

## *Massonia mimetica* (Hyacinthaceae, Hyacinthoideae), a new remarkable species from South Africa

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**Abstract:** As part of a taxonomic revision of the genus *Massonia* HOUTT., a new species, *Massonia mimetica* MART.-AZORÍN, M. PINTER, M.B. CRESPO & WETSCHNIG, is here described from South Africa. This new species is at first sight related to *M. echinata* L.f., but it differs in floral and vegetative characters as well as in its ecology and distribution. A complete description of the new species and data on biology, habitat, and distribution are presented.

**Zusammenfassung:** Als Teil der taxonomischen Revision der Gattung *Massonia* HOUTT. wird *Massonia mimetica* MART.-AZORÍN, M. PINTER, M.B. CRESPO & WETSCHNIG aus Süd-Afrika neu beschrieben. Auf den ersten Blick ist diese neue Art mit *M. echinata* L.f. verwandt, unterscheidet sich davon aber sowohl in Blüten- und vegetativen Merkmalen als auch in ihrer Ökologie und Verbreitung. Eine komplette Beschreibung der neuen Art sowie Daten zu Biologie, Habitat und Verbreitung werden präsentiert.

**Key words:** Asparagaceae, Flora of Southern Africa, Massonieae, Scilloideae, Taxonomy.

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### Introduction

The family Hyacinthaceae (sensu APG 2003) consists of about 1000 species of bulbous plants. They are mainly distributed in Africa and Europe extending to Asia, with a single small genus –*Oziroë* RAF.– in South America (SPETA 1998a, b, APG 2003). Within this family four monophyletic clades are accepted as the subfamilies Hyacinthoideae, Ornithogaloideae, Oziroëoideae and Urgineoideae (SPETA 1998b, PFOSSER & SPETA 1999, MANNING et al. 2004, MARTÍNEZ-AZORÍN et al. 2011). Alternatively Hyacinthaceae is treated as Asparagaceae subfamily Scilloideae, and consequently the former subfamilies are reduced to the tribes Hyacintheae, Ornithogaleae, Oziroëeae and Urgineae (APG 2009, CHASE et al. 2009). However, we favour Hyacinthaceae based on morphological grounds.

The subfamily Hyacinthoideae is divided into three tribes: Massonieae, Pseudoprosperae and Hyacintheae. The former ones are distributed through sub-Saharan Africa, the Arabian

Peninsula to India, while the latter occurs in Eurasia and northern Africa (SPETA 1998a, b, WETSCHNIG et al. 2002, PFOSSER et al. 2003, MANNING et al. 2004). The generic circumscription within the tribe Massonieae seems to be not well established, and some novelties and changes have been recently proposed. Two new genera –*Namophila* U.MÜLL.-DOBLIES & D.MÜLL.-DOBLIES (MÜLLER-DOBLIES & MÜLLER-DOBLIES 1997) and *Spetaea* WETSCHNIG & PFOSSER (WETSCHNIG & PFOSSER 2003)– were recently described and some other genera were lumped in broader generic concepts –e.g. *Brachyscypha* BAKER, *Polyxena* KUNTH, and *Periboea* KUNTH into *Lachenalia* J.JACQ. ex MURRAY (MANNING et al. 2004); *Drimiopsis* LINDL. & PAXTON and *Resnova* VAN DER MERWE into *Ledebouria* ROTH (MANNING et al. 2004); *Androsiphon* SCHLTR., *Amphisiphon* W.F.BARKER and *Neobakeria* SCHLTR. into *Daubenya* LINDL. (MANNING & VAN DER MERWE 2002); and *Whiteheadia* HARV. into *Massonia* HOUTT. (cf. MANNING et al. 2004, 2011)–. It is worth mentioning that the recent lumping of genera cited above were mainly

