notes on the Sardinian endemic *Tenuiphantes sardous* (Gozo, 1908) n. comb. (Araneae: Linyphiidae)

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## Abstract

Knowledge on Sardinian cave spiders started with Angela Gozo's 1908 description of the female of *Lepthyphantes sardous*. Because Gozo's original specimens appear to be lost, we visited Gozo's type location (Su Marmuri cave, Ogliastra, Sardinia) in an effort to find the as yet unknown male and to collect topotypic specimens on which a new diagnosis and a possible revision of the taxonomic position of the species could be based. Both efforts were successful and the results are given below. Our finding of the unknown male now allows the placement of this species within the genus *Tenuiphantes* Saaristo & Tanasevitch, 1996. Specimens of *Tenuiphantes sardous* (Gozo, 1908) n. comb. have been collected on the cave ground, among rocks in areas mostly covered with guano. In lack of proper troglomorphic traits we regard the species as troglophile. As far as the distribution is concerned, the species is currently known exclusively for the type locality. However, the troglophile habit and the general lack of arachnological prospections in Sardinian caves suggests a wider distribution on the island.

**Keywords:** cave spiders, *Lepthyphantes*, Sardinia, new combination, neotype designation.

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## Introduction

*Lepthyphantes sardous* Gozo, 1908 (Araneae: Linyphiidae) was the first spider species to be described from Sardinian caves (Pantini & Isaia 2019). The species was described by Gozo (1908) on material collected by Doderò in 1901 in Su Marmuri cave, in the region of Ogliastra (Nuoro province). The work reports a brief description of the female, including two sketches of the epigyne in dorsal and lateral view (Gozo 1908: 118). Gozo's morphological description fits the early 19<sup>th</sup> century standards, being outdated and poor in detail to allow species recognition today. On the other hand, Gozo's information on the location where the material was collected was precise and fully traceable. The male of *L. sardous* remained unknown to Gozo.

In later years, the species has been reported for the same locality by Lana et al. (2006) but no mention of the undescribed male or any taxonomical account were reported therein. In addition, citations referring to Gozo's original work – and not to original material – also appear in Cerruti (1968), Brignoli (1972), Puddu & Pirodda (1974) and Pantini et al. (2013), making the species unrecorded since its original description.

Since none of the authors ever reporting on *Lepthyphantes sardous* have seen Gozo's original type specimen and since our search for this material in most Italian and European Museums remained unsuccessful, we regard the Gozo's type as lost. Recently, we visited Gozo's type location in Sardinia in an effort to collect topotypic specimens on which a new diagnosis and a possible revision of the taxonomic position of *L. sardous* could be based. A further aim of this expedition was to find the as yet unknown male of *L. sardous*. Both efforts were successful and the results are given below.

## Methods

The neotype and one paratype are stored in 70% ethanol at the spider collection of Museo Civico Storia Naturale G. Doria, Genova (MSNG), Italy. Additional paratypes are stored at Museo Civico di Storia Naturale di Bergamo (MCSNB) and University of Torino, Italy (MI). We studied specimens using a Leica Stereozoom S8 APO stereoscopic binocular microscope equipped with a Flexacam C1 camera. Illustrations were prepared by Alessan-

dro Infuso (Turin) directly on specimens observed under the stereomicroscope and from multifocus Z-stack images taken with the same instrument. Measures were taken with a Leica M80 stereomicroscope, connected to a EC3 camera; all measurements are expressed in mm.

We referred to Saaristo & Tanasevitch (1996) for Micronetinae anatomical terms and to the World Spider Catalog (2022) for current nomenclature. For the genus placement we refer to Saaristo & Tanasevitch (1996) and to the personal advice of Andrei Tanasevitch. All illustrated structures are from the left side. All morphological measurements are in millimeters. The position of the metatarsal trichobothrium I (TmI) is expressed as the distance between the proximal end of the leg article and the trichobothrial base divided by the total length of the leg article (Denis 1949). Distances between eyes are measured across nearby margins (i.e., as the interspace between eyes).

### Taxonomy

*Tenuiphantes sardous* (Gozo, 1908) **n. comb.**

(Figs 1-8)

*Lepthyphantes sardoa* (sic!) Gozo, 1908: 117 (description of the female).

