

The genus *Zuercherella* Casey, 1954 in the Upper Aptian (Lower Cretaceous) of the Cottonwood District, Northern California

El género Zuercherella Casey, 1954 en el Aptiano superior (Cretácico Inferior) del Distrito de Cottonwood, en el norte de California

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Abstract

The presence of the Tethyan species *Zuercherella zuercheri* (Jacob, 1906) in the Upper Aptian of the Cottonwood district, northern California, is documented for the first time, allowing confirmation of an affinity between the Tethyan and Northeast Pacific biota during the Upper Aptian, *Eotetragonites wintunius* and *Acanthohoplites gardneri* Zones. The paleontological study of very well-preserved material also allows a better knowledge of the adult morphology of *Zuercherella zuercheri*.

Keywords: Ammonites, Aptian, California, Cretaceous, Paleobiogeography.

Resumen

Se reporta por primera vez la presencia de la especie tetisiana *Zuercherella zuercheri* (Jacob, 1906) en el Aptiano superior del distrito de Cottonwood, en el norte de California, lo que permite confirmar la existencia de afinidades entre la biota tetisiana y la del Pacífico nororiental durante el Aptiano superior, en las biozonas *Eotetragonites wintunius* y *Acanthohoplites gardneri*. El estudio paleontológico de material muy bien conservado también permite tener un mejor conocimiento de la morfología del adulto de *Zuercherella zuercheri*.

Palabras clave: Cretácico, Ammonites, Aptiano, California, Paleobiogeografía.

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1. Introduction

The upper Aptian ammonite fauna of northern California has been long recognized for its endemism (Anderson, 1902, 1938; Murphy, 1956, 1967a and b; Amédéo and Robaszynski, 2005; Murphy and Rodda, 2006; Rodda and Murphy, 2022).

Zuercherella zuercheri (Jacob, 1906), a distinctive species known from South America, and Europe, and reported here for the first time in western north America, allows us to highlight a connection between the Tethys and the Northeast Pacific Province during the lower part of Upper Aptian.

Most of the material herein investigated has been collected in the 1950' by one of us (M.A.M.) in the Upper Aptian of northern California, *Eotetragonites wintunius* Zone and base of the *Acanthohoplites gardneri* Zone. These specimens were previously identified as *Puzosia* sp. A and/or *P.* sp. B in Murphy (1956).

2. Systematic paleontology

Conventions. Dimensions are given in millimeters: D = diameter; W = whorl breadth; H = whorl height; U = umbilicus.

We follow the descriptive categories established by Rodda and Murphy (2022).

Abbreviations used.

- CASG - California Academy of Sciences, Geology Collection.
- UCLA - University of California, Los Angeles.
- UJF-ID - Université Grenoble-Alpes, ex Institut Dolomieu collections.

Order Ammonitida Zittel, 1884

Suborder Ammonitina Hyatt, 1889

Superfamily Desmoceratoidea Zittel, 1895

Family Desmoceratidae Zittel, 1895

Subfamily: Uhligellinae Latil, Murphy and Rodda, 2023

Definition of the subfamily. The subfamily Uhligellinae, as herein understood, is probably polyphyletic and brings together the genera *Zuercherella* Casey, 1954, *Uhligella* Jacob, 1907, *Pseudorbulites* Casey, 1961, *Grantzicerias* Imlay, 1961, *Roberticerias* Latil, Murphy and Rodda, 2023, *Leconteites* Casey, 1954, *Brewericerias* Casey, 1954, and provisionally *Boliteceras* Whitehouse, 1928 and *Cophinoceras* Whitehouse, 1928. This subfamily comprises constricted desmoceratids that derive from the genera *Zuercherella* and *Pseudorbulites* with a suture line with symmetrical to feebly asymmetrical, trifid L. We do not follow Wright (1996) and maintain the genera *Leconteites* and *Brewericerias* within the Uhligellinae because of their symmetrically trifid suture.

Discussion. The genus *Uhligella* has been extensively discussed by Riccardi and Medina (2002, p. 306) who follow the Treatise classification.

The genus *Pseudorbulites* Casey, 1961 (type species: *Desmoceras (Uhligella) convergens* Jacob, 1908, p. 29, pl. 2, figs. 24–26, by the original designation of Casey, 1961, p. 145) was considered by Wright (*in* Wright *et al.*, 1996, p. 81) as a possible synonym of *Beudanticeras (Grantzicerias)* Imlay, 1961, without any discussion. Kennedy (2000, p. 165) regarded it as a synonym of *Beudanticeras* s.s., considering that Jacob's species differs little from early *Roberticerias*. As pointed out by Riccardi and Medina (2002, p. 298), *Pseudorbulites* and *Grantzicerias* have both a stout section and funnel-shaped umbilicus, but *Grantzicerias* differs from *Pseudorbulites* by its less involute coiling, more numerous strongly biconcave constrictions and its rather broader ventral area. In spite of that, Riccardi and Medina considered that *Pseudorbulites* and *Grantzicerias* were probable synonyms. We agree with Casey (1961, p. 145) statement: 'I am of the opinion that *Pseudorbulites* should be established as an independent genus rather than as a subgenus of *Beudanticeras*. The outstanding features of *Pseudorbulites* are its stout, elliptical whorls, funnel-shape umbilicus, striated test and highly dissected suture-line.' Furthermore, *Grantzicerias* is a typical pacific boreal genus of a rather elevated Lower Albian age (*Brewericerias hulenense* Zone). Because of its stratigraphic range just below and above the Aptian-Albian boundary, and because of its tethyan origin, *Pseudorbulites* is regarded herein as a distinct genus and as a possible ancestor of the Lower-basal Middle Albian tethyan lineage *Roberticerias africana* (Pervinquièrre, 1907), *R. dupinianum* d'Orbigny, 1841, *R. arduennense* Breistroffer, 1947 and the still enigmatic *R. subparandieri* Spath, 1923.