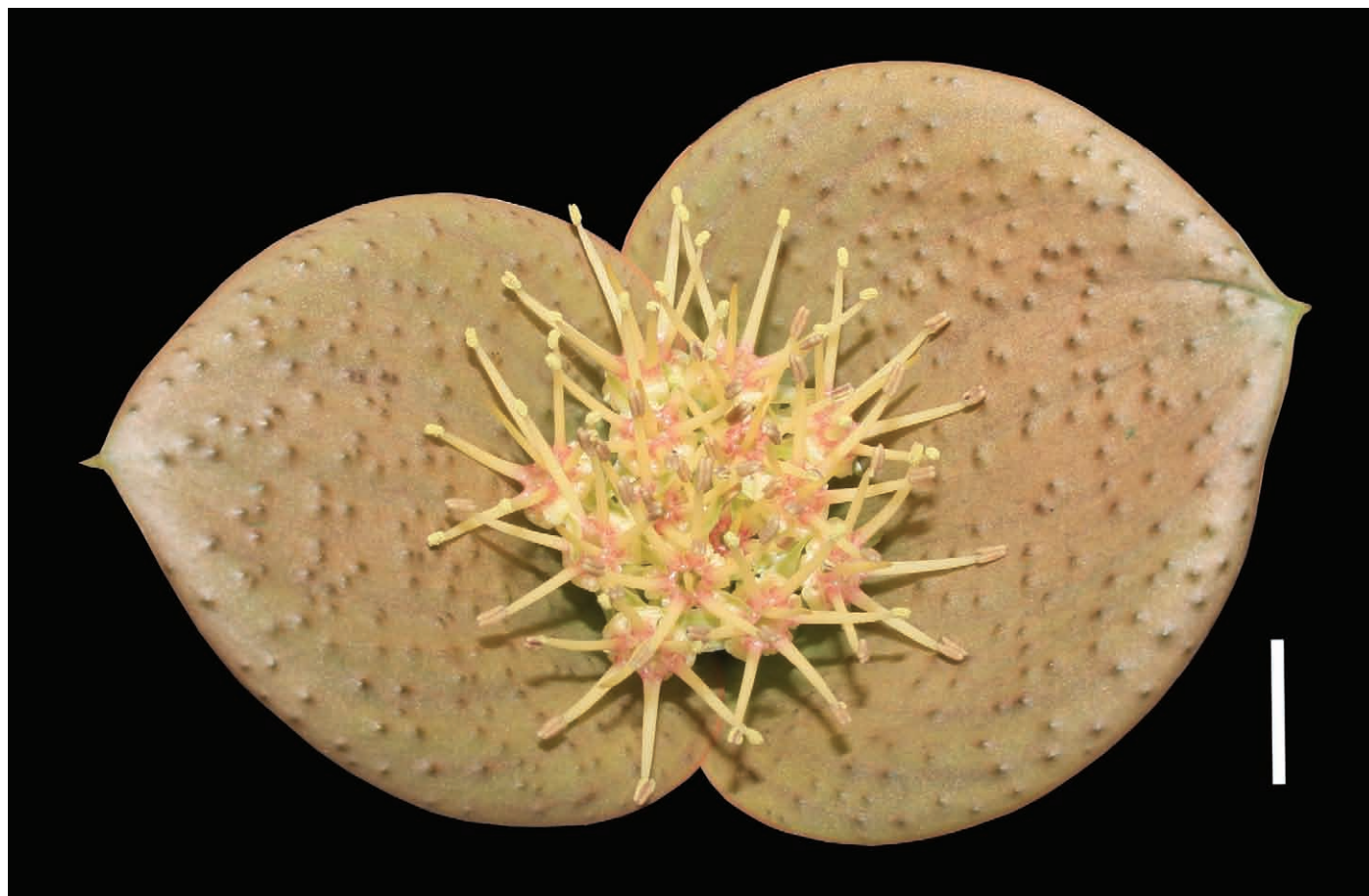


Fig. 1: *Massonia mimetica* MART.-AZORIN et al. Flowering plant in cultivation, apical view. Scale bar 1 cm.

based on preliminary and incomplete phylogenetic studies. In any case, the taxonomy and systematics of the subfamily is far from being well understood, and the inventory of species within the Massonieae is not yet finished.

The genus *Massonia* was based on a specimen that Carl Peter Thunberg sent to the Botanical Garden in Amsterdam (HOULTUYN 1780). In the beginning, the new genus included a single species, *Massonia depressa* HOUTT. With the continuous exploration of South Africa, the number of species quickly increased until BAKER (1897) accepted 33 species in his treatment of the genus in *Flora Capensis*. In more recent studies the number of species varies from only 6 (VAN DER MERWE 2002, MANNING & GOLDBLATT 2003, SUMMERFIELD 2004), to 8 (JESSOP 1976), to 12 (MÜLLER-DOBLIES & MÜLLER-DOBLIES 1997) up to 14 (SPECIES-2000 2013).

Up to now, ca. 80 species have been included in the genus *Massonia* (IPNI 2013), from which about 60 fit into its recent concept, whereas the others belong to genera such as *Daubenyia*, *Lachenalia*, *Polyxena* or *Whiteheadia*. All of them are distributed in South Africa and the southwestern part of Namibia.

Our studies in *Massonia* during the last decades evidence that the taxonomy of the genus is far from being satisfactory and several species concepts have been overseen and misunderstood by most recent researchers in the group (PINTER et al. 2013). A good example of this problem was shown by WETSCHNIG et al. (2012) with the correct identification of *M. pustulata* JACQ. and the replacement of *M. pustulata* auct. non JACQ. with *M. longipes* BAKER. Furthermore, it is evident that the very widely circumscribed species concepts accepted in recent revisions of the genus include several biological entities characterized by clear morphological, ecological and biogeographical differences. In many cases these biological entities correspond to currently described species accepted as synonyms of these widely circumscribed species.

After studying wild plants in South Africa, at first sight related to *M. echinata* L.f. sensu MÜLLER-DOBLIES & MÜLLER-DOBLIES (1997), distinct morphological and ecological differences support the description of a new species, *Massonia mimetica*, as shown below.