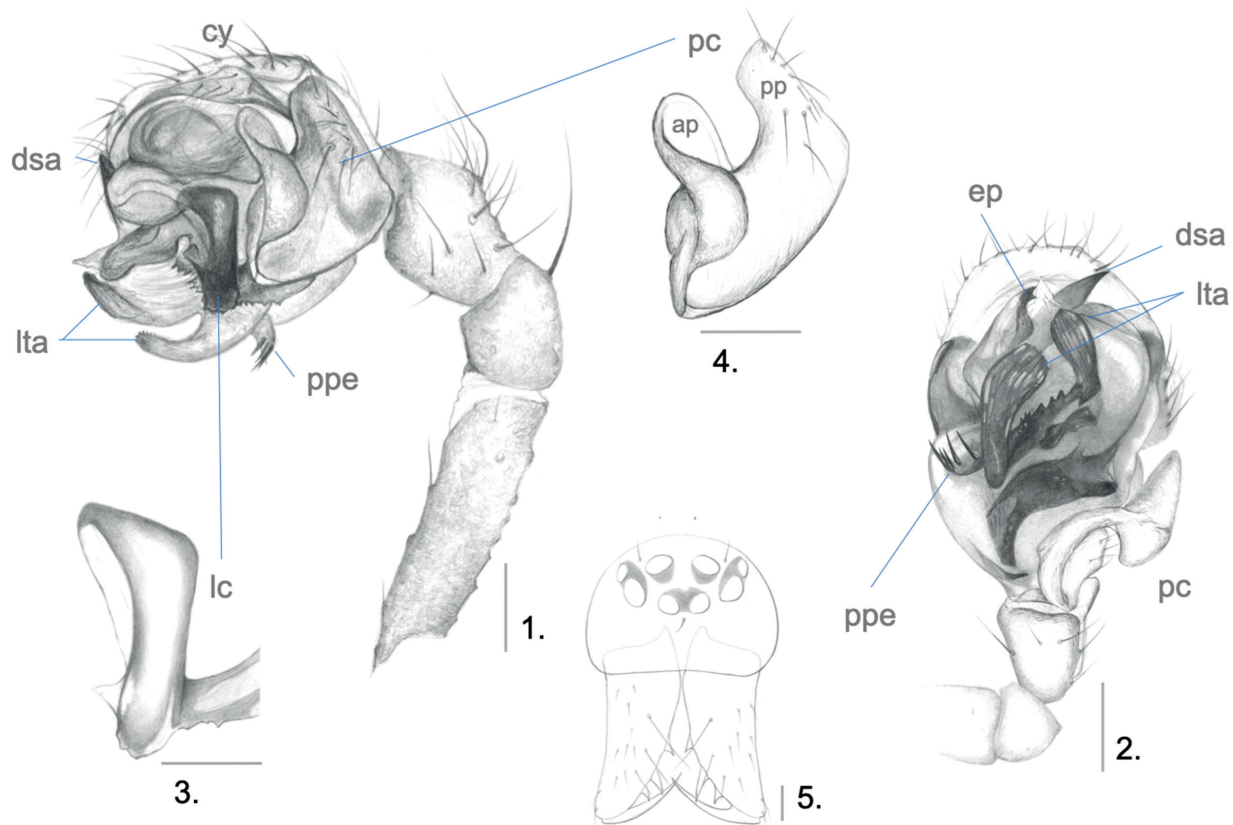
*Lepthyphantes sardous* (sic!); Roewer 1942: 554.

**Examined material.** Italy: Sardegna, Ulassai, Ogliastra (Nuoro province), Grutta de Su Marmuri [Su Marmuri cave] (0055 Sa/NU), 843 m, 21 Feb 2022, Isaia & Nicolosi leg., 1 ♂ (neotype, here designated: MSNG), 1 ♀, 1 ♂ and 3 ♀♀ (MI 3466), 1 ♂ and 1 ♀ (MCSNB 47697).

