Status and redescription of *Rossmaessleria scherzeri*, an overlooked land snail endemic on Gibraltar, with notes on *R. olcesei* and other Moroccan species of *Rossmaessleria* (Gastropoda: Helicidae)

Estatus y redescripción de *Rossmaessleria scherzeri*, un inadvertido caracol terrestre endémico de Gibraltar, con notas sobre *R. olcesei* y otras especies marroquíes de *Rossmaessleria* (Gastropoda: Helicidae)

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ABSTRACT

Rossmaessleria scherzeri was named as a new species from Gibraltar in 1867, then cited repeatedly and illustrated in the literature up to 1904. Subsequently, except for passing mentions in 1976 and 1982 it has usually been overlooked, resulting in its omission from local and European lists of threatened species. In 2006 it was dismissed as a dubious taxon, probably synonymous with *Iberus marmoratus*. We report the "rediscovery" of the species at Gibraltar in 2015 and redescribe and illustrate it, showing differences from *Iberus marmoratus* (with which it coexists) and giving the first account of its genital anatomy, which reaffirms the generic allocation. The genus has otherwise been known from nine taxa restricted to NW. Morocco, from which the genital anatomy has been described for three taxa. In addition, we provide the first descriptions of the genitalia of *R. olcesei*, redescribe its shells, report additional localities and comment on variation in its shell characters.

RESUMEN

Rossmaessleria scherzeri fue nombrada como nueva especie de Gibraltar en 1867, citada e ilustrada en varias ocasiones en la literatura hasta 1904. Posteriormente sólo ha sido mencionada en 1976 y en 1982, ya que normalmente ha pasado desapercibida, habiendo sido omitida en las listas locales y europeas de especies amenazadas. En 2006 fue descartado como taxón dudoso, probablemente sinónimo de *Iberus marmoratus*. Presentamos el "redescubrimiento" de la especie en Gibraltar en 2015 y se redescribe e ilustra, mostrando las diferencias con *Iberus marmoratus* (con el que coexiste) y dando por primera vez datos de su genitalia, la cual confirma su atribución genérica. El género es conocido por otro lado gracias a nueve taxones restringidos al noroeste de Marruecos, de los cuales se han descrito los aparatos genitales de tres de ellos. Además proporcionamos las primeras descripciones de la genitalia de *R. olcesei*, se redescriben sus conchas, se reportan nuevas localidades y se comentan los caracteres de la variabilidad de su concha.

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INTRODUCTION

Helix Scherzeri was named and described from Gibraltar by Zelebor (in Pfeiffer & Zelebor, 1867), and subsequently described and figured in several publications, including Hidalgo (1875, 1884: pl. 40), Tryon (1888: 212, pl. 60) and authoritative illustrated reviews of the species-group by Kobelt (1881c, 1882). Although its name has been cited occasionally in recent decades (Norris, 1976: 496; Bartolomé, 1982: 2), there are no reports of the species being refound or sought after and the taxon appears to have been overlooked in most of the modern literature.

The Biodiversity Action Plan for Gibraltar (Perez, 2006), Schedule 3 of the Nature Protection Ordinance, 1991 (see Menez, 2005) and the *European Red List of non-marine Molluscs* (Cuttelod, Seddon & Neubert, 2011) cover the other scarce and near-endemic land snails of Gibraltar, *Acicula norrisi* Gittenberger & Boeters, 1977 and *Oestophora calpeana* (Morelet, 1854), but there is no mention of *R. scherzeri*. Although the CLECOM Supraspecific Classification of European non-marine Mollusca (Bank, Bouchet, Falkner, Gittenberger, Hausdorf, von Proschwitz & Ripken, 2001: 102) included the genus *Rossmaessleria* P. Hesse, 1907, and Schileyko (2006: 1806) included "S. Spain" in addition to Morocco in the range of that genus, the Fauna Europaea checklist of Iberian gastropods (Bank, 2011) omitted both genus and species, apparently in error. Finally, Talaván Gómez & Talaván Serna (2006: 38) refer to it under *Iberus gualterianus marmoratus* as: "controvertida especie citada de Gibraltar, de cuyo status taxonómico se duda. A nuestro juicio, este taxón podría tratarse en efecto de *I. gualterianus marmoratus* por el gran parecido entre nuestros ejemplares y los referidos por Hidalgo (1875: lám. 40) a *H. scherzeri* ..." [i.e., they regarded it as a controversial species of doubtful taxonomic status, in their judgment best regarded as a form of *Iberus marmoratus* (A. Férussac, 1821), which is well known on Gibraltar; the taxonomic treatment of *I. marmoratus* being revised by us to follow Elejalde, Madeira, Arrébola, Muñoz & Gómez-Moliner, 2008a, Elejalde, Madeira, Muñoz, Arrébola & Gómez-Moliner, 2008b and Bank & Luijten, 2015]. Nevertheless, the suggestion that it is the same as *Iberus marmoratus* conflicts with Kobelt's (1883: 7) report that both occur in quantity on Gibraltar and that *H. scherzeri* "is easily distinguishable from *H. marmorata* by the white peristome".

Dissatisfaction over the apparent "disappearance" of this species from the literature led JSTA, FEVT and VMS to search for it on Gibraltar in January 2015. The species was relocated living in good numbers in deep crevices of limestone high on the rock (as reported by Kobelt) and a few specimens were collected. It was living with or very close to *Iberus marmoratus*, being different from it in shell characters (Fig. 1B cf. 1A), and thus immediately removing any doubt that it is specifically distinct from that species. Specimens were sent to DTH and GAH for anatomical study and comparisons with Moroccan *Rossmaessleria*.

This paper therefore reports the "rediscovery" of the population of *R. scherzeri* on Gibraltar with notes on its habitat and ecology, redescribes the shell characters and describes the hitherto unknown genital anatomy. Hesse (1915) provided good accounts and figures of jaws, radulae and genital anatomy for three *Rossmaessleria* species, *R. sicanoides* (Kobelt, 1881), *R. sultana* (Morelet, 1880) and *R. tetuanensis* (Kobelt, 1881). In order to broaden the basis for comparisons with *R. scherzeri*, we take the opportunity to redescribe shells of the poorly known *R. olcesei* (Pallary, 1899), describe its genital anatomy for the first time, and present new distributional records of it and comments on geographical variation in its shell characters. We also present new anatomical and other data on *R. tetuanensis*. The genital anatomy is thus now known from five of the ten nominal taxa that appear to have been correctly placed as species of *Rossmaessleria* (see Fig. 3 and its legend for

list of the taxa and a distribution map). A reconsideration of the relationships of *Rossmaessleria* to other genera of Helicinae and of species and subspecies limits in the genus will be the subjects of separate publications.