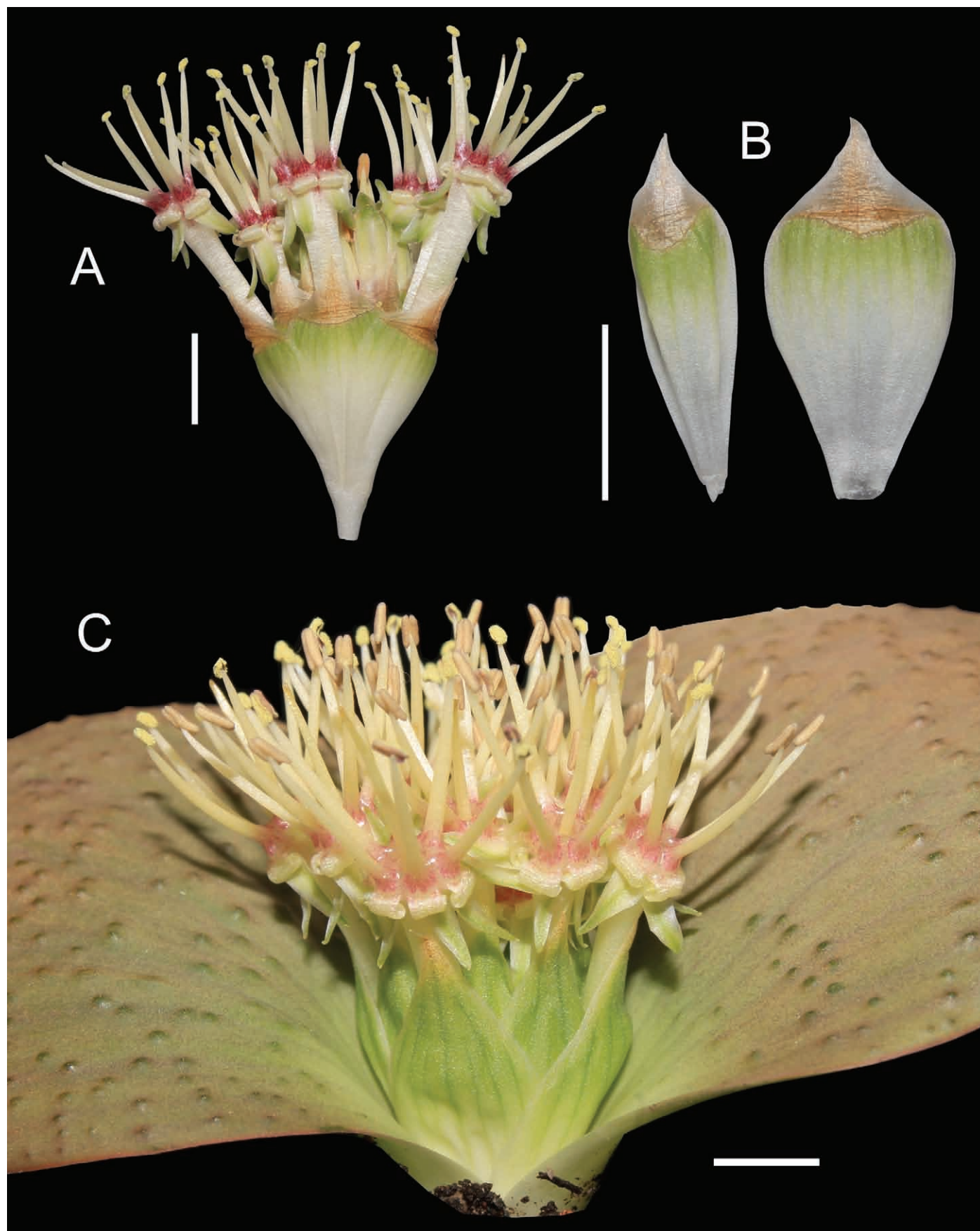


Fig. 2: *Massonia mimetica* MART.-AZORIN et al. A. Inflorescence, lateral view; B. Bracts, lower bract on the right and upper bract on the left; C. Flowering plant in cultivation, lateral view. Scale bars 1 cm.





**Fig. 3:** Flower morphology and their stages of development in *Massonia mimetica* MART.-AZORIN et al. A. Mature flower in apical view; B. Flower in bud, lateral view; C. Flower after opening, lateral view; D. Open flower with spreading perianth segments, lateral view; E. Mature flower with dehiscent anthers and enrolled and sigmoid perianth segments. Scale bars: A. 5 mm; B-E. 1 cm.