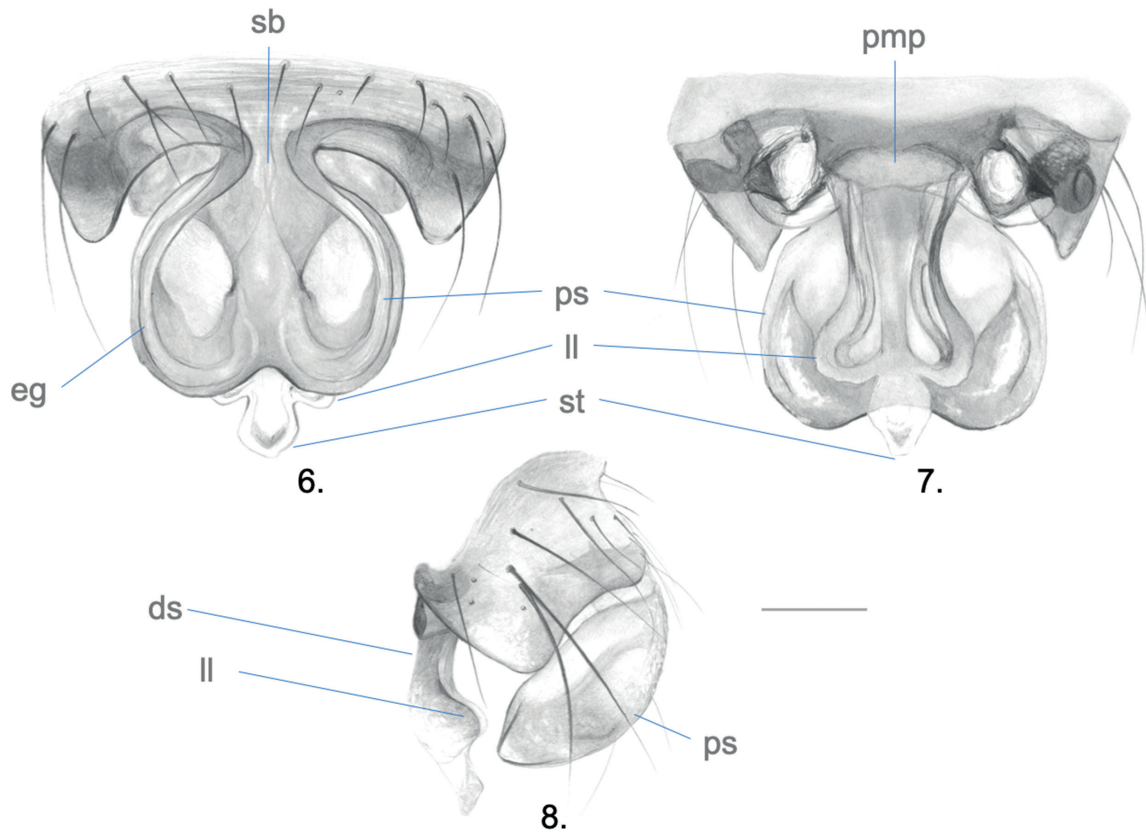
**Type locality.** Italy, Sardegna, Ulassai, Ogliastra (Nuoro province), Grutta de Su Marmuri.

### New diagnosis

The sinuous, horsefish-shaped embolus of the male with dentigerous protrusions on its proximal part (ppe in Fig. 1), the well-developed tripartite structure of the scapus (proscape, middle part, and distal part with lateral lobes and stretcher, Figs 6-8) as well as the leg formula of chaetotaxy lead to the transfer of this species to the genus *Tenuiphantes*. Males are distinguished from other species of *Lepthyphantes* sensu lato by observing the male pedipalp in external lateral (Fig. 1) and ventral (Fig. 2) view, by the club-shaped “lamella characteristica” (lc, Fig. 3), the terminal apophysis divided in two lobes (lta in Figs 1-2), the lack of teeth on the paracymbium (pc, Fig. 4), the



**Figs. 1-5** – *Tenuiphantes sardous* (Gozo, 1908) **n. comb.** (Linyphiidae): ♂ neotype from Grutta de Su Marmuri (Sardinia, Italy): 1, left palp, lateral view; 2, left palp, ventral view; 3, lamella characteristica; 4, paracymbium; 5, male prosoma and chelicerae in frontal view. Abbreviations: ap: apical part of the paracymbium; cy: cymbium; dsa: distal suprategular apophysis; ep: embolus proper; lc: “lamella characteristica”; lta: lobes of the terminal apophysis; pc: paracymbium; pp: proximal part of the paracymbium; ppe: proximal part of the embolus. Scale: 0.1 mm in all illustrations. Illustrations by Alessandro Infuso.