The genus *Boliteceras*, a rather involute, with funnel-shaped umbilicus, and inflated ammonite, with broad, shallow, sinuous constrictions, fine, feeble ribs and broadly rounded venter, is in need of further study. The suture, not figured, is said to have wide-stemmed saddles and regularly trifid first lateral lobe. This genus has been regarded as a doubtful genus by Wright (1996) without further explanation. Riccardi and Medina (2002) regarded it as a synonym of *Beudanticeras* (now *Roberticerias*). Whitehouse (1928) assigned an Upper Albian age to the genus *Boliteceras* on the basis of the occurrence of Upper Albian ammonites within the same formation. Both *Boliteceras daintreei* (Etheridge, 1872) and *Boliteceras perlatus* (Whitehouse, 1928) are known from Hughenden, Queensland, Wallumbilla Formation and possibly Allaru Mudstone (Rozefelds *et al.*, 1990). The Wallumbilla Formation has been redefined by Vine *et al.* (1967) and Gray *et al.* (2002) and both authors give it an Aptian to Albian age. The Allaru Mudstone, doubtfully considered as a lateral equivalent of the Oodnadatta Formation, is probably Albian-Cenomanian (Gray *et al.*,

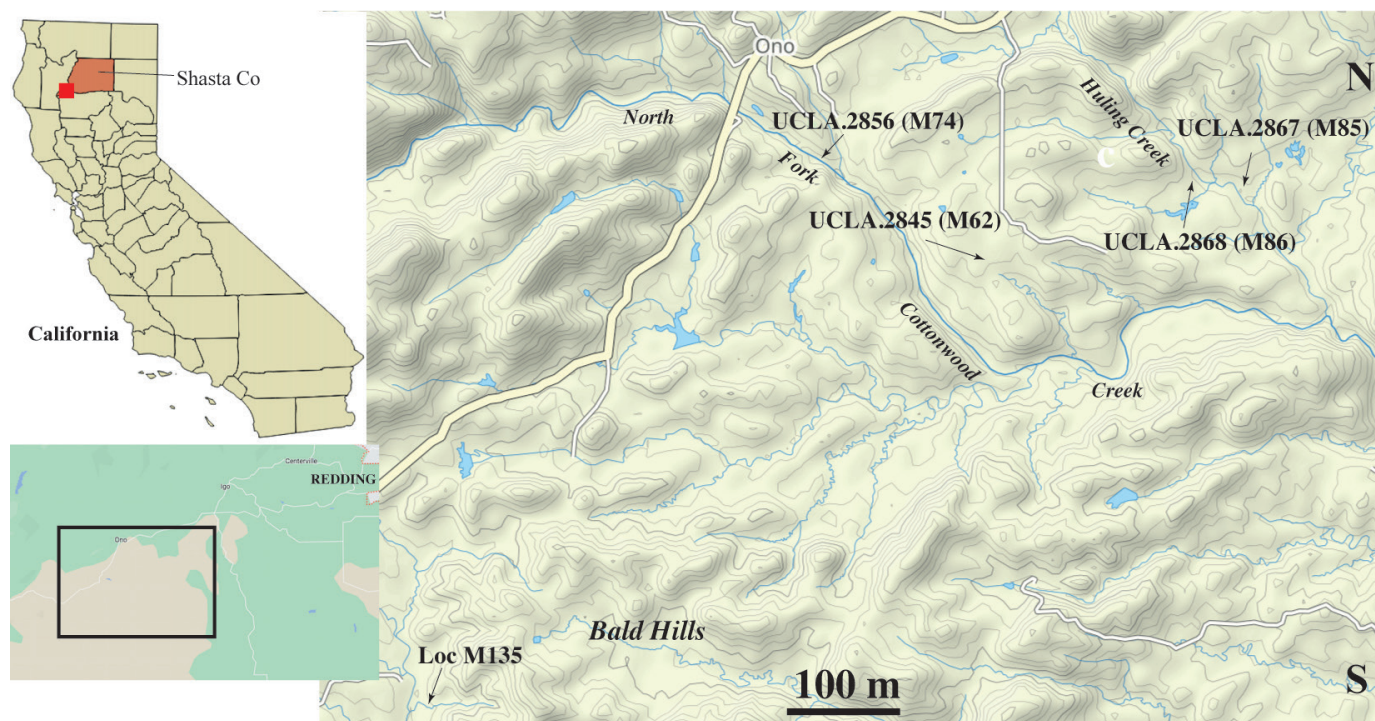


Figure 1. Map of the studied area, with location of the localities that yielded *Zuercherella zuercheri* (Jacob, 1906).