## Materials and Methods

Detailed morphological studies based on plants from natural populations and cultivated plants (as detailed in MARTÍNEZ-AZORIN et al. 2007, 2009) of *Massonia mimetica* were undertaken. Plants were cultivated in a greenhouse and flowered in Grahamstown, South Africa. Measurements of the leaves, capsules and seeds were performed from material collected in the wild and from cultivated material. Morphological measurements of flower parameters were performed on fresh material from cultivated plants. It has been proved that flowers obtained

in a greenhouse keep the size and proportions of in situ flowers, as they are addressed to the fixed size of their pollinators (MÜLLER-DOBLIES & MÜLLER-DOBLIES 2002, WETSCHNIG et al. 2012, PINTER et al. 2013). For SEM-micrographs of the leaf-surface an  $8 \times 5$  mm section of one leaf was fixed in 70% ethanol. After substitution of ethanol by acetone critical point drying was performed using a Baltec CPD030. The leaf then was mounted on aluminium stubs and coated with gold in an Agar sputter coater. Electron micrographs were obtained with a Philips XL 30 ESEM scanning electron microscope (SEM) operating at 20 kV. Specimens examined are shown in Table 1. Herbarium specimens were studied from the herbaria ABH, GZU, GRA,



**Fig. 4:** Dissected flowers of *Massonia mimetica* MART.-AZORIN et al. A. Dissected flower in bud, lateral view; B. Dissected mature flower, lateral view. Scale bar 1 cm.

LI (acronyms according THIERS 2013). Authorities of the cited taxa follow IPNI (2013). *Massonia echinata* L.f. is treated in the sense of MÜLLER-DOBLIES & MÜLLER-DOBLIES (1997).

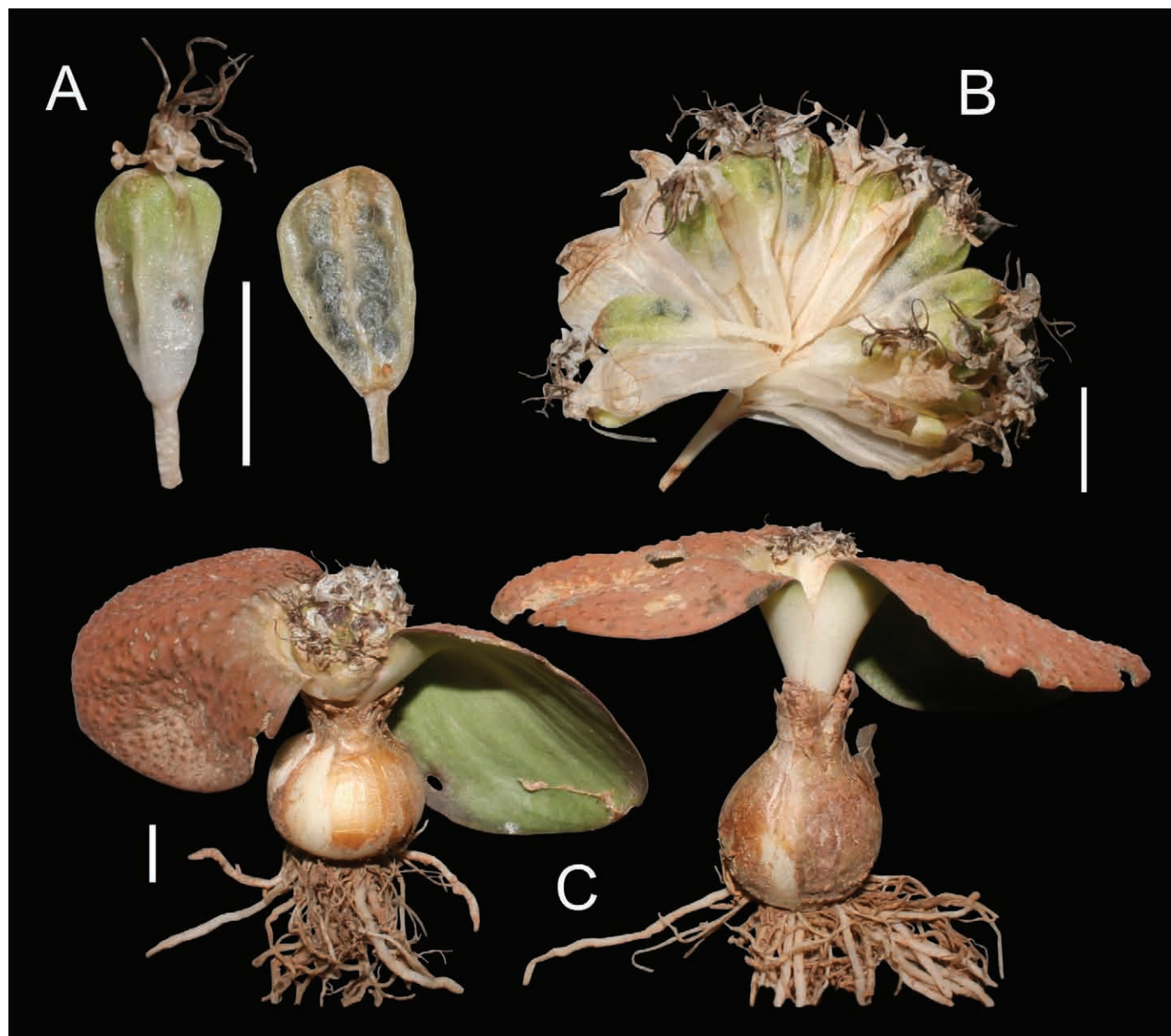
## Results and Discussion

### *Massonia mimetica* MART.-AZORIN, M. PINTER, M.B. CRESPO & WETSCHNIG, spec. nov. (Figs. 1-9)

Planta herbacea perennis. Bulbus ovoideus, tunicatus, ca. 25 mm diam., tunicis papyraceis brunneis vestitus. Folia 2, coae-tanea, decidua, ovoidea vel subrotunda, 3.5-10 cm longa et