MATERIAL AND METHODS

Samples of shells and specimens preserved in alcohol were collected in the field in August 1984 and June 1986 in Morocco and January 2015 on Gibraltar by direct searching around crags and other rocky habitats, seeking living animals resting in crevices or under boulders. Adult shells were recognisable because of the reflected lip of the peristome, allowing selection of adult shells for measurement and mature specimens for dissection of genitalia. Measurements of shell breadth and height and counts of whorls followed the methods illustrated by KERNEY & CAMERON (1979: 13). Measurements of some shells were made with vernier callipers; those of breadth being accurate to within ± 0.05 mm, those of height were less precise because the greatest height of the shell is widely offset from the columellar axis, so shell orientation affects the measurement. Other shells were measured accurately to ± 0.25 mm. The genital anatomy was studied from the same material, dissection being carried out using Meiji RZ Series stereo-microscopes and drawings prepared with a Meiji drawing tube.

The basic pattern of the genital anatomy in *Rossmaessleria* is closely similar in all five species for which it is known. To avoid repetition it is therefore described here, only the possible differences between species being discussed below under the species headings. For all of them, study of larger numbers of specimens than are currently available will be necessary to check the extent to which any consistent differences exist between the species. In descriptions of the genital anatomy the terms proximal and distal refer to lesser and greater distances from the gonad.

The genitalia is of semidiaulic monotrematic type. The gonad (ovotestis) is branched, giving rise to a long contorted first hermaphrodite duct functioning as a seminal vesicle, which ends in a small talon. The albumen gland is large and long; the spermoviduct (second hermaphroditic duct) arises from its distal end, consisting of a female channel (with a seminal groove) and prostate gland fused to define a single lumen. The vas deferens is long and slender, following the sperm groove in the prostate gland of the spermoviduct, passing in a loop between the distal vagina and the penial complex (joined to distal vagina and distal penis by thin connective tissues), ending in the penial complex at or close to the point where flagellum enters epiphallus.

A long penial flagellum is present (longer than epiphallus). The well developed muscular epiphallus is somewhat shorter to slightly longer than the penis and connects the proximal end of the penis with the flagellum/vas deferens junction; the inner wall of the epiphallus has five or six longitudinal ridges projecting into the lumen. The penial retractor muscle inserts near the distal end of the epiphallus and ends on the body wall. The penis in mature snails generally has the proximal part wider than the distal part. The proximal penis is ± ovoid, with a thin-walled outer sheath and a thick muscular inner wall within which are two small verges, the proximal verge apparently representing the distal end of the epiphallus, the distal verge a sphincter-like constriction that may project distally as a blunt papilla with central pore; the lumen (chamber) between the two verges has transversely corrugated walls. The distal part of the penis is a narrower cylinder of variable length, joining the genital atrium distally, with thin outer sheath and an inner muscular wall thinner than that of the proximal penis.

The external genital pore is just below and anterior to base of right ommatophore. The genital atrium is a short to very short cylinder, dividing proximally into the distal end of the

penis and the distal end of the vagina. The vagina is somewhat shorter to somewhat longer than the penis, approximately cylindrical, wider distally than it is proximal to insertion of dart sac. The vagina passes proximally into the free oviduct, the transition being defined as the point where the distal end of the bursa copulatrix duct ("stalk") inserts. A single large elongate-oval or shortly and broadly cylindrical muscular dart sac ("stylophore") is broadly attached to the outer side of the vagina around the distal end. The dart sac contains a straight or slightly curved calcareous dart that tapers to a sharp point; the blunt end of the dart has a shortly cylindrical "crown" with *ca* 14 marginal grooves; for most of its length the dart is cross-shaped in transverse section, each of the four lamella-like wings being of similar height with the crest blunt or slightly expanded laterally.

Two mucus glands ("digitiform glands") arise around upper end of vagina just distal to separation of free oviduct. Each gland has a rather thick cylindrical basal stem, forking in lower half and often again beyond it, to give overall total of 4-7 branches on each gland. The branches remain ± narrowly cylindrical for most of their length, they differ slightly in diameter, but most are subequal, normally ± convoluted, folded or contorted *in situ*.

The free oviduct is a short tube, mostly shorter than the vagina. The bursa copulatrix (gametolytic gland) is a thin-walled sac, subspherical, broadly ovate or pyriform. The bursa copulatrix duct is long, slender, convoluted when *in situ*; its lower half gives rise to a considerably wider diverticulum which is somewhat longer than the duct, strongly convoluted when *in situ*; the basal stalk (the part of the duct between insertion onto free oviduct and origin of diverticulum) is narrower than diverticulum but usually wider than remainder of duct. The bursa copulatrix duct is tightly appressed to spermoviduct when *in situ*, whereas the body of the bursa copulatrix is detached from spermoviduct on a short free section of its duct. The right ommatophore retractor muscle passes through the angle between penis and distal end of vagina.

Abbreviations:

B: shell breadth,
bod: bodies kept separately from shells,
CGAH: Collection of G.A. and D.T. Holyoak,
CJSTA: Collection of J.S. Torres Alba,
CFEVT: Collection of F.E. Vázquez Toro,
CVMS: Collection of V. Meneses Sores,
Coll.: collected by,
DTH: D.T. Holyoak,
MH: M. Holyoak,
MHNG: Muséum d'Histoire Naturelle, Ville de Genève, Switzerland,
H: shell height,
MBS: M.B. Seddon,
NMW.Z: Department of BioSYB, National Museum and Gallery of Wales, Cardiff, U.K.,
s.d.: sample standard deviation,
sh: shells,
spm: specimens in alcohol (70-80% industrial methylated spirit),
TL: type locality,
#: field number of site,
†: (old) collection number.

RESULTS AND TAXONOMY

Family Helicidae Rafinesque, 1815
Subfamily Helicinae Rafinesque, 1815

Tribe Otalini Pfeffer, 1930 (p. 138, as Otalae), cf. Schileyko (1978: 319).

The position of *Rossmaessleria* in the Helicinae was accepted e.g. by Bank *et al*. (2001: 102, in Tribe Helicini) and Schileyko (2006: 1806). Razkin, Gómez-Moliner, Prieto, Martínez-Ortí, Arrébola, Muñoz, Chueca &

MADEIRA (2015) presented the first molecular-phylogenetic data on the genus, indicating a basal position in Tribe Otalini, where it forms a clade sister to *Cornu* Born, 1778 and *Cantareus* Risso, 1826. However, sequence data currently exist for only a few exemplars from a few species, representing a small fraction of the north African taxa of Helicinae.

Genus *Rossmaessleria* P. Hesse, 1907, Iconogr., (2) 14, p. 8.

Type species: *Helix sicanoides* Kobelt, 1881, by subsequent designation of HESSE (1918: 37). Syn. *Rossmassleria* [*sic*] Pallary, 1939 (p. 106).