2002). According to Day (1968) *Boliteceras daintreei* co-occurs with ?*Falciferella* and is of Lower Albian age while McKenzie (personal communication) gives a Middle Albian age. The genus *Boliteceras* is herein excluded from the synonymy of the genus *Roberticeras* and, pending a revision of the Australian material, *Boliteceras* is herein considered as a distinct genus and provisionally maintained in the Uhligellinae.

The monospecific genus *Cophinoceras* was created for Upper Albian ammonites (Tambo series) of eastern Australia, with elliptical whorl section, narrow funnel shape umbilicus, straight prorsiradiate primary ribs (constrictions covered by the test), each pair of such ribs being separated by 8–12 short straight intercalatories. The suture is said to have wide-stemmed saddles and regularly trifid first lateral lobe. *C. ogilviei* has been collected near the mouth of Bynoe River, on Normanton-Burketown Road, N Queensland, Australia, in the Normanton Formation which is considered Albian and more recently Cenomanian (Rawlings *et al.*, 1997). According to Day (1968), this species comes from the Upper Albian.

Day (1968, unpublished dissertation) described a new Upper Albian species: “*Beudanticeras*” *vinei*, for several large ammonites, saying that it could be referred to *Cophinoceras*. He adds: “*Beudanticeras*” *vinei* sp. nov. is referred to the genus *Beudanticeras* with some reservation. The species attains an exceptionally large size for a *Beudanticeras* and approaches the dimensions of many species of *Puzosia* Bayle. However, typical *Puzosia*

has a more depressed whorl section. The deep ventral lobe of the suture is also unusual for a *Beudanticeras*. The suture of *Desmoceras* Zittel is very similar, but that form also has a depressed whorl section. ». This species co-occurs with *Myloceras*, *Labeceras* and *Appurdiceras* and is of Late Albian age.

In our opinion, «*Beudanticeras*» *vinei* probably represents the adult stages of *Cophinoceras ogilviei*. The taxonomic position of the genus *Cophinoceras* remains uncertain but is in no way related to the European Lower Albian *Roberticeras*. As for *Boliteceras*, it is provisionally maintained within the Uhligellinae, keeping in mind that it seems to be more closely related to the Puzosiinae.

Genus *Zuercherella* Casey, 1954
(= *Corteziceras* Etayo Serna, 1979, p. 27; type species
C. cortezi by original designation)

Type species. *Desmoceras zuercheri* Jacob, 1906, p. 9, by the original designation of Casey, 1954, p. 112.

Diagnosis. Medium-sized high-whorled shell with oval or subquadrate whorl-section, venter narrowly rounded; constrictions shallow, sinuous; between the constrictions are several ribs. Main ribs begin slightly above or at the umbilical rim; intercalatory ribs occur only in the upper half of the flanks. Outer whorls appear to be feebly ornamented based on a single specimen.

Zuercherella zuercheri (Jacob 1906)
Figures 2a–d, 3a–c, 4a–c, 5, 6

Synonymy.

- 1906 *Desmoceras zürcheri* Jacob, p. 9, pl. II, fig. 1–3.
 ?1907 *Desmoceras (Uhligella)* cf. *zürcheri* Jacob;
 Pervinquière, p. 137, pl. 5, fig. 26.
 1910 *Uhligella zürcheri* Jacob and Tobler; Kilian,
 pl. 10, fig. 3.
 1920 *Uhligella zürcheri* Jacob and Tobler; Fallot,
 p. 261, pl. 3, fig. 7.
 Non 1933 *Uhligella zuercheri* Jacob and Tobler;
 Rouchadze, p. 183, pl. 2, fig. 4, 5.
 1949 *Uhligella zürcheri* Jacob; Luppov et al., p. 211,
 pl. LX, fig. 1a, 1b, text-fig. 37.
 1954 *Zuercherella zuercheri* (Jacob and Tobler);
 Casey, p. 112.
 1956 *Puzosia* sp. A; Murphy, fig. 6.
 1956 *Puzosia* sp. B; Murphy, fig. 6.
 1957 *Zurcherella zurcheri* Jacob; Wright p. L368,
 fig. 481: 1a, b.
 1958 *Zürcherella zürcheri* Jacob; Luppov and
 Drushchits, p. 109, pl. 50, fig. 8.
 ?1964 *Zürcherella zürcheri* (Jacob); Fülöp, pl. 4,
 fig. 1, 2.
 1964 *Zürcherella zürcheri* Jacob; Kemper, p. 39, pl. 4,
 fig. 1; pl. 15, fig. 1; pl. 17, figs 1–3.
 1966 *Zürcherella zürcheri* (Jacob); Schindewolf,
 p. 623.
 1968 *Beudanticeras (Zuercherella) zuercheri* (Jacob);
 Wiedmann and Dieni, p. 130, pl. 12, fig. 1.
 1969 *Zurcherella zurcheri* Jacob; Egoian, p. 177, pl. 15,
 fig. 8, 9; pl. 25, fig. 64.
 1971 *Zuercherella zuercheri* Jacob; Kvantaliani, p. 98,
 pl. 15, fig. 1.
 1971a *Zürcherella zürcheri* (Jacob); Kemper, pl. 4,
 fig. 7.
 1971b *Zürcherella zürcheri* (Jacob); Kemper, pl. 29,
 fig. 1.
 1976 *Zürcherella zürcheri* (Jacob); Kemper, pl. 4,
 fig. 7.
 1980 *Zurcherella zurcheri* (Jacob); Thomel, p. 124,
 fig. 246.
 1982 *Beudanticeras* (“*Zuercherella*”) *zuercheri* (Jacob);
 Renz, p. 22, pl. 1, fig. 20; text-fig. 10c, d.
 ?1986 *Zurcherella alpina* Demay and Thomel, p. 34.
 1993 *Zuercherella zuercheri* (Jacob); Sharikadze,
 p. 135,
 text-fig. 6.
 1995 *Zürcherella zürcheri* Jacob; Kemper, pl. 5, fig. 5.
 1996 *Zuercherella zuercheri* (Jacob); Wright, p. 80,
 fig. 61: 2.
 1996 *Zuercherella zuercheri* (Jacob); Mutterlose, p. 51,
 pl. 3, fig. 2, 3.
 1996 *Zürcherella zürcheri* (Jacob); Weber, p. 79, pl. 3,
 fig. 1, 2, pl. 8, fig. 2, 3, pl. 9, fig. 4.
 ? 2004 *Zuercherella* cf. *zuercheri* (Jacob and Tobler,
 1906); Bogdanova and Hoedemaeker, p. 245,
 pl. 41, fig. 2.
 2005 *Zuercherella zuercheri* (Jacob and Tobler);
 Dutour, pl. 17, fig. 1–6, fig. 12.