**Figs. 6-8** – *Tenuiphantes sardous* (Gozo, 1908) n. comb. (Linyphiidae): ♀ from Grutta de Su Marmuri (Sardinia, Italy): **6**, epigyne, ventral view; **7**, epigyne, dorsal view; **8**, epigyne, lateral view. Abbreviations: ds: distal part of the scale; eg: entrance groove; ll: lateral lobes; pmp: posterior median plate; ps: proscapus; sb: scapoid base; st: stretcher. Scale: 0.1 mm in all illustrations. Illustrations by Alessandro Infuso.

presence of 3-4 spine-shaped teeth on the proximal part of the embolus (ppe, Figs 1-2). Females are diagnosed by the roughly rectangular proscapus (ps, Fig. 6) with curved edges, wider than long, indented midway at its base and highly protruding in lateral view (Fig. 8).

### Description of the male neotype

Overall size and leg length small. Prosoma 0.984 long, 0.852 wide, light-yellowish. Cephalic region not elevated with a few bristles interspersed among the eyes (Fig. 5). Clypeus 0.162 long, slightly indented under the eyes, then convex, with one bristle just below the head region. Eyes normally developed, with pigment and black margins (Fig. 5). AME smallest. PLE, PME and ALE slightly similar in diameter. ALE and PLE contiguous. PLE–PME distance: 0.049, ALE–AME distance: 0.045, PME–PME distance: 0.056. Eye diameters: AME: 0.041, PME: 0.071, ALE: 0.076, PLE: 0.059. Sternum heart-shaped, yellowish with blackish shades and darker margin. At high magnification a fine pattern of irregular circles is visible. Chelicerae 0.409 long, light brownish, with 18-20 lateral stridulatory ridges and armed with three teeth on the anterior margin of the chelicera: two of them almost contiguous, bigger in size and reaching the fang almost midway and the third smaller

on the proximal part of the cheliceral margin (Fig. 5). On the posterior margin, three-four very small teeth are visible, grouped on the central part of the cheliceral margin. Legs uniformly light yellowish. Leg I: femur 1.63, patella 0.31, tibia 1.67, metatarsus 1.68, tarsus 1.02, TLL 6.31; leg II: femur 1.58, patella 0.29, tibia 1.40, metatarsus 1.54, tarsus 0.93, TLL 5.74; leg III: femur 1.28, patella 0.26, tibia 1.24, metatarsus 1.19, tarsus 0.75, TLL 4.72; leg IV: femur 1.22, patella 0.23, tibia 1.17, metatarsus 1.18, tarsus 0.70, TLL 4.5. Abdomen 1.45 long, 0.994 wide; grey, generally darker than the prosoma, in some specimens very pale, lighter than the prosoma. Palp: femur 0.438, patella 0.115, tibia 0.171, cymbium 0.437. Cymbium faintly convex (cy, Fig. 1), when seen from above the internal margin is regular and the external one bears two faint lobes in its proximal half. Paracymbium U-shaped in lateral view (pc, Fig. 4), unarmed and bearing some hairs on the proximal part (ppc, Fig. 4), apical part gradually narrowed anteriorly (apc, Fig. 4), distal suprategular apophysis directed upwards (dsa, Fig. 1), with a sharp end. Embolus sinuous, horsefish-shaped, its proximal part bearing three-four stout spine-like teeth (ppe, Figs 1-2), thumb well-developed. “Lamella characteristic” club-shaped (lc in Fig. 3), terminal apophysis strongly sclerotized, divided in two lobes (lta, Figs 1-2).