3-9 cm lata, ad solum adpressa, supra cinnamomea, pustulata (pustulas pilis destitutas), subtus viridula. Perigonium cremeo-album ad pallide luteolum. Tubus perigonii 6-15 mm longus et 2.5-4 mm diam., fauce purpurea. Segmenta reflexa, sigmoidea 6-9 mm longa et 1.5-2 mm lata. Filamenta crassiuscula, attenuata, cremeo-albida ad pallide luteola, 6-13 mm longa, in tubum rubro-maculatum (1-2 mm altum), faucem 6-gibbosum, a basi connata. Antherae statu clauso ca. 2-2.5 mm longae, oblongae. Ovarium 2-2.5 mm diam. et 3-4.5 mm altum. Stylus cremeo-albus ad pallide luteolus, 11-20 mm longus.

Ab *Massonia echinata* similis, sed illa praecipue differ foliis supra cinnamomeis, pustulatis (10-25 pustulis pro cm), pilis destitutis, subtus viridulis; filamentis supra tubo periantico a basi connatis et purpureo maculatis, et antheris pallide aurantiacis purpureo sparsis.



**Fig. 5:** *Massonia mimetica* MART.-AZORIN et al. (from material collected in the wild). A. Capsules; B. nearly fully developed infructescence; C. Plants showing leaf colours on both sides. Scale bars 1 cm.

**Type:** SOUTH AFRICA. Northern Cape, Kamiesberg (3018AD): ca. 40 km east of Leliefontein, near Platbakkies settlement, 1059 m, deep red sandy soil, 29/08/2011 in fruit, M. Martínez-Azorín, A. Martínez-Soler & R. McKenzie MMA732 (holotype: GRA; isotypes: ABH, GZU, K).

Herbaceous perennial plant. Bulb ovoid to subglobose and slightly depressed, ca. 20–30 × 20–25 mm, inner scales fleshy and white, outer tunics papery and brownish. Leaves 2, deciduous, opposite, spreading and appressed to the ground, synanthous, ovoid to suborbicular with obtuse apex, with a short apicule 1–2 mm long, (3.5)5–9(10) × (3)4–8(9) cm, narrowed into

a petiole 10–20 × 12–20 mm that clasp the stem, dark orange, pale brown or cinnamomeus in colour on the adaxial side and green on the abaxial side, glabrous with entire margins, with emergences only on the adaxial side, with 10–25 slightly asymmetrical emergences/cm<sup>2</sup>, ca. 1–2 mm in diam., without typical hairs but with a conspicuous short obtuse conical cell (ca. 150 μm diameter) on top. Inflorescence a dense, subcapitate raceme, up to 1–3 cm long, with (12)18–31 flowers, shortly overtopping ground level. Bracts membranous, green in the upper half and white below, with darker green venation, translucent after flowering, sometimes flushed with pink, glabrous with entire margins, acuminate; lower bracts obovate, 19–36(40) × 8–18 mm;





Fig. 6: *Massonia mimetica* MART.-AZORIN et al. in habitat at the type locality. Scale bars 1 cm.

upper bracts narrowly obovate, (20)24–30 × 6–10 mm. Pedicels of flowers 5–14 mm, 6–16 mm in fruit. Flowers tubular. Perigone cream-white to pale-yellow, free segments (6)7–8(9) × 1.5–2 mm, with a green central band mostly visible on the upper portion, first straight and erect, later spreading and finally reflexed, folded and spirally curled in at the base at anthesis. Perigone-filaments tube (6)9–15 × 2.5–4 mm, cylindrical or slightly widening at the upper portion, tinged with reddish above the segments insertion. Filaments cream-white to pale-yellow, tinged with reddish at the base, (6)7–13 mm long, connate at the base for 1–2 mm above the perianth segments, with 6 gibbositities at the mouth of the tube, rather fleshy and thickened, suberect to spreading, straight, attenuate; anthers ca. 2–2.5 mm long when closed, oblong, pale orange with a red flush or rarely purplish-bluish before opening, dorsifixed. Ovary ovoid, pale orange, 3–4.5 × 2–2.5 mm, gradually tapering into the style. Style cream-white to pale-yellow, thickened, gradually tapering to the apex, (11)14–20 mm long, ending about at the same level

than the stamens. Capsule (6)10–14 × (4)5–8 mm, obovate, with concave valves. Seeds subglobose, black, ca. 1.5–1.8 × 1.3–1.6 mm, from smooth to rugose depending on the stage of development (Figs. 1–9).