- 2005 *Zuercherella zuercheri* (Jacob); Kvantaliani in
 Kotetishvili et al., p. 322, pl. 61, fig. 2.
 ? 2007 *Zuercherella zuercheri* Jacob et Tobler; Szives,
 p. 55, pl. 3, figs 21, 22, 23.
 2008 *Zurcherella zurcheri* (Jacob & Tobler); Joly &
 Delamette, fig. 6L.
 2011 *Zuercherella zuercheri* (Jacob); Klein and Vašiček,
 p. 113 (pars).

Type material. The species is based on four syntypes, juveniles, less than 50 mm of diameter. Two of the four syntypes are in the collections of the University Grenoble Alpes (*ex* Dolomieu collections), both from the Upper Aptian of Chaudon (Alpes de Haute Provence, France). We were unable to trace the syntypes figured by Jacob (1906, pl. 2, fig. 1 and text-fig. 3) from the Upper Aptian of Luitere Zug (Switzerland). No type specimen was designated by Jacob. Dutour (2005, unpublished) considers the specimen figured by Jacob (1906, pl. 2, fig. 1) as the holotype. Consequently, the specimen figured by Jacob (pl. 2, fig. 3) is herein selected as the lectotype. The lectotype UJF-ID.1064 *Desmoceras (Uhligella) zürcheri* Jacob, 1906, pl. 2, fig. 3, is herein refigured (Fig. 2a, b).

N°	D	H	W	U	W/H
UJF-ID.1064	39.0	18.0 (.46)	12.7 (.33)	7.8 (.20)	0.71

UJF-ID.1064 is a juvenile preserved as a pyritized internal mold. The coiling is involute ($U/D = 0.20$) with low, broadly convex umbilical wall and shoulder, feebly convex flanks, and narrow feebly convex venter. There are seven radial, feebly flexuous constrictions on the last half-whorl, with adapical rib on the outer part of the flanks and venter. There are about six feeble, fine riblets between each constriction, that arise on the inner third of the flanks. The suture shows a trifid, symmetrical L (Fig. 2d).

UJF-ID.1065 *Desmoceras (Uhligella) zürcheri* Jacob, 1906, pl. 2, fig. 2 : paralectotype

N°	D	H	W	U	W/H
UJF-ID.1065	43.0	19.0 (.44)	14.5 (.34)	10.5 (.24)	0.76

An oxidized limonitic juvenile specimen, differing only from the previous specimen by its flatter flanks.

The original figure of one of the syntypes from Luitere Zug (Jacob, 1906, pl. 2, fig. 1) is herein refigured (Fig. 2c), showing the differences of ornamentation owing to the kind of preservation.

Material. Eight specimens from Northern California:

- CASG70778 of unknown origin (Figs 5, 6);
- CASG70779 (UCLA loc. 2845, = M62: 40°27'30.91"N, 122°35'47.96W): *Acanthohoplites gardneri* Zone (Figs 4a–c);
- CASG70781 (including CAS70784: UCLA loc. 2867, = M85: 40°27'51.16"N, 122°34'13.61W): from Huling Creek, co-occurs with '*Acanthohoplites aegis*' at the base of the *Acanthohoplites gardneri* Zone;
- CASG70783 (UCLA loc. 2856, = M74: 40°27'57.73"N, 122°36'45.15W), from North Fork of Cottonwood Creek, where it co-occurs