Rossmaessleria scherzeri (Zelebor, 1867) (Figs. 1B, 2, 3, 4A-D)

Helix Scherzeri Zelebor in [L.] Pfeiffer & Zelebor, 1867 (p. 805); TL Gibraltar.
Helix Scherzeri Zelebor: L. Pfeiffer (1868: 296, 497); locality given as "insulis Nicobaricis" (p. 296), corrected to Gibraltar (p. 497).
Helix Scherzeri Zelebor: Hidalgo (1875: 117, 206, 223).
Helix Scherzeri Zelebor apud Pfeiffer: Kobelt (1881c: 335-336, pl. 10 figs 13-15); Felsens von Gibraltar.
Helix Scherzeri Zelebor: Kobelt (1882: 24 no. 60, pl. 6).
Helix (*Iberus*?) *Scherzeri* Zelebor: Kobelt (1883: 7); Gibraltar.
Helix Scherzeri, Zelebor: Hidalgo (1884: pl. 40 figs 464-466 [*sic* = 464-469]).
Helix (*Iberus*) *scherzeri* Zelebor, 1868: Tryon (1888: 212, pl. 60 figs 86-88).
Helix Scherzeri: Bourguignat (1899: 168, 169); Rocher de Gibraltar.
H.[*elix*] *Scherzeni* [*sic*]: Pallary (1904: 25); Gibraltar.
Helix (*Iberus*) *scherzeri* Zelabor [*sic*]: Norris (1976: 496); citation of Kobelt (1883).
Rossmaessleria scherzeri: Bartolomé (1982: 2); Gibraltar.
Helix scherzeri (Zelebor in Pfeiffer, 1867): Talaván Gómez & Talaván Serna (2006: 38); as noted above, regarded as form of *Iberus gualterianus marmoratus*.

Material examined: Gibraltar, Upper Rock (Mediterranean Steps), UTM: 30STF8900, crevices of limestone rocks, 22 Jan. 2015; CGAH, 3 sh & 4 bod; CJSTA 10 sh & 2 bod; CFEVT 3 sh & 2 bod; CVMS 4 sh.

Shell: Depressed-conical, somewhat flattened below, B 17.7-21.5 (mean 19.07, s.d. 1.22) mm, H 10.9-14.0 (mean 12.23, s.d. 1.10) mm, H/B 0.60-0.69 (mean 0.64, s.d. 0.028) (n = 11); of 3.4-3.5 whorls (n = 3). Whorls rounded, expanding rather rapidly, with rather shallow sutures. Body whorl descending abruptly close to mouth. Mouth broadly oval except where interrupted by penultimate whorl, but with nearly straight thickening of inner palatal margin that forms lower edge of a somewhat rectangular columellar "sinus" and which has a slight hint of a tooth at its outer end. Peristome markedly reflected outwards, most widely on inner palatal and lower columellar margins where it conceals umbilicus; parietal area with continuous thin callus.

Ground-colour whitish, often weakly marked with pale brown, especially near upper edges of whorls of spire. Most shells marked with five ± narrow spiral bands of dull brown (three above periphery, two beneath it); the uppermost band sometimes interrupted. A minority of shells lack all bands, a few lack one or both of those from beneath the periphery (see below), or lack the middle band from above the periphery. Peristome white. Inside of mouth whitish, showing bands but more weakly than on exterior.

Shell rather thin, only weakly translucent, although the dark bands more translucent than the whitish ground colour. Surface moderately glossy. Sculpture of rather fine radial ribs and growth lines which start early on proto-

conch. Low spiral microsculpture is mostly weak, sometimes obvious on body whorl.

Variation: Slight in our material, except for banding pattern of shells (see above and Figs 1B, 2). Shells figured in the literature show a similar range of variability in the bands, with a form lacking all the bands and another with only one band shown below the periphery (KOBELT, 1881c: pl. 10 fig. 13, 1882: pl. 6 no. 6 first and second shells; HIDALGO, 1884: pl. 40 figs 466-469).

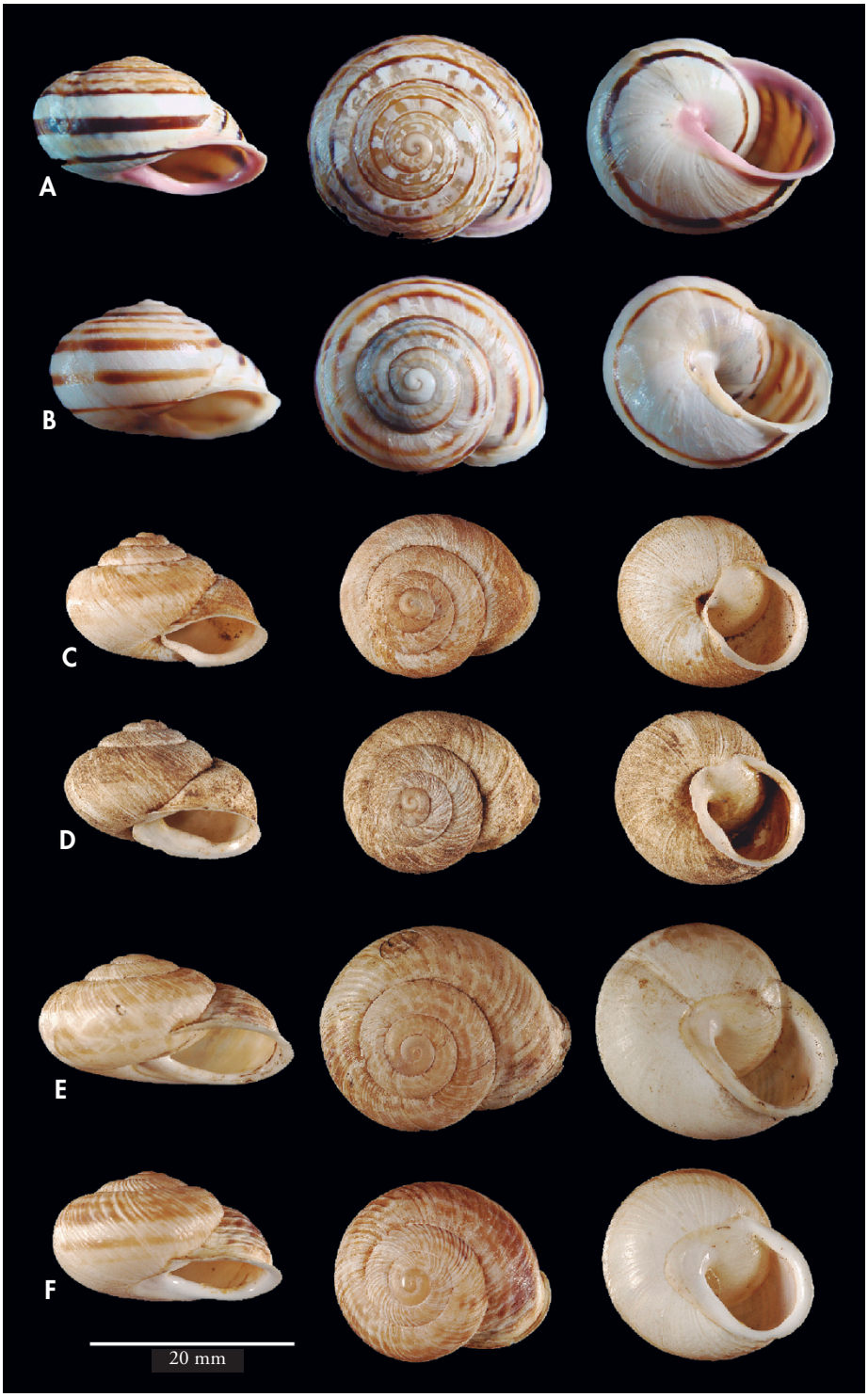
Exterior of body: On living animals (Fig. 2) exposed parts of body mainly whitish, including foot and tail, with much of skin somewhat translucent. The ommatophores appearing light grey from the dark muscles inside, the eyes black. Weak brownish skin pigmentation is present on and just behind the head and on the tentacles of some individuals. Specimens preserved in alcohol for two months have exterior of mantle inside body whorl unmarked whitish (two snails), or with weak greyish mark on inner side towards front (one), or with faint grey band just outside the inner edge (one); rest of spire whitish to pale brown externally, with uppermost 1.5-2.0 whorls light brown to dull grey-brown.