### Description of the female (paratype from Su Marmuri cave)

Similar in most features to male. Prosoma 0.954 long, 0.803 wide. Clypeus 0.162. Eyes normally developed, with pigment and black margins. AME smallest. PLE, PME and ALE slightly similar in diameter. ALE and PLE contiguous. PLE–PME distance: 0.066, ALE–AME distance: 0.060, PME–PME distance: 0.065. Eye diameters: AME: 0.045, PME: 0.061, ALE: 0.067, PLE: 0.061. Chelicerae 0.413 long. Leg I: femur 1.89, patella 0.307, tibia 1.76, metatarsus 1.60, tarsus 1.03, TLL 6.587; leg II: femur 1.82, patella 0.295, tibia 1.62, metatarsus 1.55, tarsus 0.870, TLL 6.155; leg III: femur 1.45, patella 0.284, tibia 1.48, metatarsus 1.56, tarsus 0.732, TLL 5.506; leg IV: femur 1.44, patella 0.280, tibia 1.52, metatarsus 1.41, tarsus 0.769, TLL 5.419. Abdomen 1.69 long, 1.03 wide. Palp: femur 0.363, patella 0.133, tibia 0.235, tarsus 0.439.

Epigynal plate forming a roughly rectangular proscape with curved edges (ps, Figs 6–7), wider than long, indented midway at its base. Lateral plates visible in dorsal view (ll, Fig. 7) only faintly visible in ventral view (ll, Fig. 6). Scape arched in lateral view (Fig. 8), covering entirely the inner part of the epigyne (“languette interne” according to Fage 1919); stretcher tongue-shaped (St, Figs 6–7), short, bearing a pitted knob at its end, clearly visible in ventral view. Fertilisation ducts sclerotized.

### Spination (based on all material examined)

Femur I with one prolateral spine; femur II, III and IV with no spines. Patella I–IV with one dorsal spine. Tibia I with two dorsal, one prolateral, and one retrolateral spines; tibia II with one dorsal, and one prolateral and one retrolateral spines; tibia III and IV with one dorsal and one retrolateral spines. Metatarsus I–IV with one dorsal spine. Position of TmI: 0.16. Trichobothrium on Mt IV absent.

### Taxonomical remarks

In the original description, Gozo (1908) assigned the newly described species to the genus *Leptyphantes* Menge, 1866. In lack of males, the diagnosis was based on the morphology of the epigyne, having a characteristic margin of the “*marginè del tubercolo sporgente*” (presumably the margin of the proscapus) and by the presence of one spine on femur I. The genus assignment was based on the characters provided by Simon’s (Simon 1884) description of *Leptyphantes* (Gozo 1908: 119: “*Infine la mia sàrdoa è sicuramente una Leptyphantes, secondo la descrizione del Simon, perchè presenta esattamente i caratteri del genere*” [Finally, my *sàrdoa* is certainly a *Leptyphantes*, according to Simon’s description, because it shows exactly the feature of the genus]).

The occurrence of males at the type locality together with females allowed to pair the two sexes. Moreover, the match is confirmed by morphological characters shared by

males and females, such as chaetotaxy, cheliceral teeth, stridulatory ridges, abdominal pattern and ocular pattern.

Saaristo & Tanasevitch (1993, 1996) reclassified the genus *Leptyphantes* using a typological approach, examining the morphology of the genital organs, especially males. As a result, most of the European species of *Leptyphantes* were transferred or assigned to new genera. On the other hand, given the lack of males, *L. sardous* was not transferred to any of the newly created genera.

Our finding of the unknown male now allows the placement of this species within the genus *Tenuiphantes* Saaristo & Tanasevitch, 1996. According to the original description, the genus includes small Linyphiids, having in males a sinuous embolus with a dentigerous protrusion on its proximal part (Saaristo & Tanasevitch 1996). Such character is clearly visible in our case (Figs 1–2). Moreover, other details given in the genus description such as chaetotaxy, unmodified cymbium and relatively large paracymbium do match our case. According to the morphology of the male genitalia, *T. sardous* **n. comb.** is similar to *T. alacris* (Blackwall, 1853) and *T. cristatus* (Menge, 1866), showing a similar club-shaped “lamella caratteristica” but lacking teeth on the paracymbium. The female is close to *T. flavipes* (Blackwall, 1854), with a rounded proscape covering the whole median part of the scape.