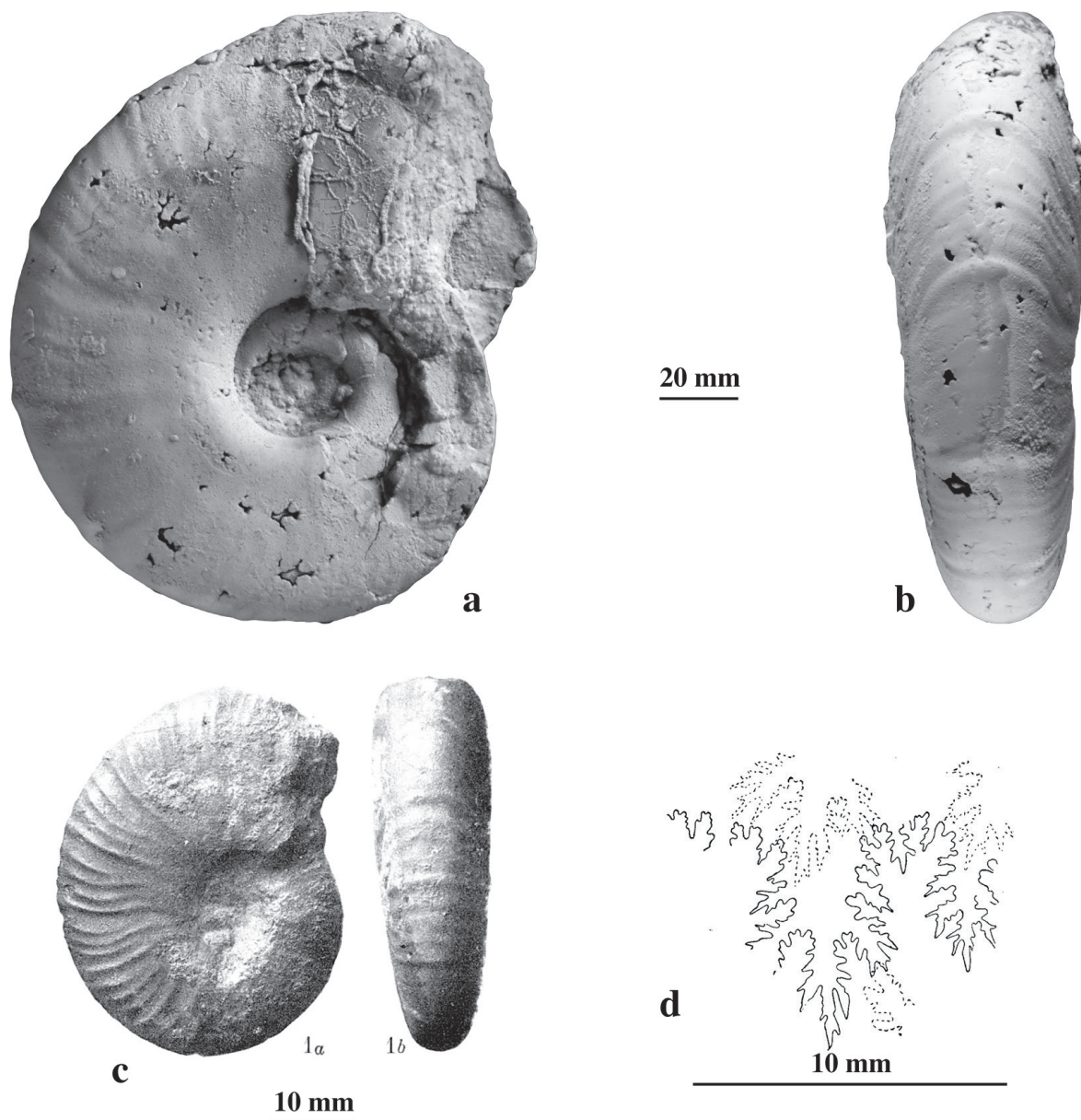


Figure 2. *Zuercherella zuercheri* (Jacob, 1906). a, b, the lectotype, a juvenile from the Upper Aptian of Chaudun (Alpes de Haute Provence, France); c, one of the syntypes from the Upper Aptian of Luitere Zug (Switzerland), the original figure of Jacob (1906, pl. 2, fig. 1); d, suture line one of the syntypes from the Upper Aptian of Luitere Zug (Switzerland), the original figure of Jacob (1906, text-fig. 3).

with *Acanthohoplites gardneri* at the base of the *Acanthohoplites gardneri* Zone (Figs 3a–c);

- CASG70784 (UCLA loc. 2868, = M86: 40°27'55.79"N, 122°34'30.11"W): from Huling Creek section, where it co-occurs with *Eotetragonites wintunius* (Anderson, 1938), *Eotetragonites wintunius* Zone;
- CASG70785 of unknown origin;
- an unnumbered specimen (loc. M135: 40°25'23.87"N, 122°39'13.78"W), from the Bald Hills, Barr section where it co-occurs with *Eotetragonites wintunius* (Anderson, 1938), *Melchiorites indigenes* (Anderson, 1938), *Hypophylloceras onoense* (Stanton, 1895) and *Argonauticeras argonautarum* (Anderson, 1902), *Eotetragonites wintunius* Zone;

- an unnumbered specimen of unknown origin.

These specimens have been collected within the *Eotetragonites wintunius* Zone and at the base of the *Acanthohoplites gardneri* Zone, Upper Aptian of Shasta Co, California (Murphy, 1956). They are preserved as calcareous internal molds, partially covered by aragonitic shell.