Genital anatomy: Penial flagellum about three times as long as epiphallus. Proximal penis oval, 2.5 times width of distal penis. Lumen of proximal penis (between proximal and distal verges) with 5-6 low transverse ribs. Proximal verge with narrow pore; distal verge with wide central opening, so appearing more like a sphincter than a verge. Distal penis a tube with smooth inner wall, except for short ridge near its distal end. Dart sac with small broken dart, the largest fragment 1.5 mm long. Vaginal mucus glands respectively with four branches (one low down, three together and higher) and six branches (one low down, bifurcating above; three together at higher level with short side branch on one of these). Free oviduct somewhat shorter than vagina. Stalk of bursa copulatrix duct short (about same length as free oviduct), rather wide; the diverticulum slightly wider and strongly convoluted (lying loosely over spermoviduct when *in situ*), remainder of bursa copulatrix duct much narrower (one-third to one-half width of diverticulum).

Range: Endemic on Gibraltar, where recorded previously auf der Höhe des Felsens... (Kobelt, 1882: 24) and at the Rock Gun, at Signal Point and below O'Hara Tower (Kobelt, 1883: 7).

Habitat and ecology: The thermomediterranean climate of Gibraltar has an oceanic character, which is strengthened by its location as an isolated hill on an isthmus projecting into the western Mediterranean. Characteristic elements in the flora include *Ceratonia siliqua* L., *Chamaerops humilis* L., *Acanthus mollis* L., *Aristolochia baetica* L., *Asparagus albus* L., *Calicotome villosa* (Poir.) Link and *Osyris lanceolata* Hochst. & Steud. The habitat of *R. scherzeri* also supports the rare or notable plant species *Iberis gibraltarica* L.,

(Right page) Figure 1. Shells of *Iberus marmoratus* and *Rossmaessleria*. A: *I. marmoratus*, Gibraltar, Jan. 2015 (CJSTA); B: *R. scherzeri*, Gibraltar, Jan. 2015 (CJSTA); C: *R. tetuanensis*, Morocco, *ca* 2.5 km due SW. of Tétouan, June 1986 (NMW.Z 1993.051.4283); D: *R. tetuanensis*, Morocco, *ca* 2 km due S. of Tétouan, June 1986 (NMW.Z 1993.051.4266); E: *R. olcesei*, Morocco, 1 km S. of Sefliane (SE. of Chefchaouèn), Aug. 1984 (NMW.Z 1993.051.1880); F: *R. olcesei*, Morocco, N. edge of Chefchaouèn, Aug. 1984 (NMW.Z 1993.051.1899).
(Página derecha) Figura 1. Conchas de Iberus marmoratus *y* Rossmaessleria. *A:* I. marmoratus*, Gibraltar, Ene. 2015 (CJSTA); B:* R. scherzeri*, Gibraltar, Ene. 2015 (CJSTA); C:* R. tetuanensis*, Marruecos, aprox. a 2,5 km al suroeste de Tetouán, Junio 1986 (NMW.Z 1993.051.4283); D:* R. tetuanensis*, Marruecos, aprox. 2 km al sur de Tetouán, Junio 1986 (NMW.Z 1993.051.4266); E:* R. olcesei*, Marruecos, 1 km al sur de Sefliane (SE. de Chefchaouèn), Ago. 1984 (NMW.Z 1993.051.1880); F:* R. olcesei*, Marruecos, extremo N. de Chefchaouèn, Ago. 1984 (NMW.Z 1993.051.1899).*


A
B
C
D
E
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20 mm

Biscutella laxa Boiss. & Reut., *Cerastium gibraltaricum* Boiss., *Silene tomentosa* Otth and *Saxifraga globulifera* Desf. Kobelt (1883: 7) recorded *R. scherzeri* as being confined to a few fissures (on the loftiest parts [in limestone] rock crevices difficult of access). Similarly, the recent records were of snails resting during dry weather in dense clusters inside crevices of limestone rock, each snail with its shell mouth firmly stuck onto the rock (Fig. 2). They were living close to several other species of Helicidae (*Iberus marmoratus*, *Otala lactea* (O.F. Müller, 1774), *Pseudotachea litturata* (L. Pfeiffer, 1851) and *Cornu aspersum* (O.F. Müller, 1774).

Remarks: As noted above, *R. scherzeri* has been overlooked as an endemic species restricted to Gibraltar, so that it has not gained the special statutory protection afforded to other rare wildlife occurring in this British Overseas Territory. It has a very small range (certainly <1 km^2) and almost certainly a small population (<1000 mature individuals), so that it qualifies for Vulnerable (VU) threat status according to the IUCN (2012) criteria. Fortunately, the whole of its range falls within the area of the "Rock of Gibraltar" SAC, which has been protected as part of the EC Natura 2000 Network since 2006 when it was placed on the List of Sites of Community importance for the Mediterranean Biogeographical Region (2006/613/EC, Pursuant to Council Directive 92/43/EEC). It is also protected by the regulations governing the Upper Rock Nature Reserve. In addition, the species should be included in future revisions of The Biodiversity Action Plan for Gibraltar (Perez, 2006) and given statutory protection by adding it to a future revision of Schedule 3 of the Nature Protection Ordinance, 1991.

Rossmaessleria olcesei (Pallary, 1899) (Figs. 1E, F, 3, 4E, F, 5A-C)

Helix Olcesei Pallary, 1899 (pp. 99-100, pl. 7 figs 5); TL Chéchaouen.
Helix (*Hemicycla*?) *olcesei* Pallary: Kobelt (1903: pl. 273 no. 1755); bei Chechaouen in Marokko.
Helix (*Iberus*) *Olcesei* Pallary: Pallary (1904: 24); gives year of original publication erroneously as 1898.
Helix (*Iberus*) *Olcesei* Pallary: Pallary (1904: 48); Chechaouen (Coll. Olcese).
H.[*elix*] *Olcesei*: Pallary (1917: 128).
H.[*elix*] *Olcesei* Plry: Pallary (1923: 277).
Rossmassleria [*sic*] *olcesei* (Pallary, 1898): Razkin *et al*. (2015: 103, 108); Sefliane, Morocco, DNA sequence data (from †1984.384.6, i.e. NMW.Z 1993.051.1880).