Species similar to *Massonia echinata*, but readily distinguishable from the former by the cinnamon-coloured leaves with about 10–25 slightly asymmetrical emergences/cm<sup>2</sup>, ca. 1–2 mm in diam. without typical hairs but with a conspicuous short obtuse conical cell on top, the filaments-tube of 1–2 mm and flushed with red in the basal parts, and the anthers pale orange with a red flush or purplish-bluish. (Table 2, Figs. 1–9).

Etymology: Named after the mimicry effect that the cinnamon-coloured and pustulate upper side of leaves produce with the equally coloured sandy soils where the new species grows (mimeticus, -a, -um = mimetic, showing mimesis of the environment) (Fig. 6).

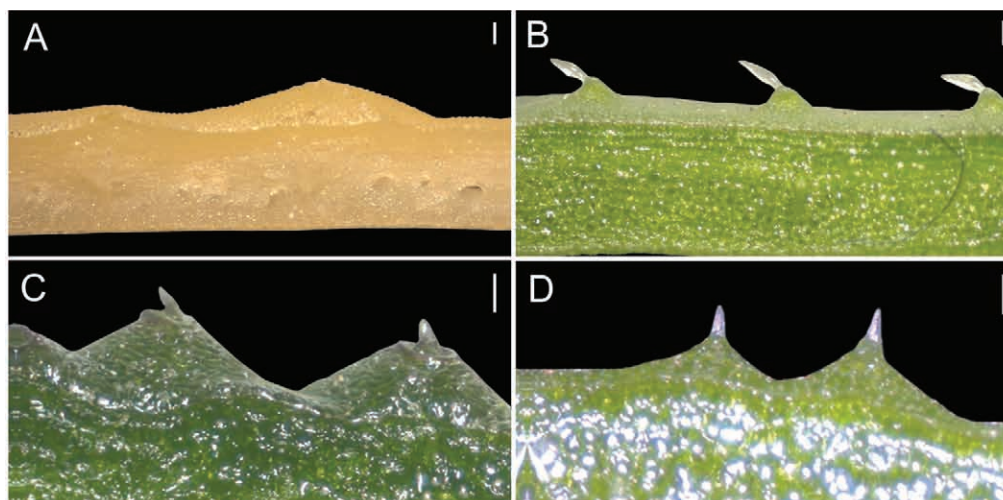


**Table 1.** List of investigated taxa in the present study, with voucher and locality information. All vouchers are deposited at ABH, GRA, GZU and LI herbaria. Abbreviations: MMA = Mario Martínez-Azorín; WW = Wolfgang Wetschnig.

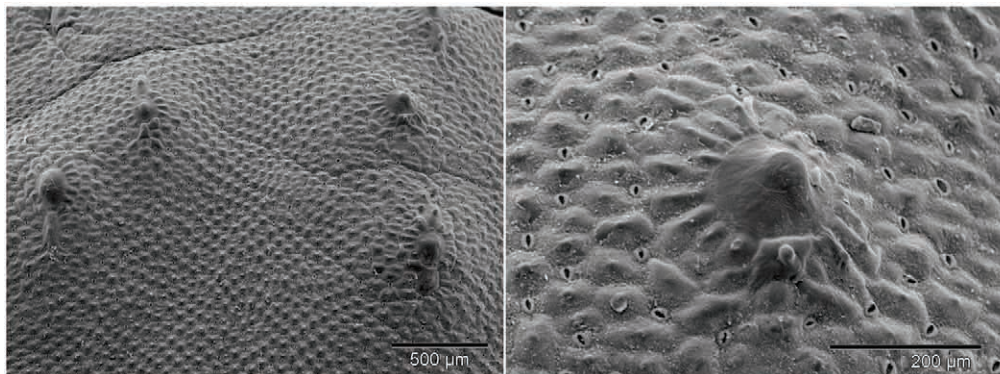
Taxon	Voucher	Locality
<i>Massonia mimetica</i> Mart.-Azorín et al.	MMA732	ZAF: Platbakkies
<i>Massonia echinata</i> L.f.	WW03970	ZAF: Vanrhyn's Pass
<i>Massonia pustulata</i> Jacq.	WW01140	ZAF: Swellendam
<i>Massonia pustulata</i> Jacq.	WW03984	ZAF: Napier
<i>Massonia longipes</i> Baker	WW03979	ZAF: Cape Infanta
<i>Massonia longipes</i> Baker	WW03983	ZAF: DeHoop, Koppie Allen



**Fig. 7:** Seeds of *Massonia mimetica* MART.-AZORIN et al. Scale bar 1 mm.



**Fig. 8:** Comparison of leaf emergences in lateral view in four species of *Massonia* (A. *M. mimetica*; B. *M. echinata*; C. *M. longipes*; D. *M. pustulata*). A from fixed material, B-D from fresh material. Scale bars 0.2 mm.