N°	D	H	W	U	W/H
Unnumbered	38.5	18.0 (.47)	14.5 (.38)	8.5 (.22)	0.81
CASG70781	44.0	19.5 (.44)	15.0 (.34)	8.5 (.19)	0.77
M135	54.5	23.5 (.43)	21.0 (.39)	15.0 (.28)	0.89
CASG70783	80.0	34.0 (.43)	26.5 (.33)	20.0 (.25)	0.78
CASG70779	98.5	41.0 (.42)	33.5 (.34)	28.5 (.29)	0.82

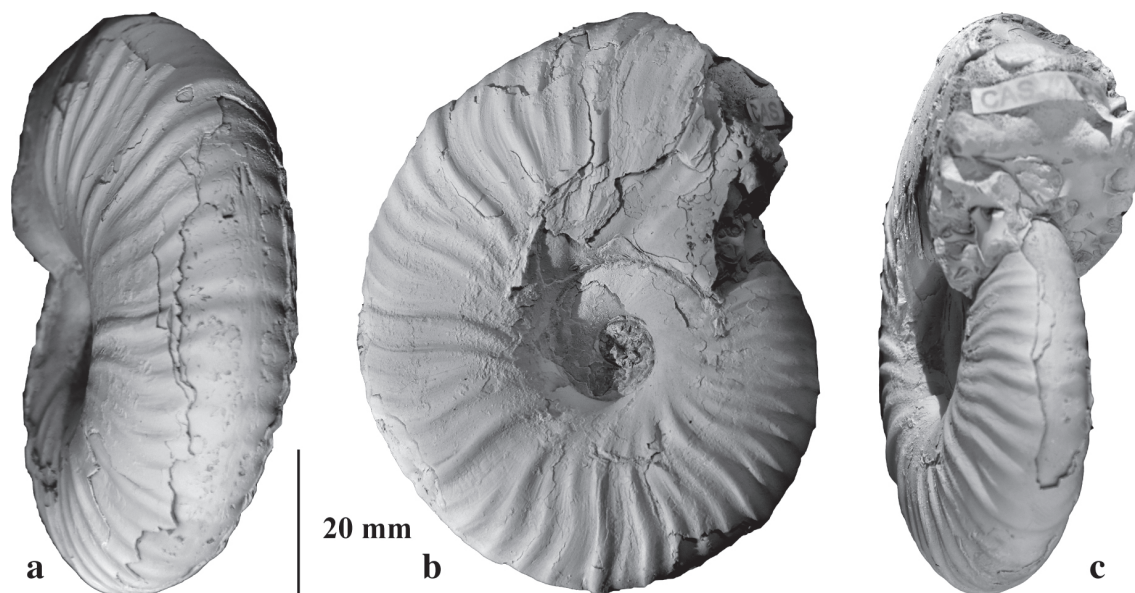


Figure 3. *Zuercherella zuercheri* (Jacob, 1906). a–c, CASG70783, UCLA locality 2856 (= M74), Huling Creek, base of the *Acanthohoplites gardneri* Zone, Upper Aptian.

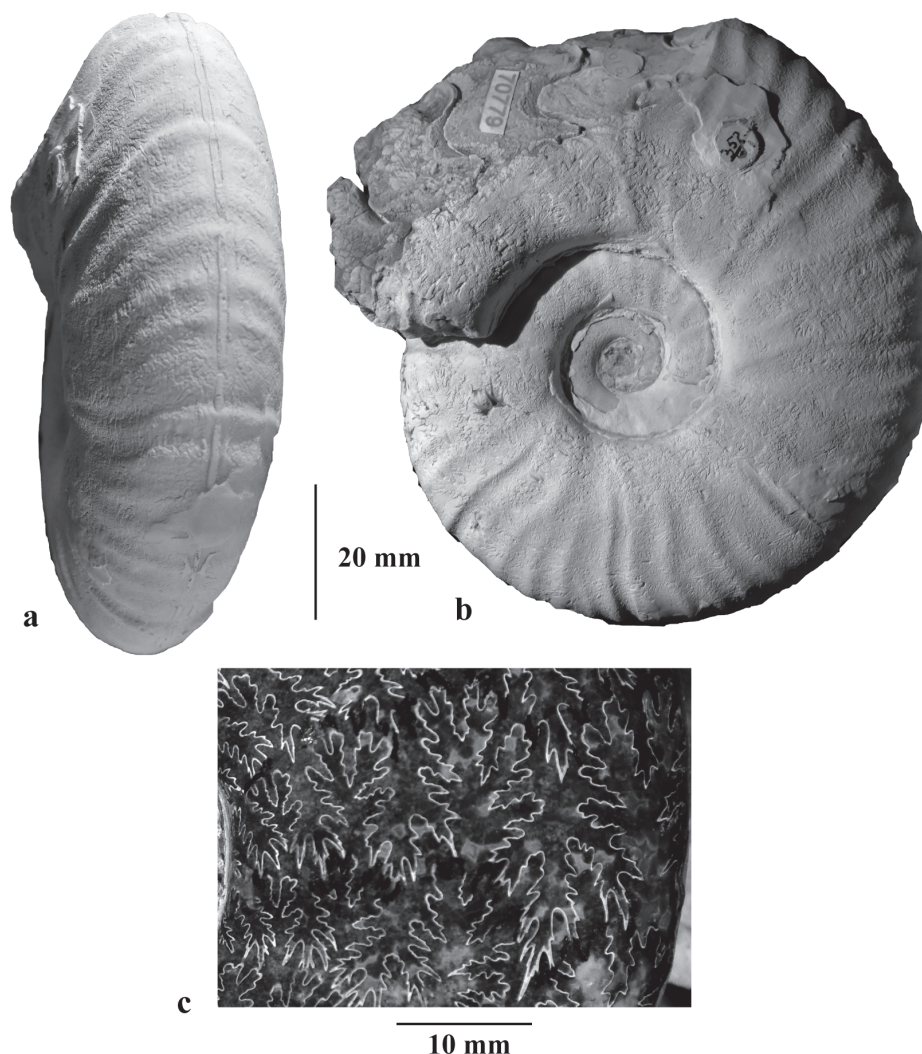


Figure 4. *Zuercherella zuercheri* (Jacob, 1906). a–c, CASG70779, UCLA loc. 2845 (= M62), *Acanthohoplites gardneri* Zone, Upper Aptian.