Material examined: Morocco, By P39 [now N2] 1 km S. of Sefliane (SE. of Chefchaouèn), 35°04'N. 5°04'W., limestone crags and rocky slopes, with few bushes and grasses and herbs, *ca* 810 m alt., 18 Aug. 1984, DTH, MH & MBS #364 (†1984.384.6), NMW.Z 1993.051.1880, 34 sh & 1 spm; By P39 [now N2] 8 km ENE. of Bab-Taza (SE. of Chefchaouèn), 35°03'N. 5°06'W., limestone crags and rocky slopes, partly shaded by bushes, few herbs on ledges, *ca* 840 m alt., 18 Aug. 1984, DTH, MH & MBS #365 (†1984.385.10), NMW.Z 1993.051.1882, 17 sh; N. edge of Chefchaouèn, 35°10'N. 5°16'W., rocky limestone hillside with low crags, patches of low bushes, grasses and herbs, *ca* 620 m alt., 19 Aug. 1984, DTH, MH & MBS #366 (†1984.386.16), NMW.Z 1993.051.1899, 19 sh.

Shell: Very depressed conical, strongly flattened below, B 19.8-25.3 mm, H 11.9-13.8 mm (H/B 0.54-0.63), of 3.6-4.1 whorls. Whorls rounded, expanding rather gradually compared to those of congeners, with rather shallow sutures. Body whorl descending just before mouth, to variable extent. Mouth

(Right page) Figure 2. *Rossmaessleria scherzeri*, Gibraltar, January 2015. Above: snails resting in crevice of limestone rock. Below: active snail photographed indoors.
(Página derecha) Figura 2. Rossmaessleria scherzeri, *Gibraltar, Enero 2015. Arriba: caracoles descansando en grieta de roca caliza. Abajo: caracol activo fotografiado en cautividad.*

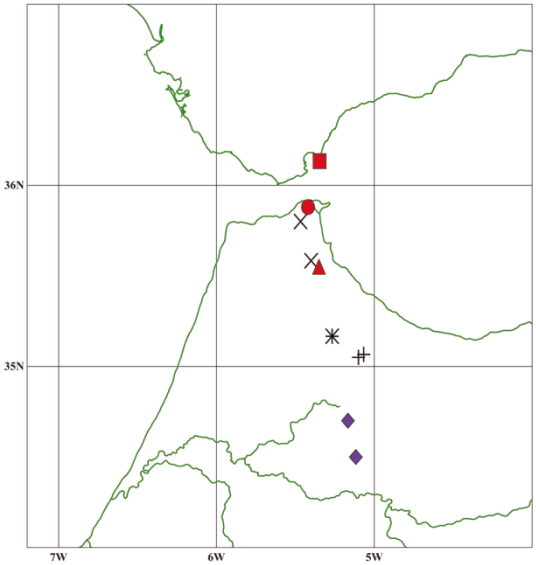


Figure 3. Map of southern Iberia and north-western Morocco to show distribution of nominal species of the genus *Rossmaessleria*. Red square: *R. scherzeri* (Zelebor, 1867); Red circle: *R. galindoae* Torres & Ahuir, 2011; ×: *R. sultana* (Morelet, 1880) and *R. viola* (Kobelt, 1889); Red triangle: Beni Hosemar mountains near Tétouan (with *R. boettgeri* (Kobelt, 1881), *R. sicanoides* (Kobelt, 1881), *R. tetuanensis* (Kobelt, 1881), *R. weberi* (Kobelt, 1887)); +: *R. olcesei* (Pallary, 1899); Blue diamond: *R. fichtalana* (Pallary, 1918).

Figura 3. Mapa del sur de la península Ibérica y noroeste de Marruecos que muestra la distribución de las especies nombradas del género Rossmaessleria. *Cuadrado rojo:* R. scherzeri *(Zelebor, 1867); círculo rojo:* R. galindoae *Torres & Ahuir, 2011; ×:* R. sultana *(Morelet, 1880) y* R. viola *(Kobelt, 1889); triángulo rojo: sierra de Beni Hosemar cerca de Tetouán (con* R. boettgeri *(Kobelt, 1881),* R. sicanoides *(Kobelt, 1881),* R. tetuanensis *(Kobelt, 1881),* R. weberi *(Kobelt, 1887)); +:* R. olcesei *(Pallary, 1899); rombo azul:* R. fichtalana *(Pallary, 1918).*

broadly oval except where interrupted by penultimate whorl, but with nearly straight inner palatal margin that forms lower edge of a somewhat angular columellar "sinus" (but does not form a tooth at its outer end). Peristome markedly reflected outwards, most widely on inner palatal and lower columellar margins where it completely covers umbilicus. Parietal area with callus absent to rather thin and continuous with peristome.

Ground colour whitish to pale brown, often with diffuse pale brown markings, with pale brown protoconch. Marked with up to five spiral bands (three above periphery, two just below it) of dull deep brown to light brown; the bands often lacking, weak or broken on underside; on upperside bands variable in width, sometimes broken into blotches. Peristome and parietal callus white. Inside of mouth white with bands not or weakly visible by translucence.

Shell rather thin, nearly opaque. Surface somewhat glossy, especially below and on peristome. Protoconch ± smooth or with low radial ribs developing on inner (sutural) side from whorl 0.3 onwards. Teleoconch with somewhat irregular weak to strong radial ribs (varying between populations, see below) that are less developed to almost lacking below. Weaker spiral microsculpture on upperside is mostly rather inconspicuous, but prominent adjacent to suture on top edge of later whorls, especially on body whorl.

Variation: Population samples of shells from three well separated localities (listed above) show marked differences in the height and width of the radial ribs on the upperside, these being much stronger in shells from N. edge of Chefchaouèn (Fig. 1F) than the others (cf. Fig. 1E). Shell size is rather variable in all three samples, but averages slightly smaller in the Chefchaouèn sample, which also had some of the proportionately tallest shells (greatest H/B) with the most strongly downturned mouths compared to the other two samples. Material from S. of Sefliane included some of the flattest shells (lowest H/B), with the mouth only slightly downturned (Fig. 1E).

Exterior of body: One body preserved in spirit since 1984 (initially dissected by DTH in 1986) with exposed parts of body pale, apparently whitish.