**Fig. 9:** SEM image of leaf surface in *Massonia mimetica* MART.-AZORIN et al. showing emergence morphology.



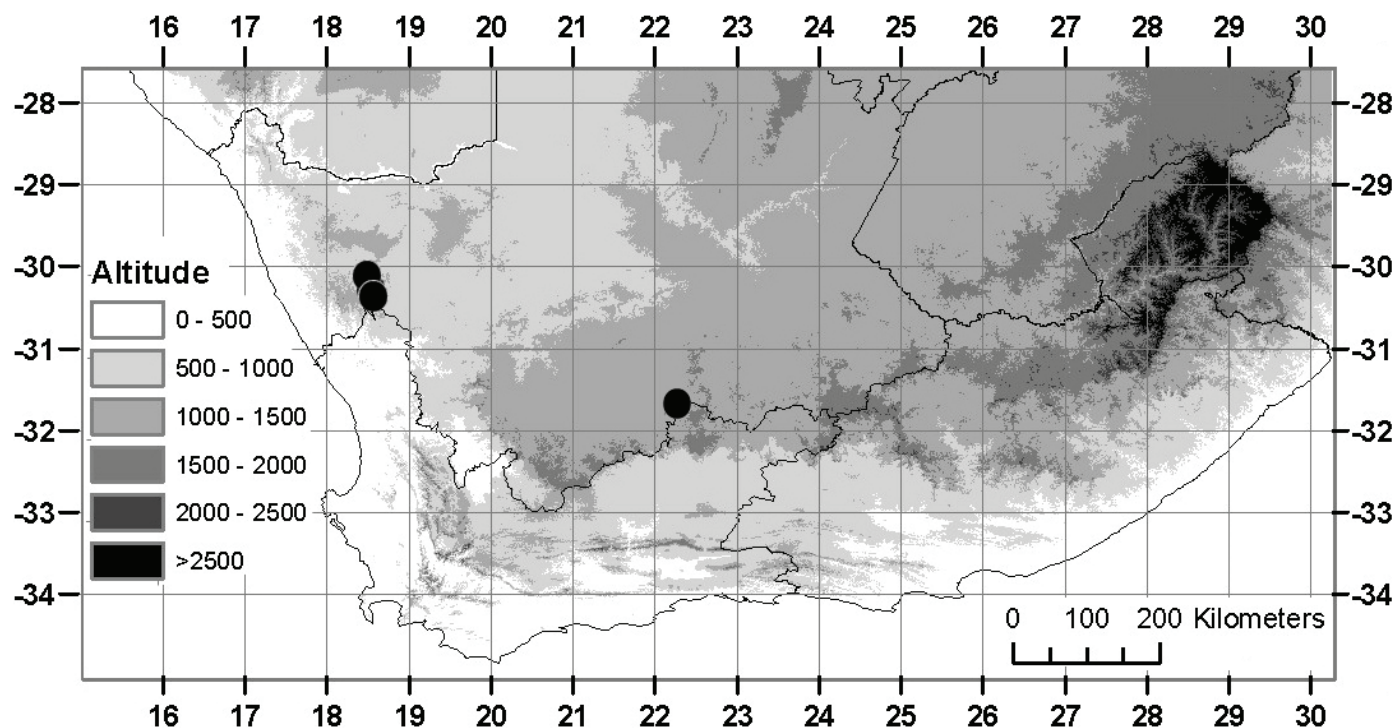


Fig. 10: Known distribution of *Massonia mimetica* MART.-AZORIN et al.

**Biology:** Leaves appear after the late summer thunderstorms and flowers are produced in late autumn and early winter, from May to July. Fruits appear in winter from July to August and capsules dehisce in late August–September.

**Habitat:** *Massonia mimetica* grows in deep, red sandy soils with scattered little stones. All known populations are located at high elevations in inland plateaus at elevations ranging from 900 and 1300 m, in rain-shadow locations with remarkable arid environments.

Two populations inland of the Kamiesberg (near Platbakkies and Kamiebes) are found in the Succulent Karoo biome, Namaqualand Hardveld bioregion and Platbakkies Succulent Shrubland (SKn5) vegetation unit (sensu MUCINA & RUTHERFORD, 2006). This region shows a seasonal winter-rainfall climate with a shallow peak from May to August. About a third of the annual rainfall (slightly above 100 mm, ranging from 80 to 120 mm) arrives as late summer thunderstorms. Mean annual temperature is about 16°C and mean maximum and minimum monthly temperatures in Platbakkies are 37°C and -3°C for January and July respectively, having around 20–40 days of frost per year (cf. MUCINA & RUTHERFORD, 2006).

The third known population, SE of Loxton, is located in the Nama-Karoo biome, Upper Karoo bioregion and Eastern Upper Karoo (NKu4) vegetation unit (sensu MUCINA & RUTHERFORD, 2006). Rainfall occurs mainly in summer and autumn, peaking in March, with a mean annual rainfall about 180 mm. Incidence of frost is relatively high, but ranging from <30 days in the lower altitudes to >80 in the upper parts of the mountains. Mean maximum and minimum monthly temperatures are ca. 36°C and -7°C for January and July respectively.