The coiling is involute on the juvenile (U/D between 0.19 and 0.22), becoming moderately involute with age with (U/D between 0.25 and 0.29). The whorl section is compressed (W/H between 0.77 and 0.89), oval to elliptical, with funnel-shape, moderately deep umbilical wall, broadly rounded umbilical shoulder, slightly convex flanks, with a maximum of width at the inner third. The outer part of the flanks converge to a narrowly rounded venter. The inner whorls, up to a diameter of 30 mm, show inconspicuous coarse ribs on the outer part of the flanks of the internal mold, and numerous falcoid growth lines on the shell that are strongly prorsiradiate on the inner part of the flanks. Beyond 30 mm, there are 9–10 prorsiradiate, coarse, wide, shallow constrictions, that are slightly projected forward on the ventral area where they are feebly collared backward. The internal mold bears almost inconspicuous, fine, sinuous, prorsiradiate ribs on the less ornamented specimens (unnumbered, M135) to coarse, low, prorsiradiate, biconcave ribs, arising at the umbilical seam and tending to branch at mid flanks on strongly ornamented specimens (CASG70781–85). When the shell is preserved, the constrictions are replaced by slightly biconcave, strong, prorsiradiate ribs that cross the venter without diminution, where they are slightly projected forward. The intercalatories arise

at the umbilical seam or at the inner third of the flanks and are mostly attenuated on the siphonal area. With age, the costation becomes coarser and feebler on both internal mold and shell. The largest available specimen (CASG70778: Figs 5, 6), has an estimated diameter of 180 mm, comprising a 80° sector of body chamber, which is crushed and weathered, seeming to retain only inconspicuous ribbing and feeble growth striae on the shell. The suture (Fig. 4c) is moderately divided, having a deep L and a strongly retracted suspensive lobe, and it is very close to the partial suture figured by Jacob (1906, text fig. 3) (fig. 2d).

Discussion. The measurements given by Dutour (2005) for the material from south-east France, and those of the Californian material are consistent. The Californian ammonites differ from the lectotype of *Zuercherella zuercheri* (Jacob, 1906, pl. 2, fig. 1), by their narrowly convex venter, wider constrictions that are slightly projected forward on the venter, stronger, broader, coarser ribs and a slightly wider umbilicus. *Zuercherella latecostata* (Riedel, 1938) from the Upper Aptian of Colombia, differs from our material by the presence of numerous strong collared ribs that tend to bifurcate on the outer part of the flanks and its lower whorl section. *Zuercherella etayosernay* Bogdanova

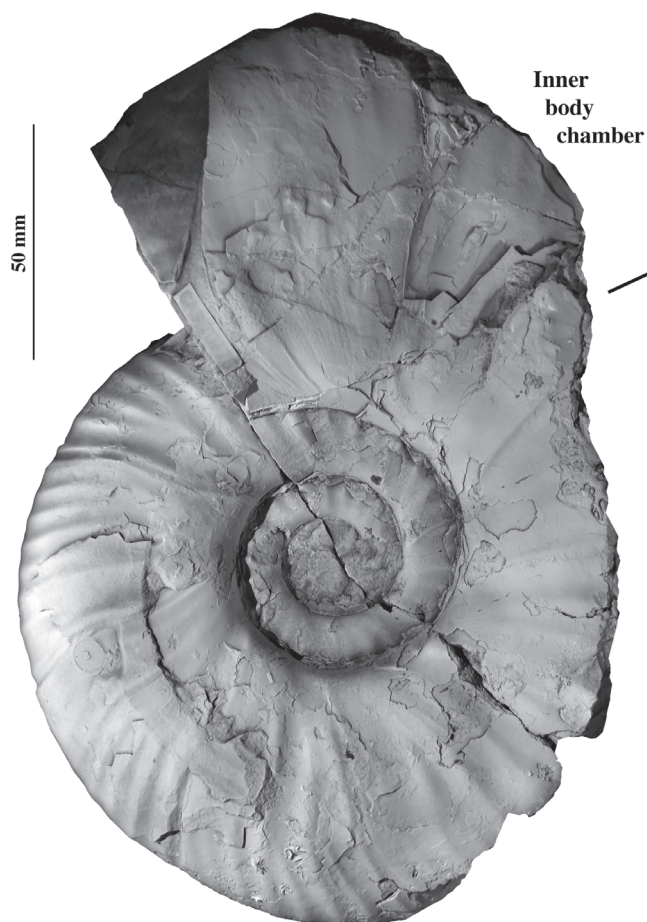


Figure 5. *Zuercherella zuercheri* (Jacob, 1906). CASG70778, locality and age unknown, Upper Aptian.