Genital anatomy: Penial flagellum slightly less than twice as long as epiphallus. Epiphallus thick-walled, the interior with six tall longitudinal ridges. Proximal penis elongate-oval, more than twice length of distal penis. Lumen of proximal penis (between proximal and distal verges) with *ca* 8 low rather irregularly spaced transverse ridges. Proximal and distal verges rounded papillae, each with narrow central pore. Distal penis with low rather irregular longitudinal ridges on inner wall. Dart sac with dart 2.2 mm long in snail dissected, with tip broken off. Mucus glands respectively with six branches (gland bifurcating at one-third total length, the branches then bifurcating once or twice) and minimum of four branches (bifurcating at one-third length, then both branches bifurcating again a bit further distally). Free oviduct short, less than one-half length of vagina. "Stalk" of bursa copulatrix duct rather short (1.5 times length of free oviduct) and wide; diverticulum long and wide (length > three times that of stalk with tip of diverticulum lying close to bursa copulatrix), not strongly convoluted, remainder of bursa copulatrix duct much narrower.

Range: Endemic in NW. Morocco (from Chefchaouèn south-eastwards to vicinity of Sefliane).

Habitat and ecology: As noted above, records made in 1984 were at three localities with limestone crags or rocky slopes, with grasses and herbs and few or patchy low bushes, at 620-840 m altitude.

Remarks: The quarrying of limestone over large areas that may threaten *Rossmaessleria* taxa in the hills from Tétouan northwards has not occurred further to the southeast. It is also very likely that *R. olcesei* occurs within the Talassemtane National Park, a protected area covering 589.5 km2 that forms part of the Transcontinental Biosphere Reserve of the Mediterranean.

Rossmaessleria tetuanensis (Kobelt, 1881) (Figs. 1C, D, 3, 5D-G)

Helix tetuanensis Kobelt, 1881 (1881a: 131); TL in montibus "Beni Hosemar" dictis prope Tetuan imp. Maroccanae.

Helix tetuanensis Kobelt: Kobelt (1881c: 333-334, pl. 10 figs 7-9); Felsenspalten in dem mittleren der Tetuan gegenüberliegenden Berge.

Helix tetuanensis Kobelt: Kobelt (1881b: 173); near Tetouan.

Helix tetuanensis Kobelt: Kobelt (1882: 23 no. 58, pl. 6); Bergen der Beni Hosemar bei Tetuan.

Helix (*Iberus*) *tetuanensis* Kobelt, 1881: Tryon (1888: 213, pl. 54 figs 30-33).

Helix tetuanensis Kob.: Westerlund (1889: 378).

Helix tetuanensis, Kobelt: Pallary (1899: 102).

Helix Tetuanensis, Kob., 1881: Bourguignat (1899: 168, 169).

Helix (*Iberus*) *tetuanensis* Kobelt: Pallary (1904: 25); "abonde dans les Beni Smelal sur les roches calcaires ... plus petites que le type".

Helix (*Iberus*) *Böttgeri* var. *tetuanensis* Kob.: Pallary (1904: 48).

Rossmaessleria tetuanensis Kob.: Hesse (1915: 36, pl. 635, 636 figs 14-20); Umgebung von Tetuan; figs of jaws, radula, genitalia, dart.

H.[*elix*] *tetuanensis* Kobelt: Pallary (1923: 277).

Rossmässleria tetuanensis Kob.: Pallary (1929: 50); Tétouan.
Rossmaessleria tetuanensis (Kobelt): Bartolomé (1982: 2, 5).
Rossmaessleria tetuanensis (Kobelt, 1881): Cossignani (2014: 95); figs of shell, from Tetuan.

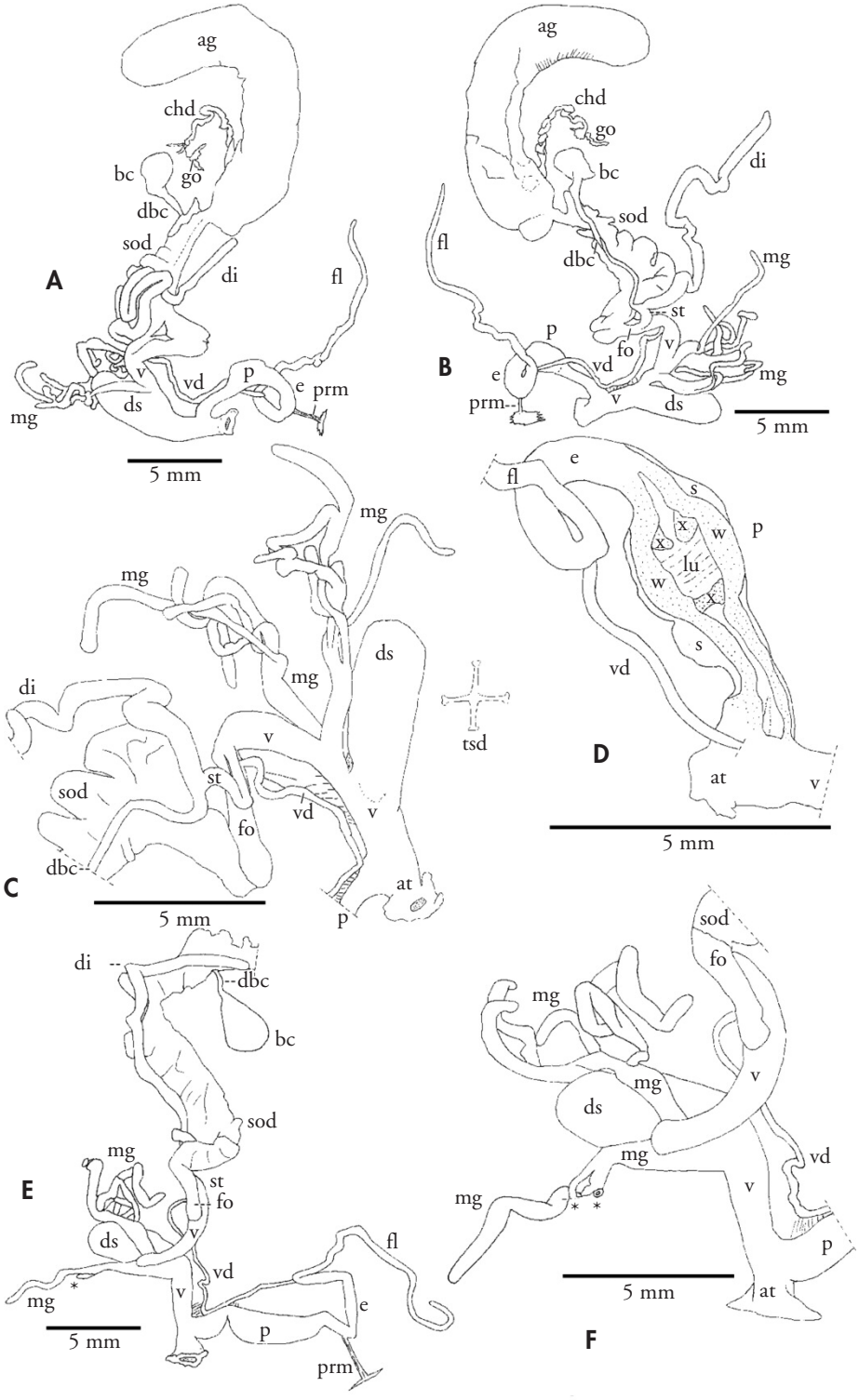
Material examined: Morocco, *ca* 2 km due S. of Tétouan (centre), 35°32'N. 5°23'W., limestone crags and rocky slopes, grasses and herbs on ledges, few bushes, 235 m alt., 26 June 1986, DTH, MH & MBS #22 (†1986.66.21), NMW.Z 1993.051.4266, 74 sh & (†1986.66.22), NMW.Z 1993.051.4267, 5 spm; *ca* 2.5 km due SW. of Tétouan (centre), 35°31'N. 5°23'W., limestone crags and slopes, patchy low maquis scrub, grasses and herbs, 280 m alt., 26 June 1986, DTH, MH & MBS #23 (†1986.67.17), NMW.Z 1993.051.4283, 12 sh.