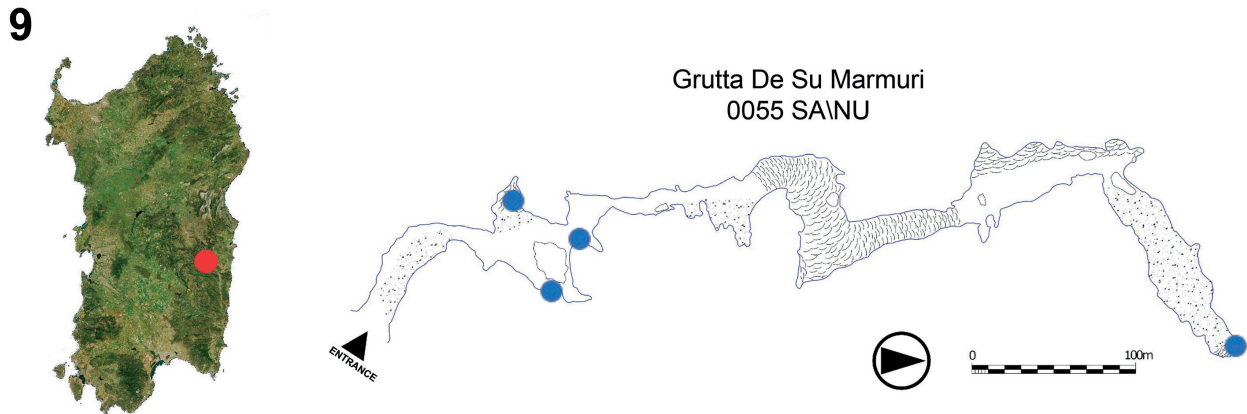
### Ecology and distribution

Specimens of *T. sardous* **n. comb.** have been collected on the cave ground, among rocks in areas mostly covered with guano. At the collection localities, the cave has an almost constant temperature of ~8°C (Cossu 2022, personal communication). In lack of noticeable troglomorphic traits and in accordance with Mammola et al. (2018), we regard the species as troglophile – not a troglobiont as reported by Lana et al. (2016). Interestingly, despite the eyes being normally developed in all specimens (Fig. 5), the abdomen of the specimens collected in the deepest sector of the cave is paler compared to the others. As far as the distribution is concerned, the species is currently known exclusively for the type locality. However, the troglophile habitus and the general lack of arachnological prospections in Sardinian caves suggest a wider distribution on the island.

The Su Marmuri cave is located at 874 m a.s.l. on Tisiddu Mountain (Ulassai, Nuoro province). A huge sinkhole, evidence of an ancient water drainage, gives access to a large, mostly horizontal, underground tunnel (Figs 9–10). The difference in height from the entrance to the sinkhole is approximately 35 m, and the length of the tunnel is about 900 m (Cossu et al. 2022). Su Marmuri cave is a remarkable geoheritage site and a hotspot for the conservation of cave-dwelling fauna, hosting a large winter colony of about 27.000 individuals of the common bent-wing bat *Miniopterus schreibersi* (Chiroptera, Miniopteridae), and several endemic species of subterranean arthropods

such as the beetle *Ovobathysciola gestroi*, the chilopod *Lithobius doderoi* (see Graffiti 2009). The cave opened to tourism in the mid-1950s and through the years has become an important tourist attraction, with approximately 15.000 tourists/year visiting the cave from May to October. In light of the biological and geological characteristics of the cave and the concurrent pressure of tourism, an environmental monitoring program of Su Marmuri cave started in 2021, in the framework of the research project

of national relevance “Showcave”. Data shows how the presence of tourists in the cave during summer does not alter the cave microclimate (Cinus et al. 2021; Cossu et al. 2022). Moreover, tourist facilities inside the cave do not seem to have any significant effect on the cave ground that could potentially alter the species habitat. In general terms, the current management of the cave as a tourist attraction does not seem to have negative effects on the survival of this endemic species.



**Figs. 9-12** – Su Marmuri cave (Ogliastra, Sardinia). **9**, Geographic location in Sardinia (red dot) and cave map with occurrence points of *Tenuiphantes sardous n. comb.* (blue dots). **10**, The sinkhole that gives access to the cave. **11-12**, Alive male specimens of *Tenuiphantes sardous n. comb.* Photographs by Alessandro Infuso (11) and Marco Isaia (12). Cave map was obtained from Catasto Speleologico Regionale Sardegna, available online at [www.catasto-speleologicoregionale.sardegna.it](http://www.catasto-speleologicoregionale.sardegna.it).

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