**Distribution:** Known to us only from three localities in two regions of the Northern Cape Province of South Africa. Two populations are located inland to the Kamiesberg, near Platbakkies settlement and Kamiebes, and the third one is placed about 400 km apart to the SE, between Fraserburg and Loxton, in the Sakrivierspoort farm (Fig. 10). It is worth mentioning that two populations are located near the Western Cape Province, especially the latter that is placed just ca. 500 m from its border. Plants of *M. mimetica* are expected to be also found in the Western Cape Province.

### Diagnostic characters and relationships

*Massonia mimetica* can be easily distinguished from all other species in the genus by the combination of cinnamon-coloured leaves with about 10–25 slightly asymmetrical emergences/cm<sup>2</sup>, ca. 1–2 mm in diameter, without typical hairs but with a conspicuous short obtuse conical cell on top (Figs. 8–9), the strongly reflexed perianth-segments, folded and spirally curled in at the base at anthesis, the filaments-tube (1–2 mm long) flushed with red in the basal parts (above the insertion of the perianth-segments) and the anthers pale orange with a red flush or purplish-bluish (Figs. 1–4). Its closest known relative appears to be *M. echinata*, but the latter differs by the green leaves with smaller cone-shaped emergences bearing an asymmetrically inserted, thickened, declinate trichome on top (Fig. 8), the inconspicuous or absent filaments-tube, which is white in colour, the bluish-grey anthers, and the moister habitats (Table 2). Other species also show leaves with emergences, such as *M. longipes* or *M. pustulata*, but the latter two species show leaves with more numerous emergences (27–170 emergences/cm<sup>2</sup>) bearing a tri-

**Table 2.** Comparison of main characters of 6 selected specimens of *Massonia*.

	<i>M. mimetica</i>	<i>M. echinata</i>	<i>M. pustulata</i>	<i>M. longipes</i>		
	(MMA732) Platbakkies	(WW03970) Vanrhyn's Pass	(WW01140) Swellendam	(WW03984) Napier	(WW03979) Infanta	(WW03983) DeHoop
Leaf length (cm)	(3.5)5–9(10)	13.5	10	11.5	9	12
Leaf width (cm)	(3)4–8(9)	8	12	13	11	12
Leaf colour	orange-brown	green	green	green	green	green
Emergences number/cm <sup>2</sup>	10–25	0–12	170	115	27	36
Emergences diameter (mm)	1–2	0.3–0.4	0.5	0.7	1.1	1.1
Perigone-filaments tube length (mm)	(6)9–15	(8–)11(–14)	12	15	12	10
Perigone-filaments tube width (mm)	2.5–4	(2–)4	5×7	9	5	5
Filaments-tube/apex of perigone-filaments tube colour	flushed of red	white	bluish-green	bluish-green	pink	light pink
Filament length (mm)	(6)7–13	(9–)12	16	17	17	15
Filaments-tube length (mm)	1–2	0–0.5	3	3	2	2
Gibbositities at the mouth of the filaments-tube	6	6	Absent	Absent	Absent	Absent
Anther length before opening (mm)	2–2.5	2	3	3	1	2
Anther colour	pale orange with a red flush or purplish-bluish	bluish-grey	yellow	yellow	yellow	yellow
Ovary length (mm)	3–4.5	(4–)5(–10)	6	7	6	5
Ovary width (mm)	2–2.5	2	4	4.5	4	3
Style length (mm)	(11)14–20	(14–)15(–20)	19	15	22	23

chome on top (Fig. 8), pink or bluish-green longer filament tubes (2–3 mm long), and ovaries abruptly narrowed at the apex connecting to the filiform style (Table 2).

It is worth mentioning that *Massonia cordata* JACQ., a species described and illustrated by JACQUIN (1804), resembles in some respects to *M. mimetica*, especially regarding the inflorescence, flower colouring and morphology. However, *M. cordata* clearly differs from *M. mimetica* by its green, not pustulate leaves and the ovaries abruptly narrowed at the apex connecting to the filiform style, among other characters (cf. JACQUIN 1804).

### Molecular data

Our preliminary phylogenetic studies (not shown) place *Massonia mimetica* close to *M. echinata*, which accords with their similar flower morphology. A more complete sampling of *Massonia* including a higher number of taxa and additional markers is in preparation (WETSCHNIG et al. in prep.).

### Other materials examined:

South Africa. Northern Cape: Kamiesberg (3018AD): ca. 40 km east of Leliefontein, north of Platbakkies settlement, 1059 m, deep red sandy soil, 26/07/2013 in fruit, W. Wetschnig (GZU photo!); Kamiesberg (3018AB): S of Gamoep, Ka-

mieebes, 940 m, photo!; Loxton (3122CC): ca. 70 km NNW of Beaufort West, SW of Loxton, Sakrivierspoort farm, adjacent to the Sak river, 31°49'21''S 22°10'14''E, edge of riparian vegetation, base koppie on floodplain, 1339 m, 14/05/2013 in flower, Bonnies (iSpot Photo!, <http://www.ispot.org.za/node/198679#comment-99442>).

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