Shell: Shell depressed-conical, somewhat flattened below, B 17.8-20.5 mm, H 12.4-15.1 mm (H/B 0.64-0.76), of 3.0-3.4 whorls. Whorls rounded (with bluntly rounded keel in juveniles), expanding rather rapidly, with sutures moderately deep around apex but rather shallow below. Body whorl descending abruptly close to mouth. Mouth very broadly oval (almost round) except where interrupted by penultimate whorl, but with nearly straight thickening on inner palatal margin that forms lower edge of somewhat angular columellar "sinus" and at outer end forms ± definite low tooth. Peristome markedly reflected outwards, most widely on inner palatal and lower columellar margins, where it ± overlaps the small excentric umbilicus, but is raised above it and so does not conceal it from at least an oblique view; parietal area with thickened callus that is continuous with peristome.

Ground colour whitish, often with diffuse pale or light brown markings, with pale brown protoconch. Marked with up to five spiral bands (three above periphery, two beneath it) of dull light brown; the bands often lacking on underside, on upperside they may be narrow, wide, weak, interrupted to give blotches, or all absent. Peristome and parietal callus white. Inside of mouth white with bands only weakly visible by translucence.

Shell rather thin, nearly opaque. Surface almost lacking obvious gloss

(Right page) Figure 4. Drawings of genital anatomy of *Rossmaessleria* species. A-D: *R. scherzeri*, from Gibraltar, Jan. 2015 (from single specimen, now in CGAH; D shows detail of penis opened to expose internal structures); E, F: *R. olcesei*, Morocco, 1 km S. of Sefliane (SE. of Chefchaouèn), Aug. 1984 (from single specimen, NMW.Z 1993.051.1880, with additional drawings on Fig. 5A-C; lower mucus gland incomplete due to breakage at *). Abbreviations: ag: albumen gland; at: genital atrium; bc: bursa copulatrix; chd: common hermaphrodite duct; dbc: duct of bursa copulatrix; di: diverticulum on duct of bursa; ds: dart sac; e: epiphallus; fl: flagellum; fo: free oviduct; go: gonad; lu: lumen of penis; mg: mucus gland; p: penis; prm: penis retractor muscle (inserted on epiphallus); s: thin (membranous) penis sheath; sod: spermoviduct; st: "stalk" of bursa copulatrix duct; tsd: transverse section of middle of dart (not to scale); v: vagina; vd: vas deferens; w: muscular wall of penis; x: verge inside penis.
(Página derecha) Figura 4. Dibujos de la anatomía genital de las especies Rossmaessleria. *A-D:* R. scherzeri, *de Gibraltar, Ene. 2015 (de un ejemplar, ahora en CGAH; D representación de los detalles del pene abierto mostrando las estructuras internas); E, F:* R. olcesei, *Marruecos, 1 km al sur de Sefliane (SE de Chefchaouèn), Ago. 1984 (de un ejemplar, NMW.Z 1993.051.1880, con dibujos adicionales en la Fig. 5A-C; glándula mucosa inferior incompleta debido a rotura en *). Abreviaturas: ag: glándula del albumen; at: atrio genital; bc: bursa copulatrix; chd: conducto hermafrodita común; dbc: conducto de la bursa copulatrix; di: divertículo del conducto de la bursa, ds: saco del dardo; e: epifalo; fl: flagelo; fo: oviducto libre; go: gónada; lu: lumen del pene; mg: glándula mucosa; p: pene; prm: músculo retractor del pene (inserto en el epifalo); s: vaina del pene delgada (membranosa); sod: espermiducto; st: "tronco" del conducto de la bursa copulatrix; tsd: sección transversal del dardo de la zona media (no a escala); v: vagina; vd: conductos deferentes; w: pared muscular del pene; x: borde interior del pene.*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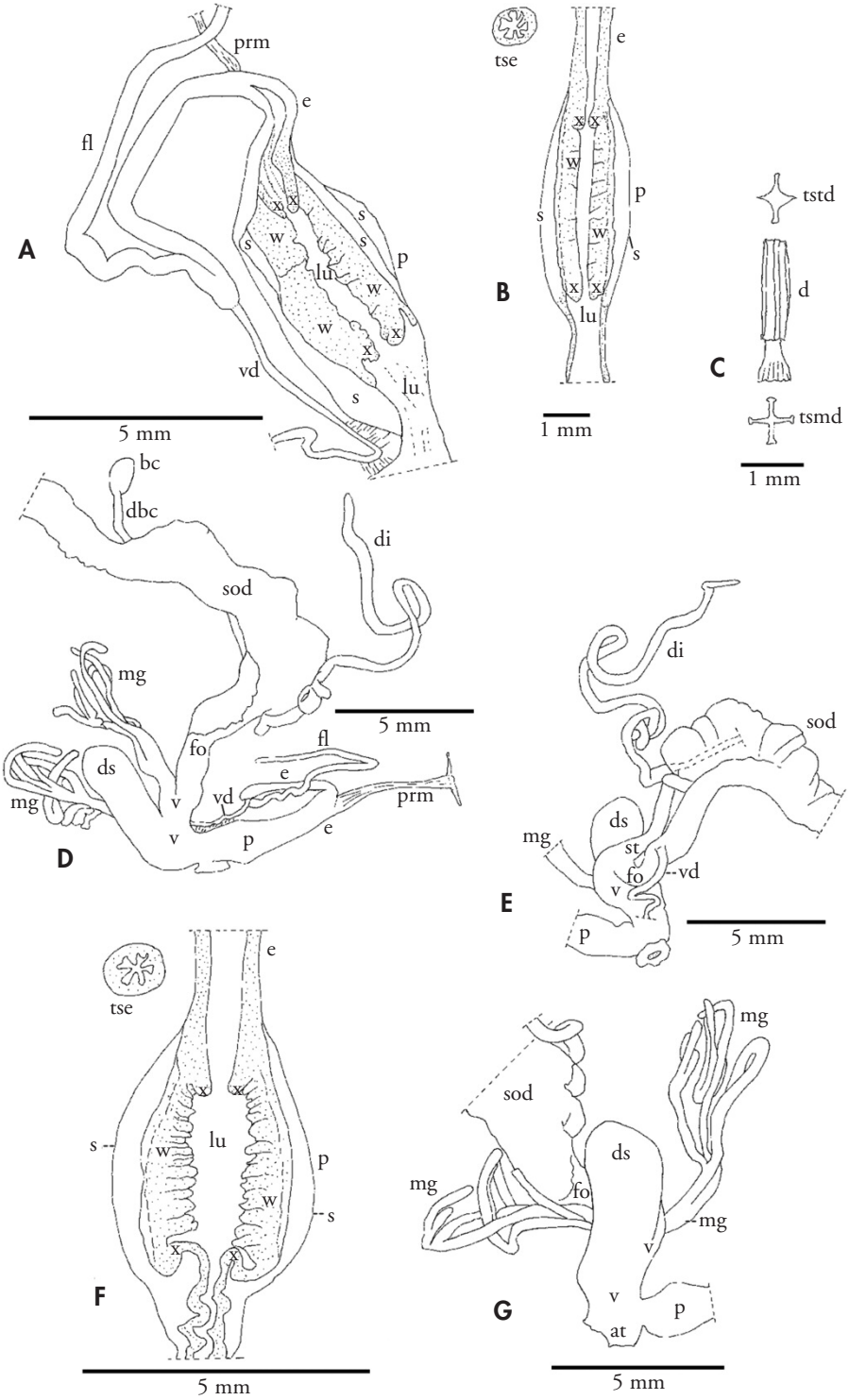
because of dense sculpture (which appears shiny under microscope), except in mouth and on peristome. Protoconch almost smooth up to whorl 0.7. Teleoconch with close rather regular low ribs, intersected by similar rather regular close spiral grooves, to give rounded papillae arranged in ± regular pattern. Sculpture below similar but weaker.