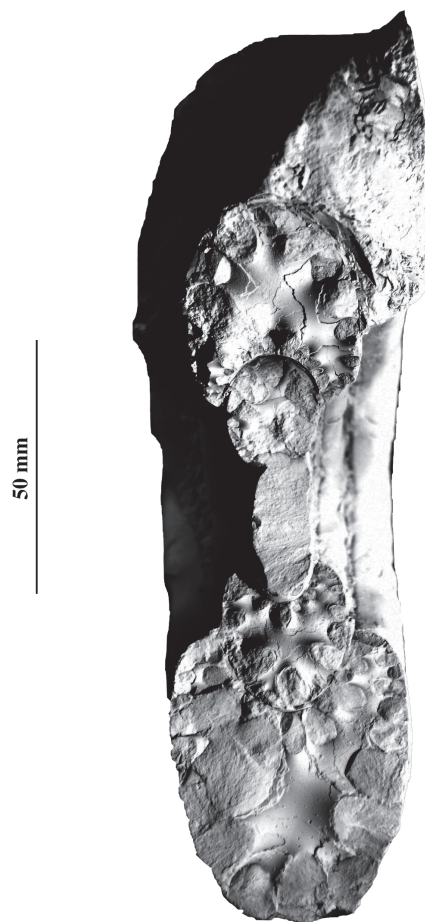


Figure 6. *Zuercherella zuercheri* (Jacob, 1906). CASG70778, locality and age unknown, Upper Aptian.

and Hoedemaeker, 2004, from the Aptian–?Albian of Colombia, is characterized by its narrow umbilicus and feeble ornament.

The specimen figured as *Zuercherella* cf. *zuercheri* (Jacob, 1906) by Bogdanova and Hoedemaeker (2004, p. 245, pl. 41, fig. 2) is very close to the syntype figured by Jacob (1906, pl. 2, fig. 1), herein refigured (fig. 2c).

Demay and Thomel (1986) proposed to assign specimens figured by Fallot as *Uhligella zurcheri* (1920, p. 261, pl. 3, fig. 7) to *Zuercherella alpina* (Demay and Thomel, 1986). These authors recognize three distinct species in the upper Aptian of the south-east of France, *Zuercherella alpina* occurring in lower part of the interval (*Dufrenoyia furcata* zone and base of the *Epicheloniceras subnodosocostatum* Zone), *Zuercherella impressa* and *Z. zurcheri* occurring in the upper part of the interval (*Epicheloniceras subnodosocostatum* Zone and *Parahoplites melchioris* Zone). The morphological differences between those three species concern the strength of the ornamentation on the juvenile growth stages but this material was neither described nor figured.

According to Dutour (2005, p. 144), it might be conceivable that the morphologies of the *Dufrenoyia furcata* Zone and those of the *Parahoplites melchioris* Zone belong to distinct species, but such an approach has still to be supported by further studies.

Occurrence. According to Dutour (2005), the species occurs with certainty from the *Dufrenoyia furcata* Zone to the upper part of the *Parahoplites melchioris* Zone (first half of Upper Aptian). The species has been reported from France, Switzerland (Jacob, 1906; Dutour, 2005), Germany (Kemper, 1964), Italy (Wiedmann and Dieni, 1968), Morocco (Rey *et al.*, 1988), Georgia (Kvantaliani, 2005) and Venezuela (Renz, 1982). It occurs also in the *Eotetragonites wintunius* Zone and the base of the *Acanthohoplites gardneri* Zone, Upper Aptian of Shasta Co, California.

3. Conclusion

Zuercherella zurcheri is well-documented for a long time from North Tethyan margins and Germany (see the synonymy above). It has been sporadically reported from the south margin of Atlantic regions, in Morocco (Rey *et al.*, 1988) but without any illustration, in Venezuela (Renz, 1982), and its presence is suspected in Colombia (Bogdanova and Hoedemaeker, 2004, see above) (Fig. 7). The species is reported for the first time in north California, and it is the first known record of a Tethyan ammonite species in the upper Aptian of northern California. Affinities between Tethyan and Northeast Pacific biota have been already suggested by Iba and Tanabe (2007), and Iba *et al.* (2011) during Upper Aptian time, based on the record of bivalvs. It is reasonable to assume that a migration path existed

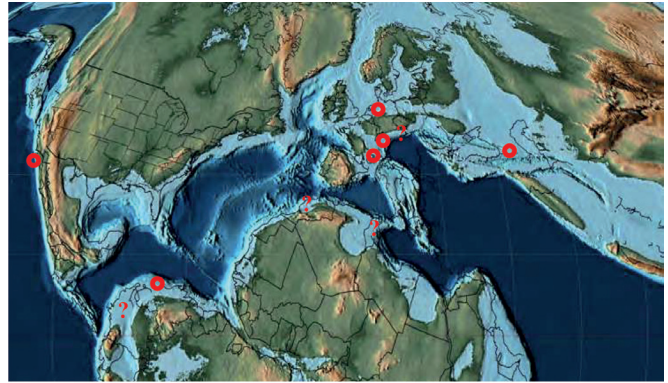


Figure 7. Paleogeographic map at the Upper Aptian with the distribution of *Zuercherella zurcheri* (Jacob, 1906) (map after Scotese, 2014).

along the south Atlantic margin through the Colombian sea.

Further investigations among the abundant material housed in the California Academy of Sciences, San Francisco, would be required to better understand the affinities between Northeast Pacific, south Atlantic margin and Colombian biota.

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