Variation: See above for comments on variability in banding patterns in shells we examined. Kobelt (1881c: 334, 1884: 23) commented on the variability of *tetuanensis* and thought that intermediates may connect it with *boettgeri*, as discussed further under *Remarks* below.

Exterior of body: In material preserved in alcohol since 1986, exposed parts of body whitish below, pale greyish above; mantle surface inside body whorl whitish externally; top of spire light brown.

Genital anatomy: Penial flagellum about twice as long as epiphallus (but probably variable, Hesse, 1915: pl. 636 fig. 19 depicted it as three times epiphallus length). Epiphallus thick-walled, the interior with five tall longitudinal ridges. Thin membranous penis sheath also conceals distal end of epiphallus. Proximal penis oval, much longer than distal penis (but dissection showed latter was strongly contracted; Hesse, *loc. cit.*, showed proximal and distal parts of penis to be similar in length). Lumen of proximal penis (between proximal and distal verges) with *ca* 10 low closely spaced transverse ridges. Proximal and distal verges both with narrow central pore. Distal penis with narrow lumen. Dart sac lacking dart in snail dissected (for figure of dart see Hesse, *op. cit.*, pl. 636 fig. 20). Mucus glands respectively with six branches (five arising at one-quarter to one-third length, sixth a side branch at one-half total gland length) and seven branches (four arising at *ca* one-quarter length, of which first branched twice more at one-third and one-half total length; second branched once at two-thirds length; third unbranched, small and slender; fourth unbranched, long and stout). Hesse (*op. cit.*, pl. 636 fig. 19) depicted both glands with four branches, all the branches arising at one-quarter to one-third total length, implying that individuals vary. Free oviduct short, about one-half length of vagina. "Stalk" of bursa copulatrix duct moderately long (1.5 times length of vagina, > twice length of free oviduct); diverticulum long and wide, length > three times that of stalk, strongly convoluted (lying loosely over spermoviduct when *in situ*), remainder of bursa copulatrix duct somewhat narrower.

(Right page) Figure 5. Drawings of genital anatomy of *Rossmaessleria* species. A-C: *R. olcesei*, Morocco, 1 km S. of Sefliane (SE. of Chefchaouèn), Aug. 1984 (from single specimen, NMW.Z 1993.051.1880, with additional drawings on Fig. 4E, F; Fig. 5A shows detail of penis opened to show internal structures; Fig. 5B is semi-schematic longitudinal section of distal epiphallus and penis; D-G: *R. tetuanensis*, Morocco, *ca* 2 km due S. of Tétouan, June 1986 (from single specimen, NMW.Z 1993.051.4266; E shows outline of concealed part of duct of bursa copulatrix with dotted lines; F shows detail of penis opened to show internal structures). Abbreviations as in Fig. 4, except: d: dart (to scale; tip missing); tse: transverse section of epiphallus, tsmd: transverse section in middle of dart (to scale), tstd: transverse section near tip of dart (to scale).
(Página derecha) Figura 5. Dibujos de la anatomía genital de las especies Rossmaessleria. *A-C:* R. olcesei, *Marruecos, 1 km al sur de Sefliane (SE. de Chefchaouèn), Ago. 1984 (de un ejemplar, NMW.Z 1993.051.1880, con dibujos adicionales en la Fig. 4E, F; Fig. 5A representa detalles del pene abierto mostrando las estructuras internas; Fig. 5B es un semiesquema de sección longitudinal de la parte distal del epifalo y el pene; D-G:* R. tetuanensis, *Marruecos, aprox. 2 km al sur de Tétouan, Junio 1986 (de un ejemplar, NMW. Z 1993.051.4266; E muestra el contorno de la parte oculta del conducto de la bursa copulatrix con líneas punteadas; F representa detalles del pene abierto mostrando las estructuras internas). Abreviaturas como en la Fig. 4, excepto d: dardo (a escala, falta la punta), tse: sección transversal del epifalo, tmsd: sección transversal de la parte media del dardo (a escala), tstd: sección transversal cercana a la punta del dardo(a escala).*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Range: Endemic in NW. Morocco (Beni Hosemar mountains near Tétouan; Beni Smelal).

Habitat and ecology: Rock crevices in crags in the hills (Kobelt, 1881c: 333-334). As noted above, records made in 1986 were from limestone crags and rocky slopes, with open vegetation of grasses and herbs with few bushes or patchy low maquis (scrub), at 235-280 m elevation.

Remarks: Pallary (1899a: 102) regarded this form as a variety of *H. boettgeri* Kobelt, 1881 from which it was stated to differ only in the 4 mm higher spire of the shell. Since both names were published on p. 131 in Kobelt (1881a), this will result in the epiphet *boettgeri* being adopted for the species as a whole if the taxa are combined. However, besides the difference in shell shape mentioned by Pallary, they also differ in the stronger spiral sculpture of *tetuanensis*. Both taxa have very restricted geographical ranges and could be placed at risk if the extensive quarrying of limestone that has taken place in the hills northwards from Tétouan to around Taghramt is repeated further south.

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